

# Balancing Knowledge Creation



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# Balancing Knowledge Creation

Examining Organizational Slack and Knowledge Creation  
in Product Development

Anders Richtnér



**STOCKHOLM SCHOOL OF ECONOMICS**  
*EFI, THE ECONOMIC RESEARCH INSTITUTE*



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**To my wife Maria**



# Preface

This report is submitted as a doctor's thesis at the Stockholm School of Economics. The research has been carried out as part of the research program at the Centre for Innovation and Operations Management at EFI, the Economic Research Institute at the Stockholm School of Economics.

The research project has been conducted within the Institute for Management of Innovation and Technology (IMIT). The project has been generously funded by Lars Erik Lundbergs Stiftelse, the Swedish Council of Work Life Research (Rådet för Arbetslivsforskning, RALF), and the Stockholm School of Economics. This support is gratefully acknowledged and special thanks are given to all involved parties at Communication Ltd. and Support Inc. for their generosity and openness.

As usual, the author has been entirely free to conduct and present his research in his own way as an expression of his own ideas.

Stockholm in October, 2004

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Although a doctoral thesis lists only one name, everyone who has written a thesis knows that in reality the ideas it molds together have been contributed and refined by many insightful and selfless friends and colleagues. Be certain that this thesis would have been completely different if it hadn't been for the generous support and guidance over the last four years given by the following friends and colleagues.

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Stockholm in October, 2004

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# CHAPTER ONE

## Organizational Downsizing and Innovation – Two (in)compatible Trends?

*“Cutting back on expenditures has been a top priority for Ericsson for some time now. How big is the risk of hurting long-term growth and development?”*

*That is probably the question that I am pondering over the most these days. We have to find a satisfactory balance between the short-term and the long-term. It is more difficult in turbulent times. It was easier to focus on the long-term ten years ago.”<sup>1</sup>*

*“Our strategy is to reduce operating costs to a level commensurate with project sales levels. To accomplishing this goal, we have implemented a number of tough cost-cutting measures, which includes downsizing of the workforce, facilities and operating costs. In addition to cutting costs, we are focusing on product innovation through our highly effective Research and Development team”<sup>2</sup>*

When there is a downturn in business many companies initiate actions to cut their costs in order to improve the competitive position of the company (Freeman & Cameron, 1993). ‘Creating wealth in the organization by banishing waste’ (Womack & Jones, 1996) has been the overall message in many organizations during the last few years resulting in various activities such as downsizing, but at the same time innovation is emphasised as the key to long-term success for companies (Amabile & Conti, 1999; Schumpeter, 1934; Wheelwright & Clark, 1992). But are innovation and downsizing two organizational trends that are compatible or are they incompatible? In this thesis the relationship between downsizing and innovation form the overall frame from which it is possible to arrive at a more precise area of research.

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<sup>1</sup> Interview with Torbjörn Nilsson, Strategy Manager at Ericsson, in Dagens Industri November 5<sup>th</sup>, 2001, translated from Swedish.

<sup>2</sup> From a letter to shareholders in the 1996 annual report of an international electronic games company. The citation can be found in Amabile and Conti (1999).

The decision to initiate downsizing has been described by Freeman and Cameron (1993, p. 12) as an intentional strategy from the management that affects the size of the work force and the work processes used, with the desire to improve organizational efficiency, productivity and/or competitiveness of the organization<sup>3</sup>. Recently, however, concerns have been raised towards whether companies have gone too far in their attempts at decreasing costs, as evidence shows that downsizing companies fail to achieve their intended goals (Fisher & White, 2000). For the purpose of this thesis the concerns raised by Cascio (1993) and Amabile and Conti (1999) are important to bear in mind. They argue that companies which downsize may only have time for the necessary activities, causing a reduction in innovation.

In the literature it is well documented that the management of innovation is a key source of competitive advantage (e.g. Kogut & Zander, 1992; Schumpeter, 1934; Tidd *et al.*, 2001; Wheelwright & Clark, 1992; Zander & Kogut, 1995) and most executives and scholars agree that continuous innovation is a competitive necessity for their organizations. However, it is not always clear what 'innovation' means and how it differs from 'invention'.

Tidd *et al.* (2001, p. 6) argue that innovation is essentially about change and degree of novelty involved. Change can either be in the *things* (service/product) an organization offers, or in how these things are *created and delivered*, which can also be expressed as the distinction between product and process innovation (Abernathy & Utteback, 1978). The degree of novelty is the perceived extent of change in both these dimensions; running from minor, incremental improvements, to radical changes. Thus, there can be many types of innovations (Tidd *et al.*, 2001, pp. 7-8) depending upon whether the organization is facing product and/or process innovation and/or incremental or radical changes.

Having stated that innovation is about change and degree of novelty, it is now time to outline the difference between innovation and invention - two terms which are easily confused. Marquis (1969, p. 42) offers the following definition of the difference between the two: 'an innovation can be thought of as the unit of technological change; an invention - if present - is part of the process of innovation'. Tidd *et al.* (2001, pp. 37, italics in original) offers a similar definition: 'innovation is more than simply coming up with good ideas; it is the *process* of growing them into practical use'. These two definitions are a good summary of the literature on the difference between innovation and invention

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<sup>3</sup> Cascio (1993, p. 96) has also done a review on the literature on downsizing and suggests that downsizing occurs when a company 'eliminates functions, hierarchical levels, or units. It may also occur by implementing cost containment strategies that streamline activities such as transaction processing, information systems, or sign-off policies'. I have chosen to use the work by Freeman and Cameron (1993) in defining organizational downsizing as they are writing for an academic community, while Cascio is writing for more practitioner oriented readers.

(for an overview of the literature see Tidd *et al.*, 2001, p. 38; Trott, 2002, pp. 11-12).

Thus, what distinguishes innovation from invention is that innovation is concerned with the *commercial and practical application* of the inventions (or ideas). Or in other words; an invention is only the first step in a long process of developing good ideas to an effective and widespread use (Tidd *et al.*, 2001, p. 38), which corresponds to the view adopted in this thesis. To sum up, in this thesis I am concerned with innovations, i.e. the whole process, and the cases examined in the study differ in terms of change and degree of novelty.

But it is not enough to develop innovative products and processes, regardless of whether we are concerned with incremental or radical changes. Many companies, especially in industries with short product life cycles, have realized that innovation speed is of great importance in order to build a competitive advantage. Tidd *et al.* (2001, p 5) points out that companies not only have to introduce new products, but to do it faster than competitors, and as a consequence companies try to accelerate their product development (Brown & Karagozoglou, 1993; Dumaine, 1989; Vesey, 1991).

## **Balancing Knowledge Creation**

An organization trying to manage innovation faces difficulties as both the acceleration of product development and the implementation of programs to decrease cost and increase operational efficiency may reduce a company's ability to innovate in the long run. The risk is that short-term problem solving is prioritised over the handling and solving of long-term problems, damaging long-term strategic thinking. Another risk is that creativity and idea generation is not given enough room in the organisation, since there is only time for the most necessary activities (Amabile & Conti, 1999). The consequence is a reduction in innovation.

As companies strive towards accelerating their product development they may, at the same time, begin focusing only on incremental innovations, since these are cheaper and faster. The reason being, as Crawford (1992, p. 191) points out, is that 'to gain speed it is necessary to avoid projects that require lots of learning'. In addition members may find themselves having difficulties in creating knowledge because they are hurried or rushed (Garvin, 1993). Calatone *et al.* (1997) supports the arguments put forward by Crawford and Garvin and adds that companies trying to accelerate product development tend to skip steps in the development process in order to hurry the product to market. The risk being that it is the most difficult steps which are the ones avoided. However, it is these steps that are most important for new product's success.

At the same time as companies are trying to accelerate their product development they are also implementing programs aimed at decreasing costs and increasing operational efficiency, often trying to eliminate organizational slack<sup>5</sup>, which is often viewed as a form of inefficiency. However, organizational slack is also essential for innovation (Geiger & Cashen, 2002; Nohria & Gulati, 1996), as slack provides an opportunity for employees to review their jobs, to learn to perform them more creatively and efficiently, and to obtain higher-quality results (Millson *et al.*, 1992). Thus, the consequence of trying to reduce slack is that companies may risk eliminating slack to a point that undermines their capacity to innovate (Nohria & Gulati, 1996).

During the last decade there has been an increased interest both among scholars and practitioners on the role of knowledge in the organization and it is argued that knowledge can be a major source of competitive advantage (Grant, 1996b; Kogut & Zander, 1992; Spender, 1996a; Teece, 1998; Zander & Kogut, 1995). One reason why knowledge is an important resource is its positive relation to innovation (Darroch & McNaughton, 2002; Leonard, 1995; Soo *et al.*, 2002).

But it is not clear how the ability to create knowledge in order to be innovative in an organization is affected by programs trying to accelerate product development and the implementation of cost cutting programs. There are arguments claiming that acceleration of product development and cost cutting programs may hamper the creation of knowledge. Crawford (1992) argues that the companies accelerating product development may tend to avoid projects involving learning. Fisher and White (2000, p. 249) propose that 'downsizing /.../ may seriously damage the learning capacity of organizations'.

Thus, there is a concern that programs aiming at accelerating product development and downsizing hamper an organisation's ability to create, as the aim is often to eliminate inefficiencies, i.e. reducing organizational slack. However, the arguments by Crawford and Fischer and White are propositions, which need to be researched and that is the starting point of this study.

Neither Crawford, nor Fisher and White have examined how the creation of knowledge is influenced by a reduction in organizational slack. The relationship between organizational slack and knowledge is the central problem examined in this study. In particular this thesis is concerned with how companies can find a balanced level of organizational slack in order to create knowledge, or put another way - as the title of the thesis suggests - balancing knowledge creation.

The rest of this chapter is structured as follows. To begin with a theoretical review is conducted on the acceleration of product development and organizational downsizing. Then the literature on, firstly, organizational slack and innovation and, secondly, knowledge and innovation is reviewed. After

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<sup>5</sup> A more thorough discussion on organizational slack is provided later in this and the next chapter.

these reviews the motivation for the present study is found and it is possible to arrive at a more precise formulation of the purpose of this thesis. The chapter concludes with some comments on the research design, and the structure of the thesis.

## **Acceleration of Product Development and Organizational Downsizing**

There is an increasing amount of studies pointing out the need for companies to accelerate their product development in order to retain a technological edge and create a competitive advantage (see Kessler & Chakrabarti, 1996, for a review). At the same time companies must also be flexible and efficient due to the reduction of both product and technology life cycles (Gupta & Wilemon, 1996; McDonough III & Barczak, 1991; Takeuchi & Nonaka, 1986). This is especially salient in high velocity environments characterised by short product life cycles and rapidly shifting competitive landscapes, which demands that companies have the ability to engage in rapidly and relentless continuous change that is crucial for survival (Bourgeois & Eisenhardt, 1988; Damanpour, 1991).

Downsizing, on the other hand, to some extent, stands in contrast to the emphasis on speed. As companies try to accelerate their product development, by focusing on finding ways to increase the efficiency, quality and flexibility, they are also faced with challenges from the stock market to maintain and increase year-to-year or quarter-to-quarter profit (Hayes & Abernathy, 1980), often referred to as economic short-termism (Lavery, 1996). During the last few years one especially salient trend among companies has been to downsize the company with the aim of improving productivity and gaining the favour of the stock market (Fisher & White, 2000).

Before arriving at the core problem researched in the present study, the literature on, firstly, acceleration of product development and, secondly, organizational downsizing is reviewed. The review attempts to highlight the challenges many organizations are facing today and which need to be addressed to build an organization with a competitive advantage.

### **Review of Reasons for the Acceleration of Product Development**

The key to innovation success and profitability is often viewed as the ability to reduce the cycle time in product development. As companies face intensified competition both in the home market and abroad, experience rapid changes in both customer needs and technology, and face shorter product life cycles, companies see that the solution is to accelerate product development in order to speed up innovations (Gold, 1987; Kessler & Chakrabarti, 1996). The reasons put forward for accelerating product development are several and have been

synthesized into three major factors (cf. Cooper & Kleinschmidt, 1994; Lambert & Slater, 1999; Millson *et al.*, 1992), which are reviewed below<sup>6</sup>. As there are doubts about the robustness of these three factors, counterarguments have been included as well.

- *Speed enhances competitive advantage.* A “pioneer” company can have a market share advantage (Urban *et al.*, 1986) as they create the rules for subsequent competition, favoring their position (Day & Wensley, 1988; Gold, 1987; Lieberman & Montgomery, 1988). Other factors besides order of entry, such as managerial skill, superior resources, ability to learn from competitors’ mistakes etc., are also pointed at as determinants of product success (Lambert & Slater, 1999).
  - However, other studies have showed that being first to the market only has a marginal positive effect (Cooper & Kleinschmidt, 1993). In addition new product failure rates are often high, and true innovations are rare (Crawford, 1992). There is no guarantee that pioneering results are any guarantee of success and long-term rewards (Lieberman & Montgomery, 1988).
- *Speed enables companies to respond quickly to changes in the marketplace.* A company that has rapid product development is able to move fast and change direction quickly in order to retain their technological edge. Cordero (1991) found that when there is increased product obsolescence there is a shorter window of opportunity, which creates a need for more rapid product innovation.
  - However, pushing for speed in product development projects may reduce the ability to clearly identify the requirements from the customers, causing the development team to shoot at a moving target, with the obvious risk of making mistakes and developing obsolete products and processes (Crawford, 1992).
- *Speed means greater profitability.* In high-growth markets with short product life cycles it is better to be on time, but well over budget, rather than to be late and on budget. For instance a high-tech product that is six months

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<sup>6</sup> It should be noted that there are two research streams within the literature on product innovation (Brown & Eisenhardt, 1995): first, an economic-oriented tradition, which examines macro economic issues and patterns in the diffusion of innovations across nations and industries, and second, an organizations-oriented tradition (e. g. Cooper & Kleinschmidt, 1987; Damanpour, 1991), which examines micro issues such as the influence that people, processes and structures have on the product development. This study focuses on innovation speed in the second, intraorganizational product development stream.

Within the intraorganizational stream it is possible to categorize the literature on: (1) the level of analysis: the organization, the project, and the individual, and (2) the type of analysis: literature review, personal experience, broad survey, case studies, and deductive hypothesis testing (Kessler & Chakrabarti, 1996). This study focuses on the project level, but considers all types of analysis in the discussion on acceleration of product development in order to increase innovation speed.

late to the market can have its profitability reduced by one-third (Dumaine, 1989). One source of profitability is the higher price an early entrant can charge, and as a consequence a late entrant may never see this profitability during a model cycle (Millson *et al.*, 1992).

- However, it is also important to take into account quality and product capabilities and not only focus on fast product-development cycle time (Lambert & Slater, 1999). Additionally, there is little empirical data to support the claim that launching time is a competitive factor (Crawford, 1992; Lambert & Slater, 1999).

### **Acceleration of Product Development**

Despite the conflicting evidence on the benefits of accelerating product development, there are many suggestions and recommendations on how to increase the speed in product development. One of the first contributors in this stream of articles and books is Bela Gold's (1987) article *Approaches to Accelerating Product and Process Development*. In the article Gold argues that accelerating the development of advances in products and processes can be achieved through three different strategies. A company can *rely on external sources*, examples of this strategy are the buying or licensing of advances made by others, to buy other companies, or to contract independent R&D companies for specific innovation projects. The second strategy is a reliance on *internal research and development projects*, which can be achieved by increasing the rewards for successful performances, or to initiate simultaneous R&D on successive stages of innovation. The third strategy is to rely on *innovative R&D management strategies*, for instance using peer reviews to accelerate the progress, or to have a closer integration of R&D with other functions.

Two subsequent studies (Gupta & Wilemon, 1990; McDonough III & Barczak, 1991) were not so concerned with the process in order to accelerate product development as Gold (1987), but rather they focused more on the human side as a way of accelerating product development. Gupta and Wilemon (1990) suggest that there are four broad areas that are of significant importance: (1) Senior management should support innovation, (2) early involvement of all functional groups, (3) availability of NPD resources (the right people, tools, facilities etc.), and (4) an organizational environment that supports teamwork.

McDonough and Barczak (1991) examined the acceleration of product development by focusing on the effects of leadership style and sources of technology. Their major finding was that leadership style (participatory or not) contributes more to the speed of development than the sources of technology (internal or external) do. In addition they found that when the sources of technology are internal, the leadership style should be participative, in order to accelerate product development. They did not find a relationship between the

leader's style and speed of development when the technology came from external sources.

In an early review of the literature on the approaches to accelerate product development Millson *et al.* (1992) identified five basic acceleration methods that can be used in isolation or in combination<sup>7</sup>. Making the operations *simpler* is the first basic approach. It includes the generation of explicit R&D goals and linking different groups from various parts in the company to foster teamwork and mutual understanding of internal and external demands. The second approach is the *elimination of delays* such as linking R&D goals to manufacturing capabilities and to provide early product training. *Eliminating steps* is the third approach and includes the utilization of lead users (von Hippel, 1986) and a reduction of parts. A company can also, as a fourth approach, try to *speed-up* processes by using small groups that generate ideas and use computer-aided design (CAD). The fifth, and final, approach for accelerated product development is *parallel processing*, including the initiating of mutually exclusive research projects. Millson *et al.* (1992, p. 65, emphasis in original) concludes the article by saying that 'implementing new product development **acceleration takes time**', i.e. the implementation of these five approaches does not give immediate results.

Karagozoglou and Brown (1993) continued in the same tradition and found ways to accelerate product development and identified that the use of multifunctional teams, customer involvement and computer-aided tools are the most important methods for accelerating product development. A later study by Cooper and Kleinschmidt (1994) gave support to the positive effect of using multifunctional teams and customer involvement as ways of increasing the speed in product development.

In addition Cooper and Kleinschmidt (1994) also found that the use of cross-functional teams dedicated to the project from beginning to end, lead by a strong project leader or champion and with top management support, is the strongest determinant of time efficiency and staying on schedule. The second factor identified as important for accelerating product development is up-front homework. Projects that spend time and effort in the pre-development phase saved time later. Up-front activities include initial screening, technical and market assessments, detailed market studies and detailed business and financial analysis. The third factor in reducing cycle time is that the projects have a strong market orientation. It is important to build the customer into the new product process early. This is consistent with research that points to the importance of involvement of lead-users (von Hippel, 1986).

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<sup>7</sup> In this study I have chosen to focus on the consequences for R&D brought forward in the review made by the Millson *et al.* (1992), not on manufacturing or marketing as that is outside the scope of this thesis.

A study by Eisenhardt and Tabrizi (1995) in the computer industry identified that acceleration of product development can be achieved by using an experimental strategy of multiple design iterations, using extensive testing, and having frequent milestones. Having an experienced project leader and multifunctional teams were also positively associated with speed. Factors that have previously been associated with speed, such as supplier involvement, overlapping development stops and computer-aided design, were not found to be associated with speed. Eisenhardt and Tabrizi explain that the reason for the contradictory findings in their study is that previous research on the acceleration of product development has been conducted in mature industries.

To sum up, the underlying argument in these studies is a belief that the acceleration of product development in order to increase innovation speed is important for a company in creating and sustaining a competitive advantage (Kessler & Chakrabarti, 1996). Accelerating product development implies using one or more of these suggested speed-related facilities (e.g. senior management support, multifunctional teams, customer involvement), and avoiding the barriers of speed-related activities (e.g. sequential activities, weak project leaders, functionally focused teams).

Thus, the results from these various studies on how to accelerate product development indicate that there is no single way to be fast; instead there are numerous ways for accelerating the product development in a company. It is also necessary to identify that these different tactics for the acceleration of product development are related to the environment the company is operating within.

### **Acceleration of Product Development – Not Without Costs**

However, looking at speed is not everything. It has been argued that having time-efficient development and getting the product to the market on, or ahead of, schedule does not necessarily impact a great deal on financial performance. There are other factors that determine profitability (Cooper & Kleinschmidt, 1993). In particular they argue that when a new product is developed the focus must be to build a product advantage into the product itself, e.g. in terms of quality, price/performance, value for money, and unique superior and visible product benefits. Additionally it has been argued that as speed is increased in product development the difficulties, cost and uncertainties of the process also increase. This forces managers to make trade-offs among development schedule, development costs and product performance (Gupta *et al.*, 1992; Karlsson & Åhlström, 1997; Rosenau Jr, 1989).

Crawford (1992) argues that there are 'hidden costs' with accelerating product development. By focusing on low-profit trivial innovations that can be brought to the market quickly there is a risk that the company drive out the more profitable breakthrough types that are critical for survival in the long run (cf.

McDermott, 1999). And in the quest for rapid product development there is a risk that the number of mistakes made increases and that development and commercial costs are increased. Crawford (1992) recommends that companies wanting to accelerate their product development should take these hidden costs into consideration and try to minimize their effects.

Calatone *et al.* (1997) found that managers under pressure, who try to shorten time to market, often tend to skip steps in the product development process. However, it is often the more difficult steps that are avoided, and these are the most important ones for new product success. Therefore, they recommend companies to strive towards finding a balance between speed and quality of execution.

The need for accelerating product development is, as has been stated above, a quest towards achieving a better competitive position. A company that tries to accelerate product development faces many challenges, one of the most prominent ones is not to hamper the knowledge creation in the product development. Crawford (1992) touches upon the issue, claiming that acceleration of product development may cause a reduction of projects involving a lot of learning. However, the literature on acceleration of product development says little about what effect organizational downsizing may have on the ability of the organization to develop new products and create knowledge. Is it possible to accelerate product development during downsizing, whilst still being able to create knowledge and be innovative?

## Reviewing Studies on Organizational Downsizing

Accelerating product development and avoiding the difficulties associated with it is but one challenge facing companies today. Another challenge comes from the stock market which puts pressure on companies to maintain and increase year-to-year or quarter-to-quarter profit (Hayes & Abernathy, 1980). Downsizing is a form of *intentional* effort (Freeman & Cameron, 1993) at restructuring the organization that has the goal of improving the economic situation (enhanced profits, lower expense ratios, increased return on investment) of the company in order to satisfy the stock market (a higher stock price) (Cascio, 1993; Freeman & Cameron, 1993).

Downsizing is often equated with a reduction in the workforce (Palm, 2000), but it is not limited solely to personnel reductions (Freeman & Cameron, 1993). Examples of other strategies are transfers, outplacements, retirement incentives, buyout packages etcetera (Freeman & Cameron, 1993).

Freeman and Cameron (1993, p. 12, italics in original) argue that 'downsizing is not something that happens *to* the organization, but is something that organization members undertake *purposively*'. This implies that downsizing is

an organizational action, differentiating the concept from loss of market share or loss of revenues, which is often associated with organizational decline. It is important to recognize that downsizing is more than just decreasing the size of the work force or scale of operations. Downsizing also influences the work processes, intentionally or unintentionally, positively or negatively. Positively through improved productivity or speed by designing better processes. Negatively through overload, burnouts or inefficiencies as fewer employees are left to do the same amount of work (Freeman & Cameron, 1993).

There are other negative attributes associated with downsizing that have been pointed out in the literature. Palm (2000) argues that downsizing increases the centralization of decision making and creates a focus on the short-term, there is also a loss of innovativeness, as well as a resistance to change, and a lack of teamwork. In addition, many companies also fail to achieve their intended goals, such as an expected increase in productivity, or realizing a long-term gain in shareholder value (Koretz, 1998).

Thus, despite the fact that downsizing is popular, it is not always productive or valuable (Fisher & White, 2000) and the question is if it pays off in the long run (von Krogh & Kameny, 2002). To be able to understand the reason behind why organizational downsizing is initiated the literature on economic short-termism is helpful.

### **Economic Short-termism – The Underlying Phenomena of Organizational Downsizing**

Economic short-termism describes the dilemma for managers facing downsizing. In economic short-termism the best course of action in the short-term is not desirable, because it is sub-optimal in the long run (Lavery, 1996). Short-termism refers to when a company is investing in a more short-term manner than is advisable due to pressure from the stock market. Long-term investments in R&D, developing new competencies and entering new markets are not prioritized, since it is not appreciated by the stock market.

The focus on short-term profits can be traced to the owners of the stocks. Large institutional investors, e.g. pension funds and mutual funds, own more and more companies. These investors are not interested in, and do not engage in, the long-term development of the companies, but focus instead on the short-term profits (Segelod, 2000). In the debate as to whether or not economic short-termism exists there is evidence for both views (see Lavery, 1996, for a review).

#### *Advocates for the Existence of Economic Short-termism*

Ever since Hayes & Abernathy (1980) wrote their article *Managing Our Way to Economic Decline* there has been debate as to whether or not short-termism<sup>8</sup> exists in companies. The central theme of the article by Hayes & Abernathy is that companies have a preference for servicing existing markets instead of finding new ones. In addition there is a devotion to short-term returns and “management by the numbers”. Both of these trends may reduce the ability to create a long-term technological superiority as the competitive weapon for the company. In short, maximizing short-term financial returns is the overriding criterion for many companies and this damages the long-term strategic thinking.

In a later article Hayes and Garvin (1982) were more precise in their criticisms concerning short-termism. They argue that the use of discounted cash-flow techniques in connection with short time horizons and excessive hurdle rates creates a climate where cost reduction is favored, causing a bias against new technology and basic investments. From these two articles a main hypothesis emerged: the shortsighted stock market forces managers to prioritize short-term profits (Segelod, 2000).

#### *Advocated Against the Existence of Economic Short-termism*

However, the debate on short-termism is not a one-sided debate. Counterarguments have claimed that there are: (1) few empirical evidences on the existence of short-termism (Bruce & Taylor, 1991), and (2) efficient markets do exist for the long run (Jensen, 1989; Pickins, 1986). The capital market pressure guarantees that the organization maximizes its value by emphasising cash flow, instead of maximization of earning that is otherwise most common. Thus, the organization avoids making decisions that dissipate the wealth because of choices that represent either too much long-term orientation, or too much short-term orientation (Jensen, 1989). Pickins (1986) argues that it is not possible to value a stock on a short-term basis since the capital market hypothesis claims that the value of a stock is the underlying value of the company’s assets and the future anticipated gains. If the market feels that these values are overestimated they sell the stock, or vice versa, if values are underestimated they buy the stock. Therefore there can be no short-termism as long as the capital market is working.

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<sup>8</sup> The same problem has also been referred to as *myopia* or *short-term horizons*. The terminology used here is intended to put emphasis on the economic consequences of thinking too little of the long run (cf. Lavery, 1996, p. 825).

## Acceleration of Product Development and Organizational Downsizing – Possible to Combine?

It is outside the scope of this thesis to investigate whether or not short-termism exists. However, both views on short-termism seem to agree on the fact that listed companies are under pressure from the stock market. In order to maximize the profits of the company, one measure is to downsize and restructure the organization aiming at decreasing costs, improving organizational efficiency, productivity, and/or competitiveness (Freeman & Cameron, 1993). Yet, at the same time organizations are challenged to accelerate their product development in order to build a competitive advantage (Brown & Karagozoglu, 1993; Dumaine, 1989; Vesey, 1991).

However, little is said about what happens to the organization's ability to be innovative, while on the one hand trying to accelerate the product development, yet on the other hand being faced with downsizing. Is it possible to accelerate product development during downsizing whilst still being innovative? In order to examine this question further it is necessary to examine the factors that lie behind this relationship. Previously in the chapter it has been suggested that organizational slack and knowledge are two facilitators of innovation, and we now examine each of these two concepts in more detail.

### **Facilitators of Innovation: Organizational Slack and Knowledge**

It is now time to introduce the core problem researched in the present study: the relationship between organizational slack and knowledge. Downsizing programs may reduce a company's ability to innovate in the long run and the question is whether or not a company can stay competitive, develop new products and create new knowledge, while simultaneously cutting down on the resources in the organization. Downsizing programs often target organizational slack as it is often viewed as a form of inefficiency. However, slack has also been described as a facilitator of innovation (Nohria & Gulati, 1996), and as a consequence companies may risk eliminating slack to a point that undermines their capacity to innovate (Geiger & Cashen, 2002; Nohria & Gulati, 1996).

As organizations face increasingly complex technologies there is a need to have time to reflect, learn from experience, and to anticipate consequences where possible. This requires people and systems that are not committed to short-term output, i.e. the resources often targeted when an organization tries to increase efficiency. It is easy to eliminate resources that are invisible in the short-run, but necessary for the creation of knowledge in the long run if a company wants to be innovative over time (Lawson, 2001).

Both organizational slack and knowledge have been related to innovation. But it is not clear in the literature what processes underlie the relationship between slack and innovation. Instead these processes have been regarded as a “black box”. In this study an attempt is made at opening up this black box and identifying the mechanisms that link organizational slack and innovation.

Previous literature has identified that the ability of an organization to innovate is closely linked to the ability to create knowledge (Darroch & McNaughton, 2002; Leonard-Barton, 1992; Soo *et al.*, 2002). However, the link between knowledge and innovation is not necessarily straightforward, there are obstacles as well. Most important for this thesis are the arguments by Fisher and White (2000) who propose that the knowledge capacity of an organization may be damaged by downsizing. Another concern is raised by Garvin (1993) who argues that the creation of knowledge may be difficult if the members are hurried or rushed, which may be an effect of the organization’s attempts at accelerating the product development. The proposition underlying this study is that the creation of knowledge is an important underlying mechanism for the relationship between innovation and organizational slack.

An organization that attempts to downsize and/or accelerate their product development often tries to eliminate organizational slack, which is often viewed as a form of inefficiency. In the literature it is possible to identify studies linking: (1) slack and innovation, and (2) knowledge and innovation. However, it is not clear how programs aimed at decreasing costs and increasing operational efficiency, trying to reducing organizational slack, affect the ability of the organization to create knowledge. Exceptions in the literature are Crawford (1992) and Fischer and White (2000) who have *proposed* (but not explicitly examined) that these kinds of programs may hamper the ability of an organization to create knowledge. Thus, there are, so far, no studies addressing this relationship between organizational slack and the creation of knowledge. It is in this void that motivation is found for the present study.

## Reviewing Studies on Slack and Innovation

Organizational innovation has been associated with different organizational factors, such as technical-knowledge resources, administrative intensity, and specialization (Damanpour, 1991). Most importantly, for the purpose of this thesis, organizational slack has been used to explain outcomes in innovation (Nohria & Gulati, 1996). Existing studies on the relationship between organizational slack and innovation have been at the level of the firm. The focus has been on examining the level of slack, which is supposed to lead to a certain outcome in innovation at that level (Geiger & Cashen, 2002; Kuitunen, 1993; Nohria & Gulati, 1996, 1997; Singh, 1986). There are two conflicting views on the relationship between organizational slack and innovation (Nohria & Gulati,

1996). One view is that slack is necessary for organizational adaptation and renewal. The other view is that slack is unnecessary and a form of inefficiency.

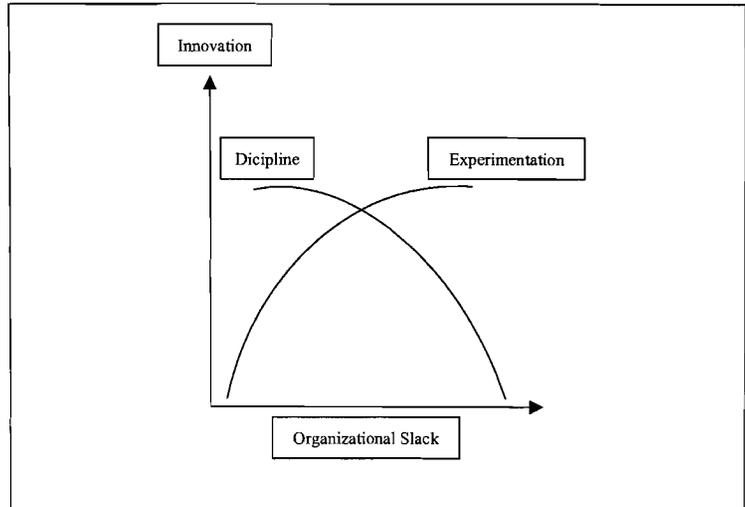
Singh (1986) argues that slack can free-up resources necessary for creative behavior, which can create new innovations. Slack allows an organization to experiment with new strategies and innovative projects that would not be approved of in an environment where there was a lack of slack (Cyert & March, 1963/1992, pp. 188-190). Slack has a positive effect on innovations for three reasons (Nohria & Gulati, 1996). First, it relaxes the controls and serves as a fund that may be used even in uncertain situations. Second, it frees managerial attention, another scarce resource. Third, it allows projects to continue even though their success is uncertain. With the presence of slack it is possible for the organization to experiment, introduce new products and enter new markets (Hambrick & Snow, 1977).

However, there are also those who argue that organizational slack is negatively related to innovation: the more slack there is, the less innovation there is (Liebenstein, 1969). Slack is here viewed as an unnecessary cost that detracts value from the overall value of the company, and as a consequence it should be eliminated. Too much slack leads to a lack of discipline that makes bad projects survive. According to Jensen (1993), firms with high amounts of slack invest in dubious R & D projects and have difficulties exiting unsuccessful projects.

These two views seem to stand in conflict with each other. On the one hand it is important for a company to have slack in order to be innovative, but on the other hand slack is some sort of inefficiency. Addressing this apparent conflict, Nohria and Gulati (1996) found that the relationship between slack and innovation is inversely U-shaped ( $\cap$ ). When there is too little slack, innovation is hampered due to the uncertainty of success, and so experimentation is discouraged. When there is too much slack, the discipline exercised over projects is decreased. Thus, there is an optimum level of slack (see Figure 1:1 below).

**Figure 1:1 ▶**  
**Organizational Slack and Innovation**

The relationship between organizational slack and innovation is hypothesized to be inversely u-shaped



The findings by Nohria and Gulati (1996) have been supported and refined by Geiger and Cashen (2002) who took a multidimensional perspective on organizational slack. They examined the relationship between innovation and, in turn; available, recoverable and potential slack. They found an inverted U-shaped relationship between innovation and both available and recoverable slack. They also found a linear relationship between innovation and potential slack – the greater the level of potential slack (less debt/equity), the greater innovation within the firm.

A complementary view of the relationship between organizational slack and innovation is offered by Judge *et al.* (1997) who argue that it is not the level of slack as such that is important; rather it is the continuity of slack. In a study of eight biotechnology firms, they found that one of the reasons for the varying levels of innovation in the firms was the continuous availability of organizational slack. To attain high levels of innovation it was necessary for organizational slack not to be constantly threatened.

Contrary to previous literature, this study makes no attempt to find a level of organizational slack that is supposed to lead to a certain outcome in innovation at the level of the firm. Instead, this study investigates the relationship between organizational slack and innovation: a relationship that has previously been regarded as a “black box”. In this thesis I attempt to open up this black box in order to start identifying the mechanisms that link organizational slack and innovation. The proposition underlying the thesis is that the creation of knowledge is an important mechanism behind, or reason for, the relationship between innovation and organizational slack.

Previous studies have pointed out that the ability to innovate is closely linked to the creation of knowledge (Darroch & McNaughton, 2002; Leonard, 1995; Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; Soo *et al.*, 2002). As organizational slack is reduced, it is hypothesised that the ability to create knowledge is affected. The relationship between organizational slack and knowledge has, so far, not been researched. Before going into details about the purpose of this thesis, a review of studies on knowledge and innovation is conducted, followed by a discussion on why knowledge management is introduced as a perspective within the larger field of organizational learning.

## Reviewing Studies on Knowledge and Innovation

Knowledge is also pointed out as a key resource in pursuing long-term advantages and being a source of profit for companies. As knowledge is partly tacit and unique to a company, it makes it difficult to imitate (Nahapiet & Ghoshal, 1998; von Krogh *et al.*, 2000, p. 260). Teece (1998, p. 75) argues that the competitive advantage of a company lies in 'its ability to create, transfer, assemble, integrate, and exploit knowledge assets'. Besides creating a competitive advantage for the company, the management of knowledge in a company is often cited as an antecedent of innovation (Darroch & McNaughton, 2002; Leonard, 1995; Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; Soo *et al.*, 2002; Tranfield *et al.*, 2003). Yet there are only a few studies that explicitly address the relationship between innovation and knowledge.

The first study linking innovation and knowledge is a study by Darroch and McNaughton (2002), who linked knowledge management processes to innovation. In their study they divided innovations into incremental and radical before they examined the relationship between the respective types of innovation to knowledge. They identified six factors, derived from a knowledge management orientation in the company, that positively affect innovation: being sensitive to information about changes in the marketplace, having a science and technology human capital profile, working in partnership with international customers, using technology to disseminate knowledge, responding to knowledge of technology, and being flexible and opportunistic. In addition they argue that companies need to find a balance between radical and incremental innovations because they put different demands on the company. Radical innovations are associated with the future, while incremental innovations are developed to meet immediate market needs.

A second study is made by Soo *et al.* (2002). In the study they examined the impact and ability of a company's knowledge system to enhance innovation and financial performance, using a survey research complemented by six case studies. Their findings indicate that: (a) the greater the level of formal and informal networking, the greater the level of information and know-how stock available to

the company, and (b) the greater ability the company and individual have to absorb this knowledge and information, the more solid the base for new knowledge creation can be. This in turn leads to: (c) more effective decision-making and that (d) the greater the level of new knowledge creation and decision-making, the greater the level of innovation. This gives the final financial and market conclusion: (e) the most innovative companies have the best market share and the best profit performance relative to competitors.

These two studies point in the direction that knowledge is important for innovation. Other studies (e.g. Leonard, 1995; Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995) argue that the management of knowledge can create a competitive advantage for the company. In order to examine the relationship between organizational slack and knowledge more closely however, it is necessary to choose a perspective on organizational learning, this choice also has implications for the level of analysis (cf. discussion in Venzin *et al.*, 1998), as will be shown below.

## Organizational Learning Applied as Knowledge Creation

The concept of organizational learning has received increased attention throughout the years (Crossan & Guatto, 1996), and learning organizations are expected to help managers build competitive companies (Ulrich *et al.*, 1993). Yet, there is little consensus on what organizational learning actually is (Huber, 1991; Kim, 1993).

Recently the literature on organizational learning and knowledge has shifted in its focus, moving from a focus on the process of learning and knowledge transfer, to the management of a firms stock of knowledge for creating a competitive advantage (Kogut & Zander, 1992; Zander & Kogut, 1995). However, there are still three fundamental questions guiding the research on organizational learning and knowledge (Argote *et al.*, 2003b, p. vi, emphasis in original):

*How do organizations create knowledge, and what factors influence that process? How do organizations retain the knowledge they create? /.../How is knowledge transferred within the organization and what factors facilitate (or inhibits) its transfer?*

In the literature there are an array of theoretical perspectives (Argote *et al.*, 2003a). According to Easterby-Smith (1997; Easterby-Smith *et al.*, 1998) the literature on organizational learning can be traced to six academic perspectives, each perspective having its own preferred research methodologies for investigating organizational learning resulting in different contributions. The six perspectives are: psychology and OD, management science, organization theory, strategy, production management, and cultural anthropology. However, as

Easterby-Smith argues it is important to note that this classification does not cover everything, and that some authors can be fitted into more than one category, for instance the recent advancements made in the area of knowledge management.

An additional, and to some extent complementary view, on the different perspectives of organizational learning, is given by Crossan *et al.* (1999) who argue that it is possible to identify three different perspectives on organizational learning in the literature: (1) the information processing perspective (Huber, 1991), (2) the bounded rationality perspective (see for instance Simon, 1991), and (3) the product innovation perspective (Nonaka, 1994; Nonaka & Takeuchi, 1995). In particular the third perspective presented by Crossan *et al.* (1999) is useful for the present study, as the overall goal is to develop the understanding of the relationship between organizational slack and innovation.

Following the pioneering work by Nonaka (1994; Nonaka & Takeuchi, 1995), I have in this study conceptualised organizational learning as the ability to share and transfer knowledge between and among members in product development projects. In this perspective on organizational learning, knowledge is created in the continuous and dynamic interplay between tacit and explicit knowledge (Nonaka, 1994; Nonaka & Takeuchi, 1995).

Tacit knowledge is defined as knowledge derived from experience and something that is difficult or impossible to articulate in written documents, i.e. *know-how* (Grant, 1996a). Explicit knowledge, on the other hand, can be found in written documents and can be expressed in totality, i.e. *know-that* (Grant, 1996a). Yet, it is important to remember that it can be difficult to draw a clear line between tacit and explicit knowledge, and as a consequence they should be seen on a continuum ranging from tacit to explicit (Tsoukas, 1996).

Thus, in comparison to the classification by Easterby-Smith (1997; 1998) and Crossan *et al.* (1996) I position the present study a little bit outside the traditional perspectives on organizational learning, and introduce knowledge management as a seventh perspective within the organizational learning literature. The rationale for this choice is, first, the concern with product innovation in the present study, and, second, the number of articles on knowledge management in the literature which is growing rapidly, making it likely that knowledge management will shortly be a seventh academic perspective in the field of organizational learning.

The choice of perspective on knowledge has implications for which level of analysis to choose (cf. Venzin *et al.*, 1998). There are macro-level knowledge-based theories of the firm, which stress the unique ability of organizations (as opposed to markets) to create and share knowledge (Grant, 1996b; Nahapiet & Goshal, 1998; Spender, 1996a). In contrast to these theories, micro-level treatments of organizational knowledge emphasise the difficulties of exchanging

knowledge between recipients within the company due to knowledge stickiness (Szulanski, 1996; von Hippel, 1994). In between the macro and the micro level of analysis lies the perspective on organizational learning chosen here, where studies focus on how knowledge is created within the company (Inkpen & Dinur, 1998; Johnson, 2002; Judge *et al.*, 1997). This choice of perspective on knowledge implies using the product development project as the unit of analysis, not the firm and not the individual (1994; Nonaka & Takeuchi, 1995).

## **Purpose and Research Design**

The discussion so far can be summarized by saying that innovation can be seen as the key to a company's long-term success, as it may create a competitive advantage for the company. For that reason many organizations try to accelerate their product development, since they believe that it is not enough to be innovative, it is also necessary to be fast. Yet another trend during the 1990's and the beginning of this century has been to implement cost-cutting measures resulting in various activities such as downsizing.

However, concerns have been raised that both the acceleration of product development and downsizing may reduce the company's ability to innovate in the long run since there is only room for the most necessary activities (Amabile & Conti, 1999). The consequence is a reduction in innovation. Several authors have pointed out that the reason for the reduced innovation ability may be attributed to a reduction in organizational slack (Geiger & Cashen, 2002; Greenley & Oktemgil, 1998; Nohria & Gulati, 1996, 1997).

The central problem addressed in this study is whether or not it is possible to simultaneously reduce organizational slack whilst still being able to create knowledge. In the literature there are a number of studies that have investigated the relationship between slack and innovation at the level of the firm, by looking at public financial information (see for instance Nohria & Gulati, 1996; Singh, 1986; Zajac *et al.*, 1991). In these studies the focus has been on identifying a level of slack that eventually leads to a specific outcome in innovation. In the literature there are also studies examining the relationship between knowledge and innovation (Darroch & McNaughton, 2002; Nonaka, 1994; Nonaka & Takeuchi, 1995; Soo *et al.*, 2002). The focus of these studies has been to establish a relationship between knowledge and innovation. By managing central knowledge processes the company is able to create new innovations.

However, there is no study, so far, that has addressed what underlies the relationship between slack and innovation. In the present study, knowledge is used as an explanatory mechanism to increase our understanding of the relationship between organizational slack and innovation. So far in the literature, there have been no attempts to link organizational slack to the

creation of knowledge. The present study aims at achieving exactly that. The motivation for this research aim is that by linking organizational slack to knowledge creation, it will increase our understanding of the relationship between organizational slack and innovation, and ultimately of the effects on innovation from programs to decrease cost and increase efficiency. In comparison to previous studies on, on the one hand, slack and innovation and, on the other hand, knowledge and innovation respectively, this study differs in four ways.

- First, this study *makes no attempt to find a level of organizational slack* that is supposed to lead to a certain outcome in innovation at the level of the firm.
- Second, this study focuses on *organizational slack and knowledge*, not on the relationship between organizational slack and innovation, nor on the relationship between knowledge and innovation.
- Third, as acceleration of product development is part of the overall problem the *area of interest is product development*.
- Fourth, the *unit of analysis is not the firm, but instead different projects* inside the company, which reflect the chosen perspective on knowledge, and the fact that most work within product development is conducted in the form of projects (e.g. Wheelwright & Clark, 1992).

Addressing these gaps in the literature and taking the four differences mentioned above, it is now possible to state the purpose and the research questions of the present study, which is also illustrated in figure 1:2 below.

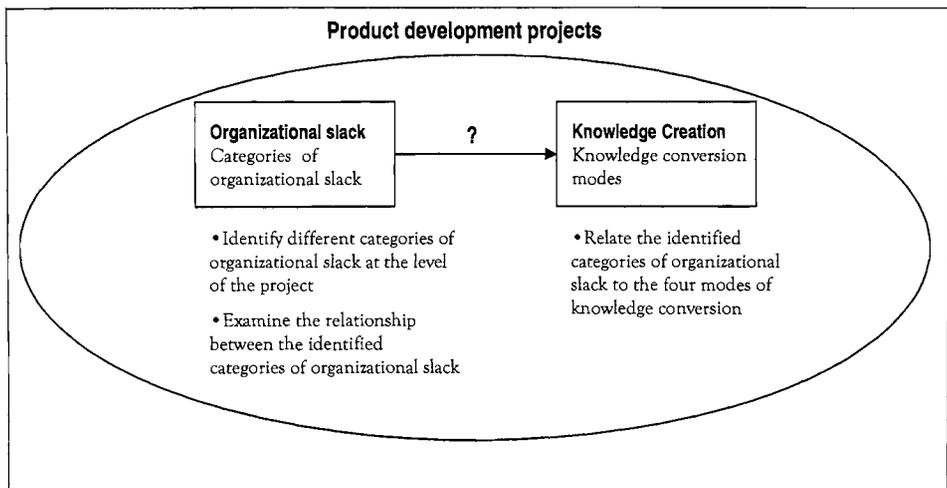
*The purpose of the present study is to determine the relationship between organizational slack and knowledge creation at the level of the product development project.*

This will be done by answering the following three research questions:

- What different categories of organizational slack can be identified at the level of the project?
- What is the relationship between the identified categories of organizational slack?
- What is the relationship between the identified categories of slack to the four modes of knowledge conversion?

**Figure 1:2** ▼  
**Focus of the Research**

The relationship between organizational slack and knowledge creation is the focus of the present study



On the basis of the research design<sup>9</sup> that guided the present study the following considerations were made:

- As organizational slack is a concept associated with conceptual and empirical difficulties, which has been an obstacle to research on this topic (Nohria & Gulati, 1996, p. 1246), it was chosen to study changes in

<sup>9</sup> For a more detailed discussion about the research design the reader is encouraged to read chapter three where the methodology and the design guiding the study is discussed in greater detail.

organizational slack over time, and in particular to identify categories of slack and how changes in these categories of slack affect the creation of knowledge.

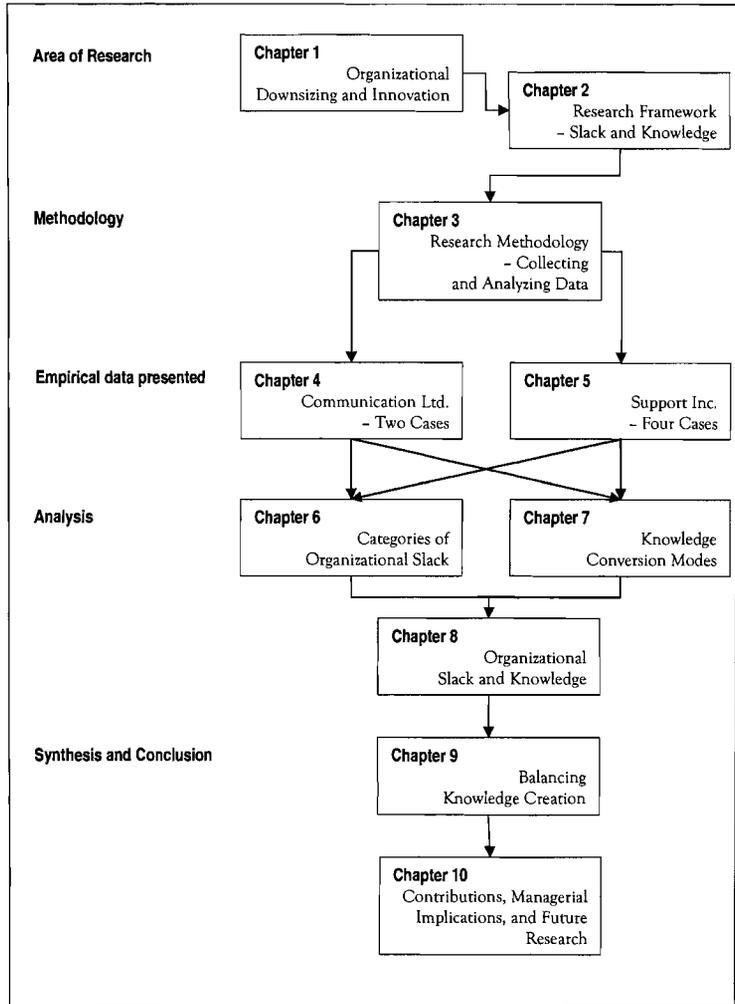
- The choice of studying changes in the categories of organizational slack over time implies the choice of a longitudinal study. Since previous studies on organizational slack and innovation have mostly been concerned with finding an optimal level of slack that is supposed to lead to a certain outcome in innovation at the level of the firm, this study can be characterised as being exploratory.
- The present study is conducted within the area of innovation management and in particular focuses on product development. The rationale for choosing to conduct the study in a product development setting is nicely captured by Lynn *et al* (1999, p. 440) who points out that 'learning is important to organizations in general, but critical in product development because innovation spans many functional areas including engineering, marketing, manufacturing, finance, etc., and product development teams must be composed of individuals from different backgrounds and perspectives'.

Having these considerations in mind a multiple case study approach was chosen. I wanted to avoid the limitations of using a single case, such as limits in generalization and other potential biases (Yin, 1994, p. 44-45), but also to produce more robust results (Pettigrew, 1990). After conducting a theoretical sampling I ended up with four potential companies, of which two agreed to participate in the study. The two companies have been made anonymous at their own request and are called Communications Ltd. and Support Inc. Within these two companies it was possible to identify six different product-development projects which I followed for one year through interviews and project protocols. However, I also reviewed the histories of the projects to gain a deeper understanding of the projects.

## Structure of the Thesis

In this, the first chapter of the thesis, the aim has been to give a picture of the overall frame that has guided this study. I have tried to describe some trends that influence companies; in particular, the literature on organizational downsizing and acceleration of product development has been helpful. Building upon these two concepts it was possible to arrive at a more precise area of research; namely the relationship between organizational slack and knowledge. It is from this relationship that the study now continues, and the structure of the study, in terms of different chapters, is described in figure 1:3 below.

**Figure 1:3** ▶  
**Structure of the Thesis**



The thesis consists of five parts. The first part introduces the area of research. Chapter One introduced the background to the study and stated its purpose. In Chapter Two a research framework is presented as a result of a literature review of the two central concepts in this study: organizational slack and knowledge. In the second part of the thesis, the research methodology is presented. Chapter Three first discusses the research design, and how a reference population was found through a theoretical sample selection, and then discusses the process of collecting and analysing data. The chapter concludes with a discussion of the quality aspects of the study.

The third part consists of Chapters Four and Five, where the empirical data is presented. Communication Ltd is presented in Chapter Four, and Support Inc., in chapter Five. The analysis of the cases is done in Chapter Six, Seven, and Eight, making up section four. The analysis in Chapter Six and Seven is closely related to the empirical material. In Chapter Six an answer is found to the first research question, as different categories of slack are identified. In addition the relationship between these categories of slack are also discussed, corresponding to the second research question. In Chapter Seven an analysis is made of the four modes of knowledge conversion. The findings in Chapter Six and Seven are used in Chapter Eight to take the analysis one step further, as different categories of organizational slack at the level of the project is related to the four modes of knowledge conversion, i.e. answering the third research question of the study .

The fifth and final part of the thesis synthesizes the findings and takes them to a higher level of abstraction. In Chapter Nine a synthesized model entitled “balancing knowledge creation” is presented. Chapter Ten concludes the thesis and discusses the contributions from the present study to existing knowledge, and what the implications are for managers. The study ends with a discussion about what can be done in future studies in order to further advance our knowledge.



# CHAPTER TWO

## A Framework for Studying Organizational Slack and Knowledge Creation

*In this chapter the research framework is introduced. The research framework is the tool that guides the gathering of empirical data. It defines the focus of the study, and its boundaries – what will not be studied. The framework consists of two parts: organizational slack and knowledge creation. Each of these two constructs is reviewed before arriving at the research framework.*

A recent trend in innovation management includes a focus on accelerating product development and innovation speed (Kessler & Chakrabarti, 1996). At the same time companies have to cope with demands from the stock market on belt-tightening activities aimed at reducing unnecessary resources (Fisher & White, 2000). Organizational slack is often targeted in these programs as it is often viewed as a form of inefficiency. At the same time, organizational slack is used to explain various organizational phenomena including innovation. In the near term slack resources may appear inefficient, but ‘in the longer term, slack will be necessary for survival and, hence, for long-run effectiveness’ (Sharfman *et al.*, 1988, p. 603). The focus on reducing slack in the organization may thus hamper the ability to be innovative. The proposition underlying this thesis is that knowledge processes, necessary for innovation, are damaged as organizational slack is reduced, causing a reduced ability to be innovative.

The research aim of this study is to link organizational slack to the creation of knowledge, which has not been done in previous studies. The motivation for linking organizational slack to knowledge creation is that it will increase our understanding of the relationship between organizational slack and innovation, and ultimately of the effects on innovation from programs targeted at decreasing cost and increasing efficiency. To be able to achieve the research aim it is

necessary to begin developing our understanding of the construct of organizational slack, as applicable to a product development project. In doing so, previous literature on organizational slack, which is at the level of the firm, is helpful. This is the first step in the theoretical review and will result in the first part of the research framework that later on guides this study.

The review of organizational slack is followed by a theoretical review of the literature on organizational learning, in which I argue that knowledge management, which is applied as knowledge creation in the thesis, is part of the larger theoretical field of organizational learning. It is knowledge creation that forms the second part of the research framework. Towards the end of the chapter the two research frameworks – organizational slack and knowledge creation – are presented in a synthesized research model that will guide the rest of this thesis.

## **Firm Level Categories of Organizational Slack**

The concept of organizational slack has been used to explain various organizational phenomena, aside from innovation (Cyert & March, 1963/1992, p. 43). Organizational slack has been used to explain top management teams' strategic and political behaviour (Bourgeois & Jitendra, 1983), risk taking (Bromiley, 1991; Palmer & Wiseman, 1999; Singh, 1986; Wiseman & Bromiley, 1996), environmental management issues (Bowen, 2002), and firm performance (Greenley & Oktemgil, 1998). There is also literature that examines the concept of budgetary slack (Merchant, 1985), where the focus is on managers' intentional use of the budget process to create and bargain for slack budgets. This is then related to areas such as budgetary participation (Dunk & Perera, 1997), managerial short-term orientation (Van der Stede, 2000), and the corporate diversification and business unit strategy (Van der Stede, 2001). Finally, organizational slack has been seen as a buffering mechanism against changes in an organization's external surroundings (Sharfman *et al.*, 1988; Thompson, 1967).

The diversity of phenomena to which organizational slack has been applied, means that there are different views of, and definitions of, the concept. Therefore, an important starting point for a review of the literature on organizational slack is the conceptual and empirical difficulties associated with defining slack (Nohria & Gulati, 1996, p. 1246). An often-used definition has been proposed by Bourgeois (1981, p. 30), who defines organizational slack as:

*That cushion of actual or potential resources which allow an organization to adapt successfully to internal pressure for adjustment or to external pressure for change in policy, as well as to invite changes in strategy with respect to the external environment.*

This definition implies that slack or spare resources are accumulated to adapt to future changes in the environment. The purpose of slack is to allow the organization to forego short-term gains in favor of long-term gains. Slack resources are not committed to necessary expenditure, but are built up for future use (Sharfman *et al.*, 1988).

Using this definition of organizational slack, Bourgeois (1981) distinguished between six different effects of organizational slack. The first three effects are related to the internal maintenance of the organization and the last three are viewed as facilitators of strategic behavior:

1. Slack can act as a form of inducement to make individuals remain in the organization.
2. Slack can be a resource for conflict resolution, as it is a spare resource used to decrease internal tensions and conflicts among independent parts of the organization.
3. Slack can also be a workflow or technical buffer protecting the organizational core from environmental uncertainties.
4. Slack can provide opportunities for experimentation and innovation, making it possible for the organization to experiment with new strategies such as entering new markets and introducing new products.
5. Slack can result in the organization undertaking only a limited search for solutions, being satisfied with an acceptable solution.
6. Slack can be a promoter of political activity as managers compete for any newly available resources.

In the literature relating organizational slack to innovation, the focus has so far been on examining the level of slack, which is then related to innovation outcomes at the level of the firm (Geiger & Cashen, 2002; Kuitunen, 1993; Nohria & Gulati, 1996, 1997; Singh, 1986). These studies have most often used financial data to measure organizational slack, following the definitions of Bourgeois (1981). The use of financial data as a measure of organizational slack is highly prevalent in the literature (Bourgeois & Jitendra, 1983; Bromiley, 1991; Geiger & Cashen, 2002; Greenley & Oktemgil, 1998; Palmer & Wiseman, 1999; Riahi-Belkaoui, 1998; Wiseman & Bromiley, 1996). Studies attempting to measure slack have either used the model developed by Bourgeois and Singh (1983), or the model developed by Singh (1986).

The use of financial information as an indicator of slack has been concerned both with the present status of the firm, as well as the firm's long-term capabilities. Bourgeois and Singh (1983) argue that slack can be differentiated on an ease-of-recovery dimension, i.e. a continuum representing how quickly the slack resource can be recovered for potential redeployment. They conceptualised the ease-of-recovery dimension into available (readily), recoverable (with some effort) and potential slack. Available slack is measured as the current ratio (current assets/current liabilities), recoverable slack as selling and general administrative expenses divided by sales (S&GA/sales), and potential slack is measured as the company's debt to equity ratio. Singh (1986) made a distinction between absorbed and unabsorbed slack, in which absorbed slack is closely related to available slack, and unabsorbed slack is similar to potential slack.

Although the view of organizational slack as being related to (financial) resources dominates the literature, there are other views of organizational slack (Geppert, 1996; Lawson, 2001; Meyer, 1982; Nohria & Gulati, 1996; Sharfman *et al.*, 1988). Particularly important for the purposes of this thesis, is the existence of different views of the categories of organizational slack (Meyer, 1982). Regardless of the category, slack is used by the organization to adapt to changes. These changes can be external to the organization, such as environmental jolts – sudden and unpredictable events (Meyer, 1982). The changes can also come from inside the organization, in the form of internal pressure for adjustment (Bourgeois, 1981). In the review of the literature on organizational slack, I have identified seven categories of organizational slack at the level of the firm (highlighted in the text).

### Categories of Organizational Slack at the Firm Level

The first and most common category of slack is *financial resources* (Bourgeois & Jitendra, 1983; Bromiley, 1991; Cheng & Kesner, 1997; Geiger & Cashen, 2002; Greenley & Oktemgil, 1998; Kuitunen, 1993; Palmer & Wiseman, 1999; Riahi-Belkaoui, 1998; Singh, 1986). Organizational slack has also been viewed as a facilitator of creative behaviour (Bourgeois, 1981), creating room for the organization to experiment with new strategies, for instance developing and introducing new products, or entering new markets and segments, i.e. targeting new customers (Hambrick & Snow, 1977). As a consequence, the characteristics of the *product* and its *customer* are identified as important categories of slack.

Another category of slack is human resources (Meyer, 1982), where a firm can have a surplus of employees (Nohria & Gulati, 1996, 1997). Therefore the *members* can be identified as an important category of slack. The availability of *time* that is not fully engaged in the current delivery of the organization's primary product or service (Geppert, 1996; Lawson, 2001) is a fifth category of slack. Time is needed for the members of the organization to learn from

experience, in order to adapt to environmental changes and be innovative (Lawson, 2001, pp. 126-127). The organization's members need slack in order to reflect, analyze and discuss (Lawson, 2001). It is difficult to learn if the members are hurried or rushed. However, learning does not happen automatically just because time is available. The organization must give its members room to develop and collaborate (Stewart, 1996).

The availability of time is closely related to *goals and deadlines* (Cyert & March, 1963/1992; Nohria & Gulati, 1996). Goals and deadlines are often influenced by the exercise of *governance and leadership* by top management (Cyert & March, 1963/1992). Organizational slack can result in less stringent demands to meet forecasted deadlines, resulting in more freedom given to individual projects. But it can also be the other way around – the governance of a project can increase, as there is little slack (Nohria & Gulati, 1996).

The seven categories of organizational slack identified in the literature serve as an important starting point for my research. Perhaps most importantly, the review reveals that slack is not only to be viewed as excess (financial) resources, there are other categories of slack as well. However, these categories of slack are identified at the level of the firm, not at the project level which is the unit of analysis in this study. The seven categories of slack, and their respective explanation at the level of the firm, are summarized in table 2:1 below. This is the first part of the research framework in this study.

**Table 2:1 ▼**  
**Different Categories of Slack Identified at the Level of the Firm**

Categories of slack	Explanation at the level of the firm
Financial	$\Delta \text{Slack} = f(\Delta (\text{RE}, \text{DP}, \text{G\&A}, \text{WC/Sales}, \text{D/E}, \text{CR}, \text{I/P}, \text{P/E}))^{10}$
Product	Is it possible to experiment and introduce new products?
Customer	Is it possible to address new customers?
Members	Is there a surplus of employees in the organization?
Time	Is there time available not fully engaged in the organizations' primary product or service?
Goals and deadlines	Is there less stringent demands on forecasted milestones?
Governance and leadership	Is there a lax discipline in selection, ongoing support and termination of projects?

At this point it is once again worth emphasising that previous studies have been concerned with categories of slack at the level of the firm. In comparison to

<sup>10</sup> RE - Retained earnings (+), DP - Dividend payout (-), G&A - General and administrative expenses (+), WC/Sales - Working capital as a percentage of sales (+), D/E - Debt as a percent of equity (-), CR - Credit rating (+), I/P - Short-term loan interest compared to prime rate (-), P/E - price/earnings ratio (+). A positive sign corresponds to an increase in slack; negative signals a decrease in slack (Bourgeois, 1981).

these studies, the present study differs both in the research methodology and research design. First, the focus is on identifying categories of slack at the level of the project, not at the level of the firm. Second, the relationship between these categories of slack is also examined. Third, a case study methodology is chosen due to the exploratory nature of the study. A fourth difference is the research design – which to some extent is given by the research methodology – where multiple cases are studied longitudinally.

## **Organizational Learning Applied as Knowledge Creation**

During the last ten years there have been arguments raised that suggest our society is leaving the industrial era and becoming a “knowledge society” or “learning economy” (c.f. Tell, 1997, p. 7). However, it is not always clear what is meant by such a change. Hellgren and Löwstedt (1997) discuss in terms which would suggest that our society has always been a knowledge society. To claim that our ancestors were not concerned with developing their knowledge is a bit far-fetched. Particularly considering that philosophers of science have studied the nature of knowledge, and the distinctions between different kinds of knowledge, since the beginning of thought.

However, what is new is the growing interest in organizational learning and knowledge in the management literature and these two concepts have become a major area of study on organizations, which is reflected in the growing number of books, articles and special issues on organizational learning and knowledge management in leading academic journals (Crossan & Guatto, 1996; Scarbrough & Swan, 2001). In addition, what is emphasised is that greater demands must be put on the systematic and continuous acquiring of knowledge. At the same time as product life cycles become shorter (Gupta & Wilemon, 1996; McDonough III & Barczak, 1991; Takeuchi & Nonaka, 1986), acquired knowledge will also decrease. A development towards the knowledge society thus puts new demands on society, companies and people.

During the last decade there has been an increased amount of management books published on different techniques, such as Total Quality Management (TQM) and Business Process Reengineering (BPR), which can be implemented in order to increase the output of the company. The trend towards implementing these programs in combination with shorter product life cycles and accelerated product development, all point in a direction where the company needs to do new things in new ways, requiring a capacity to learn and develop knowledge (Hellgren & Löwstedt, 1997). The motivation for why learning and knowledge is becoming more and more important is well captured by von Krogh *et al.* (2000, p. 5) who argue that ‘knowledge is one of those

concepts that is extremely meaningful, positive, promising, and hard to pin down’.

Despite the interest in, and popularity of, concepts such as organizational learning, learning organizations and knowledge, there is still a lack of consensus among scholars on how these concepts should be defined, what perspective to take and the conceptualization and methodology to be used (Argote *et al.*, 2003a; Tsang, 1997). Thus, there are shortcomings to the examination of learning and knowledge as discussions about learning and knowledge are often based on ‘high philosophy and grand themes, sweeping metaphors rather than the gritty details of practice’ (Garvin, 1993, p. 79). In addition it has been argued by scholars that the relationship between individual learning and organizational learning is not well understood and has received little attention (Kim, 1993; Tsoukas & Vladimirou, 2001). It is also argued that much of the literature on knowledge management focuses on technical issues, lacking a discussion and analysis of knowledge (Scarbrough & Swan, 2001).

The lack of appreciation of the different concepts of knowledge limits the work in the area of knowledge management. The failure to realize the difference between individual vs. organizational knowledge and explicit vs. tacit knowledge is of great importance in understanding the acquisition, maintenance, and exercise of competencies by individuals and groups. For this reason it is important to define the level of analysis and what knowledge in detail means (Schön, 1983).

Below I will argue that knowledge management is part of the larger field of organizational learning, and within knowledge management is the theory of knowledge creation (Nonaka, 1994; Nonaka & Takeuchi, 1995). Knowledge creation is conceptualized as the ability to share and transfer knowledge between, and among members, in product development projects. However, before reaching the theory of knowledge creation, it is necessary to address the link between organizational learning and knowledge management.

### **The Link Between Organizational Learning and Knowledge Management**

Learning is more and more seen as a prerequisite for the success of companies. The challenge is to speed up the learning process, to be able to learn faster than ones competitors and have a sustainable competitive advantage. Learning within an organization is a concept that can be traced back to Fredrick Taylor and his work on scientific management from the beginning of the 1900s. Management developed a science for each element of a man’s work, to replace the old rule-of-thumb method. The management scientifically selected and then trained, taught, and developed the workman to increase efficiency, whereas previously the workman chose his own work and trained himself as best as he could (Taylor, 1911).

But it was not until the 1960s that the term “organizational learning” emerged as a concept of its own (see for instance Cangelosi & Dill, 1965; Cyert & March, 1963/1992). It was then that scholars began to make propositions and find evidence on how organizations learn. Throughout the years, other studies in different disciplines have followed these pioneering studies, indicating that the study of organizational learning is not something new which developed during the 1990s. ‘What is new, however, is the recent interest in how the concept of the learning organization can help managers to build competitive enterprises’ (Ulrich *et al.*, 1993, pp. 53-54).

It has been shown that the field of organizational learning has grown, and is growing, both in terms of volume of publications appearing in scholarly journals (Crossan & Guatto, 1996; Scarbrough & Swan, 2001), and in the breadth of disciplinary interest and the adoption of the concept (Dodgson, 1993). Practitioners have also identified the importance of learning (see for instance De Geus, 1988; Stata, 1989). Stata (1989, p. 64) argues ‘that the rate at which individuals and organizations learn may become the only sustainable competitive advantage, especially in knowledge-intensive industries’.

Within the field of organizational learning it is common to make a distinction between studies on learning organizations and those on organizational learning (Dodgson, 1993; Easterby-Smith *et al.*, 1998). In addition, there are also differences concerning preferences for how to investigate and research organizational learning, because of different academic perspectives (Easterby-Smith, 1997; Easterby-Smith *et al.*, 1998).

However, despite the existence of different perspectives on organizational learning, there are few studies explicitly addressing the difference between organizational learning and knowledge management. Instead the two concepts are often treated as being unrelated, and the link between them is not addressed (c.f. discussion by Scarbrough & Swan, 2001). Below I argue that knowledge management can be viewed as a part of the larger field of organizational learning. In knowledge management it is possible to identify a theory of knowledge creation, a theory which is related to product innovation (Crossan *et al.*, 1999).

#### **A Note on the Differences Between Organizational Learning and Learning Organizations**

Within the field of organizational learning it is possible to identify two areas where the literature is diverging (Easterby-Smith, 1997; Easterby-Smith *et al.*, 1998; Tsang, 1997). The first is between the academic literature, which is concerned with the study of learning processes within organizations, and the practitioner literature, which focuses on creating learning organizations. Second, the literature is also diverging when it comes to the preferred ways of researching and investigating organizational learning, depending upon the disciplinary

perspective taken. The difference between academic studies on organizational learning and practitioner oriented studies on learning organizations has been reviewed by Tsang (1997).

The first stream is descriptive, as it is an academic stream, and tries to answer the question “How *does* an organization learn?”. The difference between the theoretical area of organizational learning and the applied area of organizational learning is that the latter tries to answer the question “How *should* an organization learn?”. The audience targeted are practitioners and the studies are often based on the authors’ consulting experience and seldom use rigorous methodologies, i.e. the literature is prescriptive. Many of these studies are concerned with implementation and are committed to the achievement of a desirable end state (Easterby-Smith, 1997). Tsang (1997) summarizes the dichotomy between descriptive and prescriptive theorizing through eight key differences, which is reproduced in table 2:2 below.

**Table 2:2 ▼**  
**Dichotomy Between Descriptive and Prescriptive Theorizing (Source: Tsang, 1997)**

	Descriptive writing on organizational learning	Prescriptive writings on the learning organization
Key question	How does an organization learn?	How should an organization learn?
Target audience	Academics	Practitioners
Objective	Theory building	Improving organizational performance
Source of information	Systematic data collection	Consulting experience
Methodology	Rigorous research methods	Rough case study and action research
Generalization	Aware of the factors limiting the generalizability of research results	Tendency to overgeneralize a theory to all types of organization
Outcome of learning	Potential behavioural change	Actual behavioural change
Relationship between learning and performance	Can be positive or negative	Taken to be positive

The position taken in this thesis leans more towards the descriptive writings on organizational learning, which should come as no surprise, a thesis being a product of the academic society. Having addressed the difference between organizational learning and learning organizations, it is now time to briefly review the different disciplines of organizational learning from which it is possible to arrive at an application of organizational learning as knowledge creation.

### **Reviewing Disciplines of Organizational Learning**

The field of organizational learning is characterized by a multitude of disciplinary perspectives, each investigating different aspects of organizational learning (Argote *et al.*, 2003a). According to Easterby-Smith (1997; 1998) the

literature on organizational learning can be traced to six academic perspectives, each perspective having its own preferred research methodologies for investigating organizational learning, resulting in different contributions. The six perspectives are: psychology and OD, management science, organization theory, strategy, production management, and cultural anthropology. The ontology, the key contributions, and the problems are summarized in table 2:3 below, and then discussed briefly<sup>11</sup>, with the aim of presenting the key ideas and problems.

However, it is important to note that this model does not cover everything, and that some authors can be fitted into more than one category. One such example is the work by Nonaka and colleagues (1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995) on knowledge creation (Easterby-Smith *et al.*, 1998, p. 264), this issue will be addressed after the review.

**Table 2:3 ▼**  
**Disciplines of Organizational Learning (Based on: Easterby-Smith, 1997; Easterby-Smith *et al.*, 1998)**

Discipline	Ontology	Key ideas	Problems
Psychology and OD	Human development	Cognitive organization; development; communication and dialogue	Defensive routines; individual to collective transfer
Management science	Information processing	Knowledge; memory; holism; feedback; error correction	Nonrational behavior; short vs. long term; information overload; unlearning
Organization theory	Social structures	Effects of power and hierarchy; conflict and interests; ideology and rhetoric	Conflicts of interests; organizational politics
Strategy	Competitiveness	Organization/environment interface; learning between organizations	Environmental alignment; competitive pressures; general vs. technical learning
Production management	Efficiency	Learning curves and productivity; design and production times	Limitation of undimensional measurement; uncertainty about outcomes
Cultural perspective	Meaning systems	Culture as cause and effect of organizational learning; values and beliefs	Instability and relativity of culture as a barrier to transfer ideas; dominating perspective

#### *Psychology and OD Perspective*

Human development within the organizational context is the central concern in the psychology and OD perspective. There are five main contributions making up the perspective:

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<sup>11</sup> This review is a summary of the key ideas presented in the literature and no attempt is made at covering all aspects within each of the six perspectives. For a more thorough review I advise the reader to look into the articles by Easterby-Smith (1997; Easterby-Smith *et al.*, 1998).

- (1) the notion that learning can be organized into a *hierarchy*, where different forms of learning are related to each other,
- (2) the *cognitive* processes of learning in which individuals build up cognitive maps of their work contexts, these maps can later be modified from experience,
- (3) *experimental learning* is the notion of successive stages in individual learning, which begins with a concrete experience that is moved on to reflective observation, abstract conceptualization, and active experimentation,
- (4) theories on *learning styles* argue that individuals have preferences for distinctive ways of learning, and that these should be recognized in order to broaden individual repertoires, which enables the individual to perform well in a range of situations,
- (5) the *problem* of why, in practice, it is so hard for individuals and organizations to learn from experience is the focus of the last stream of literature within the psychological and OD perspective.

Contributions from the psychological and OD perspective are in identifying different hierarchical levels of individual learning, and in understanding that context is important. Another important contribution is in recognizing that it is possible to adjust individual learning so that it can be related to organizational learning, as well as the recognition of cognitive maps and frames of thinking, and finally, that there is an interrelationship between thinking and action.

However, there are also problems with organizational learning. First, it is difficult to assess how to move the content of individual learning to the collective. Second, there are defensive reactions among groups and individuals, and third, poor communication may exist between organizational members.

#### *Management Science Perspective*

In the management science perspective the key concern is the *gathering and processing of information* in, and about, the organization. Hubert (1991) argues that there are four main processes: (1) knowledge acquisition, (2) information distribution, (3) information interpretation, and (4) organizational memory.

Knowledge acquisition occurs either through the inherited knowledge of company members, or by the recruiting of new staff with external knowledge. The organization may also learn through feedback on the consequences of its actions<sup>12</sup>. The distribution of information within the organization is important for learning, as people gaining new information may see new patterns emerging

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<sup>12</sup> Argyris and Schön (1978) discuss this ability through their concept of single and double-loop learning. Single-loop learning is the correction of an error within a given set of governing variables, while double-loop learning is the process of changing the governing variables.

as they interpret previous information in new ways. However, concerns have been raised on the limited cognitive capacity of individuals, which limits the amount of information available to the organization. Besides identifying the processes of the creation and dissemination of information, this perspective also contributes with the notion of organizational knowledge; that levels of learning are progressively desirable, and that it is necessary to design control systems that help rather than hinder organizational learning.

The main problem in the management science perspective is that *political behavior* may cause problems in learning as it leads to the distortion and suppression of information. A second problem is that most organizations are focusing on the *short-term*, not the *long-term*, causing constant adjustments to the immediate environment, which is related to the third problem of *unlearning*. Hedberg (1981) describes that unlearning is not only difficult, but also takes time.

#### ***Organization Theory Perspective***

Within the organization theory perspective the focus is on the broader *social system and organizational structures* where learning may be embedded, and which may affect organizational learning. The *functional view* addresses the question of why organizations do not learn as well as they might. The explanation is that structural aspects make it difficult for organizations to respond appropriately to environmental changes. Another stream within the organization theory perspective is the *contingency view*, in which it is argued that organizational learning means different things in different environments, putting different demands on the organization. The *constructivist view* emphasises the informal, as opposed to formal learning, claiming that learning is both the process and outcome of social construction. The *critical view* focuses on hierarchical differences and the ability of individuals to present useful and valid knowledge within the organization.

Summarizing the contributions, the organization theory perspective, first, fundamentally questions the nature of learning and the process of construction that underpins it. Second, it draws attention to the politics, conflicts and power in organizations, which is not something easily avoided. Third, it raises the question of whose interest is served by the concept of organizational learning.

#### ***Strategic Perspective***

The strategic perspective focuses on *competition* and learning and evaluates whether or not it gives one organization an advantage over others. The literature on organizational learning within the strategic perspective either takes an *evolutionary view* or a *processual view*. The *evolutionary view* is dominated by the work on population ecology. In these studies the key question is to examine if the ability to learn is a significant factor for the survival of an organization across

large populations. The *processual view* focuses on the micro level and identifies how learning takes place within and between organizations.

The main contributions from the strategic perspective are, first, the belief that a competitive advantage can be gained from applying the ideas of organizational learning. Second, is identifying the importance of direct experience and the significance of tacit knowledge, which may result in organizational learning. Third, is recognising the importance of exchanging technical information, which is crucial, not least in high-technology companies. One major problem is that organizational learning may have cultural limitations.

#### *Production Management Perspective*

Within the production management perspective the focus has been on the relationship between learning and *productivity/efficiency*. Early contributions within this perspective focused on the learning curve (Yelle, 1979). Today, however, arguments have been raised suggesting that it is necessary to look at more than a single measure of output (Garvin, 1993). There is a recognition that a company cannot only rely on endogenous sources, it must also look at exogenous sources in order to learn. Nevertheless, looking at the main contributions from this field the concept of learning curves is included, as is the use of productivity as a criterion to assess organizational learning. In addition, the impact of organizational design on the transfer of individual to organizational learning also deserves to be mentioned. The problem with taking this perspective is the limitation of using single criteria to assess learning, and comparative research has methodological weaknesses, as does the recognition of cultural aspects.

#### *Cultural Perspective*

The cultural perspective examines “culture” in *organizational and national manifestations*, as a significant cause and effect of organizational learning. Most of the literature on culture has been concerned with the unidirectional transfer of ideas from Japan to the US, which raises the question of whether some cultures can be considered as superior to others in facilitating learning. Other studies have drawn attention to the importance of values and beliefs for organizational learning. Studies have also shown that culture may affect both the process and the nature of organizational learning. The problem with the cultural perspective is that it may be difficult to transfer ideas from one cultural setting to another.

#### *Summarizing the Perspectives on Organizational Learning*

These six perspectives clearly show that there are different ways of thinking about organizational learning. Each perspective represents a distinct academic discipline that has its own particular ontological view and a wide range of contributions and problems. In addition, each perspective also has its own journal and conferences, implying that there is often minimal overlap between

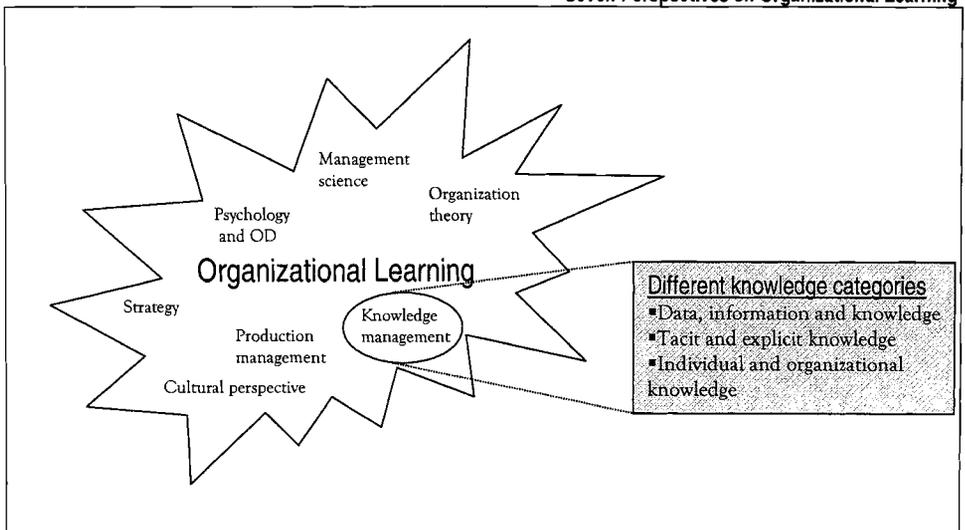
the perspectives. However, just as there are authors who fall rather neatly into one category, others may produce ideas that span different perspectives.

The work by Nonaka is concerned with knowledge; a perspective that Easterby-Smith (1997; Easterby-Smith *et al.*, 1998) does not explicitly address. However, it is acknowledged that 'this model <of disciplines of organizational learning> does not cover everything (Easterby-Smith *et al.*, 1998, p. 264), i.e. there are opportunities for refining the model, either by adding or by excluding, one or more perspectives.

The view that there are different perspectives in the literature on organizational learning is supported in a review by Crossan *et al.* (1999), who identify three different applications of organizational learning in the literature. First, is the information processing perspective of organizational learning (see Huber, 1991), which is closely related to the management science perspective. Second, is the bounded rationality perspective that explores the cognitive limitations of managers and how it affects learning (Simon, 1991), which resembles the ideas in the psychological and OD perspective. The third stream is concerned with product innovation (see Nonaka, 1994; Nonaka & Takeuchi, 1995).

The reason for arguing that knowledge management can be viewed as a perspective in its own right is, first, the large dissemination that the concept has had over the last few years (Scarbrough & Swan, 2001). Second, are the difficulties of matching knowledge with any of the other six perspectives, as theories of knowledge management can be found in each of the six perspectives. Combining these various contributions gives the motivation for adding knowledge management as a seventh perspective on organizational learning.

Figure 2:1 ▾  
Seven Perspectives on Organizational Learning



## Knowledge Management

Within the area of knowledge management there are many different theories and no unified, clear-cut theory exists. According to Williamson (1999), there are few knowledge-based theories that have been empirically tested, causing the field to look more like a theoretical patchwork than a solid body of theoretical knowledge. There are essentially two reasons why a coherent theory of knowledge management has not yet been developed. First, while most scholars seem to agree that there are two types of knowledge – explicit and tacit – the treatment of the two has been different (e.g. is it possible to turn one into another?), in addition some authors have also developed their own typologies (e.g. know-how vs. know-what). Second, there is disagreement about the level of analysis at which knowledge is a valid concept. Therefore, it is important to define what knowledge in detail means and the level of analysis (Schön, 1983).

In this thesis the focus is on knowledge creation within the area of knowledge management. Knowledge creation is conceptualized as the ability to share and transfer knowledge between, and among, members in product development projects. The ability of a company to create knowledge allows the company to develop new knowledge, which gives it the capacity to produce better products and services. Thus, the ownership of knowledge assets, and the ability to combine them with other assets, create values which in turn lead to a competitive advantage (Teece, 1998).

The choice to focus on knowledge creation is also in line with the review of the organizational-learning literature by Crossan *et al.* (1999). The review claims that in the literature the theory of knowledge creation is characterised by three things: (1) it is explicitly concerned with product innovation, (2) it links different levels (individual – group), and (3) it focuses on processes that link individuals and groups to each other, i.e. the focus, or unit of analysis is within the company.

This thesis is concerned with the effects on innovation from programs targeted at decreasing cost and increasing efficiency, by examining the relationship between slack and knowledge. Therefore, the theory of knowledge creation, which incorporates innovation and the linkages inside companies, matches well these criterions. To be able to define knowledge creation (i.e. ‘what knowledge in detail means’), it is necessary to make the distinction between learning, knowledge and knowledge creation clear.

Learning can be understood as a process, and knowledge is the result of that process (Bertels & Savage, 1998), which is similar to the view adopted by Tell (1997, p. 13) who argues that ‘knowledge is considered as a stock, while learning is the process of acquiring this stock’. In this thesis, knowledge creation is conceptualized as the ability to share and transfer knowledge between, and

among, members in product development projects. Thus, knowledge creation is also to be understood as a process and knowledge is the result of that process.

The above implies that, to some extent, learning (understood as a process) and the process of knowledge creation can be seen as being on equal footing, resulting in the same thing: knowledge. The difference between the two can be understood as a choice of perspective within the area of organizational learning - I am concerned with knowledge management and for that reason I want to place knowledge at center-stage in the present thesis, implying that the focus is not on the multifaceted phenomenon organizational learning, but on a specific perspective within the area of organizational learning. Knowledge creation is defined as *the capability of a company to create new knowledge, disseminate it throughout the organization, and embody it in products, services, and systems* (c.f. Nonaka & Takeuchi, 1995, p. 3).

After choosing to focus on knowledge creation it is now time to turn to the level of analysis, as the choice of a knowledge-management perspective has implications for which level of analysis to choose (cf. Venzin *et al.*, 1998). There are macro-level knowledge-based theories of the firm, which stress the unique ability of organizations (as opposed to markets) to create and share knowledge (Grant, 1996b; Kogut & Zander, 1992; Nahapiet & Goshal, 1998; Spender, 1996a; Zander & Kogut, 1995). In contrast to these theories, micro-level treatments of knowledge emphasise the difficulties of exchanging knowledge between recipients within the company due to knowledge stickiness (Szulanski, 1996; von Hippel, 1994).

In-between the macro and the micro level of analysis lies the perspective on knowledge chosen here, where studies focus on how knowledge is created within the company (Inkpen & Dinur, 1998; Johnson, 2002; Judge *et al.*, 1997). This choice to focus on knowledge creation within a company has implications for the unit of analysis<sup>13</sup>. In this thesis product development projects are the unit of analysis, not the firm and not the individual, which corresponds to previous work on knowledge creation (1994; Nonaka & Takeuchi, 1995).

To be able to examine the relationship between categories of organizational slack and knowledge creation it is necessary to discuss the different categories of knowledge. After having reviewed the literature on categories of knowledge, it is possible to present a categorization of how these knowledge types are related and a theory of knowledge creation can be identified that will then be used in this study.

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<sup>13</sup> Chapter 3, Research Methodology, discusses the issue of the unit of analysis in more detail.

## Different Knowledge Categories

First, it is important to make a distinction between *data, information and knowledge*. Data, information and knowledge are not the same thing. 'Data requires minimal human judgment, whereas knowledge requires maximum judgment' (Tsoukas & Vladimirou, 2001, p. 976). Between data and knowledge is information. Information is not the same as knowledge, even though there is a link between them. Information is a flow of messages, while knowledge is created when people act with the information as a point of departure. Thus, information is necessary for the creation of new knowledge.

Second, knowledge can take different forms. In this study a distinction is made between *explicit and tacit knowledge*. Explicit knowledge is the formal, systematic and codified knowledge, while tacit knowledge is the non-verbalized and intuitive knowledge (Polanyi, 1966). Explicit and tacit knowledge are two distinct, but complementary forms (Ancori *et al.*, 2000).

Third, *knowledge* can be either *individual or organizational*. Individual knowledge is the ability to learn and know different rules, concepts, to have a skill or a "feel" for something (Cook & Brown, 1999). Organizational knowledge can be a metaphor or a phrase that means a specific thing for a group (Cook & Brown, 1999); it can also be a routine that includes the structure, forms and technologies around which an organization works (Levitt & March, 1988).

### **Data, Information and Knowledge**

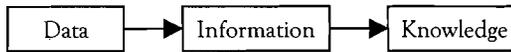
There are different views on what the difference between data, information and knowledge is depending on the point of departure. According to Ancori *et al.* (2000) there are two antagonistic positions to be found concerning the distinction between information and knowledge. First, there is the linear model, having its roots in a rationalistic school of thought. Second, there is an interactive model, which is close to constructivism.

#### *The Linear Model*

In the linear model data are turned into information and information into knowledge. It is a linear process where complexity increases with the search for knowledge. Data is considered as raw material (single bits) from nature that is turned into structured pieces of information (i.e. information constitutes a number of data bits), the information is then channelled into a search for knowledge (i.e. knowledge is when several pieces of information are put together).

Figure 2:2 ▶  
The Linear Model

The linear process of  
formation of knowledge



There are two important implications of this relationship:

1. The efficiency of the system is dependent on the channels which treat the data and information. The more efficient the system is in circulating information, the more efficient the process of forming knowledge can be, because of the ability to examine and assess different combinations of information.
2. The implicit assumption in the model is that knowledge is a result of the codification and classification of information.

However, there are shortcomings to this view. There is no attention given to the processes of selection and interpretation. Thus, there is no room for insight and creativity in the positivistic process (Magnusson, 2000). In addition, information is fragmented and transitory and something gained by being told, whereas knowledge is structured, coherent and of lasting significance, and something acquired by thinking (Ancori *et al.*, 2000). These arguments emphasise the need for making a distinction between knowledge and information that is not restricted to a linear process.

#### *The Interactive Model*

In the interactive model the underlying assumption is that continuous feedback loops are required between the components involved (data, information, knowledge). Each component interacts with each other (Ancori *et al.*, 2000). Sarvary (1999, p. 96) emphasizes that some interpretation of the data and knowledge is necessary and makes a comparison with technology. In technology there are input and output factors. The input factors in the technology of knowledge are the raw information (individuals' experience, data acquired from external sources). The output is knowledge of how to solve business problems. The difference between the input and output factors is in the structure of the two. The input factors do not have much structure, while the output is highly structured. Information *and* the casual links that helps to make sense of the information is what should be regarded as knowledge.

Tsoukas and Vladimirou (2001, p. 976) argue that the difference between data and knowledge is human involvement and give the following definition: '*data* is an ordered sequence of given items or events (e.g. the name index of a book). *Information* is a context-based arrangement of items whereby relations between

them are shown (e.g. the subject index of a book). And *knowledge* is the judgment of the significance of events and items, which comes from a particular context and/or theory (e.g. construction of a thematic index by a reader of a book)'. Thus, the human involvement and processing of reality makes it possible to arrange the three concepts on a continuum. In addition knowledge differs from information in that it is also closely related to action (Tsoukas & Vladimirou, 2001).

To take an example from the world of music, the arrangement of records in alphabetic order is merely *data*, as it takes little effort to make such an index. Because an artist or a group makes each record it is just to arrange them alphabetically. To classify the records after the genre it belongs to, such as pop, rock or hip-hop, requires more processing and is viewed as *information*, but is still quite easy to do. Finally, to relate the records within each genre to other genres within the genre (old-school hip-hop or electronic hip-hop) or to construct ones own analytical indexes demand a greater involvement, requiring *knowledge* and judgment in organizing the material.

This example highlights the difference that human involvement makes, and it is this which is the essential difference between data, information and knowledge. The example also shows that it is important to take into account the process of selection and interpretation when distinguishing between data, information and knowledge. The position taken in this thesis on the distinction between data, information and knowledge is closer to the interactive model than to the linear model. This position is similar to the one taken by Nonaka (1994; Nonaka & Takeuchi, 1995).

### **Tacit and Explicit Knowledge**

The distinction between tacit and explicit knowledge derives from the work of Polanyi (1966). It is proposed that knowledge can take two different forms: tacit and explicit. Tacit knowledge is defined as non-verbalized, intuitive and non-articulated knowledge and is, according to (Stein, 1996), knowledge that the individual does not want or lacks the ability to communicate. Explicit knowledge is defined as formal, systematic and codified knowledge. Explicit knowledge is something that can be expressed in numbers and words. According to Polanyi (1966) some knowledge will always remain tacit, which cannot be turned into explicit knowledge. Everyone does not share this view that tacit and explicit knowledge are two distinct types, instead they are seen as two ends of a continuum (cf. Nonaka, 1994; Nonaka & Takeuchi, 1995; Spender, 1996b).

Tacit knowledge is often referred to as knowledge that is gained experimentally, in terms of its incommunicability, or by stressing the privacy of personal experience. Spender (1996b, p. 67) defines tacit knowledge as 'that which has not yet been abstracted from practice'. This definition implies that it is possible to consider the traffic between them. Thus, tacit and explicit knowledge are not

totally separate but mutually complementary entities. They interact with, and interchange into, each other in the creative activities of human beings. Through a “social conversation” process, tacit and explicit knowledge expand in terms of both quality and quantity. Spender further argues that even though tacit knowledge may not be communicated through language, it does not mean that it cannot be communicated in other ways. For instance, an apprentice may learn a craft without formal instructions and even without communication by doing the work of the master.

In a similar way Lam (2000, pp. 490-491) argues that the innovative capability of an organization is dependent upon the organization’s ability to create knowledge, which in turn involves: (1) the use and generation of tacit knowledge, and (2) the ability of an organization to mobilize tacit knowledge and foster its interaction with explicit knowledge.

However, not all scholars agree with the arguments that tacit and explicit knowledge can be seen as two ends of a continuum. For instance Tsoukas (1996) argues that tacit and explicit knowledge should not be viewed as two separate types of knowledge, but are instead inseparably related, where explicit knowledge is always grounded on tacit components. Cook and Brown (1999) do not agree with Tsoukas in the sense that explicit knowledge is grounded on tacit components, neither do they agree with Spender and Lam. Instead they argue that explicit and tacit are two distinct forms of knowledge; each doing work the other cannot, and one form cannot be made out of, or changed into, the other, which is similar to the view held by Polanyi (1966).

Thus, there is not a clear cut agreement in the literature on how the distinction between tacit and explicit knowledge should be treated. Nevertheless, it is necessary to take a stance in this thesis on how tacit and explicit knowledge should be treated. The position taken in this thesis is that tacit and explicit knowledge are two complementary forms of knowledge at any given point in time, but over time their combination and composition can vary depending on the context and on the individual (or community) (cf. Nonaka, 1994; Nonaka & Takeuchi, 1995; Spender, 1996b). What is tacit for one person may be perfectly explicit to another person. In the same way, something that is tacit at instant  $t$  can be explicit at  $t + 1$ . It is also important to note that dealing with tacit knowledge is not solely a matter of communication. Tacit knowledge is managed through coordination mechanisms, codification processes and “socialization” processes and it can be learned through practical examples, experience, and practice (i.e. becoming explicit knowledge).

The question which guided my choice in treating explicit and tacit knowledge as two complementary forms was, ‘how is knowledge created in order to develop innovations?’, which is in line with the overall purpose of this thesis. As I examined the literature theories, faced with answering the same question, all

tended to treat explicit and tacit knowledge as being two ends of a continuum (e.g. Crossan *et al.*, 1999; Hedlund, 1994; Leonard-Barton, 1992; Lindkvist, 2001; Magnusson, 2000; Nonaka, 1994; Nonaka & Takeuchi, 1995), while no contrasting evidence was found. For that reason I chose to continue in the same tradition, i.e. treating explicit knowledge and tacit knowledge as being on a continuum.

It should also be noted, as pointed out in the literature (Venzin *et al.*, 1998), that Nonaka and Takeuchi (1995) use the word 'conversion' instead of 'transfer' of knowledge in the theory of knowledge creation. Because in their view knowledge cannot be directly transferred, it is always created anew. In comparison to the debate above, the divide in the literature is mainly concerned with whether or not it is possible to transfer knowledge (explicit and tacit) between individuals and groups. Thus, to some extent the debate is reconciled by a choice to focus on the creation of knowledge - which corresponds to the position taken in the thesis - as opposed to the transfer of knowledge.

### **Individual and Organizational Knowledge**

In the discussion on organizational knowledge, knowledge-creating organizations etc., there is recognition of the need to talk about individual and organizational knowledge. It is possible to identify two radically different standpoints in the literature (Nahapiet & Goshal, 1998): One argument is that knowledge exists only at the individual level, whilst in contrast, another argument is that all knowledge is organizational.

The reason for why knowledge is treated as individual is explained by Simon (1991, p. 125) who claims that 'all learning takes place inside individual human heads...'. Simon further argues that organizations can only learn either through their members, or by introducing new members into the organization who have knowledge the organization does not have. Individual knowledge is referred to as the skills or expertise of individuals (Blackler, 1995).

Individual knowledge is often privileged over organizational (Cook & Brown, 1999). For example Tsoukas and Vladimirou (2001, p. 973) argue that there is much talk about organizational knowledge, but it is little understood. And as a consequence it is important to conceptualize organizational knowledge and its implication for knowledge management. Organizational knowledge is often stored in the form of routines, including forms, rules, procedures, strategies and technologies (Levitt & March, 1988), scripts or standard operation procedures.

To reconcile the views of knowledge as either individual or organizational it has been suggested that knowledge is a mixture of both, yet not functionally equivalent (Spender, 1996a; Tsoukas, 1996). Organizations are constructed for a purpose. Individuals are not. As a consequence, the practice of the organization differs from that of individuals. It is important to recognize that organizations are capable of activities that the individual is not capable of and vice versa. For

instance, 'crowd behaviour is a well-known example where the collective seems to have a mind of its own, doing things that no-one in or out of the crowd comprehends or intends' (Spender, 1996b, p. 68).

One important aspect is the link between individual and organizational knowledge. Often knowledge is identified within the individual, but seldom is it made clear in what way it is made organizational. Without a framework or a formal definition of knowledge, things become even more complicated as we are incapable of advancing the frontier of knowledge further (Tsoukas & Vladimirou, 2001). The framework on knowledge creation by Nonaka (1994; 1995) discusses the link between individual and organizational knowledge. Thus, recognizing that the two types of knowledge complement each other as each is doing work that the other cannot do (cf. Cook & Brown, 1999; Spender, 1996a; Tsoukas, 1996).

**Knowledge Typologies**

From the discussion on explicit/tacit and individual/organizational knowledge it should be clear that the four different forms of knowledge are complementary forms of knowledge, each doing work that the others cannot. In this study individual/organizational and explicit/tacit knowledge are seen as being on equal footing with each other. By using the matrix presented by Spender (1996a; 1996b) it is possible to present different typologies that have built upon the distinction between tacit/explicit and individual/organizational knowledge. Spender identifies four different types of knowledge (conscious, objectified, automatic, and collective). Blackler (1995) suggests a typology of knowledge (embrained, encoded, embedded, and embodied) similar to the one by Spender. In a recent contribution to the typologies of knowledge Cook and Brown (1999) distinguish between the following forms of knowledge: concepts, stories, skills and finally genre.

**Figure 2:3 ▶ Knowledge Typologies**  
 Four different typologies of knowledge (Based on: Blackler 1995, Spender 1996a; 1996 b and Cook & Brown 1999)

	Individual	Group
Explicit	Conscious (Spender) Embrained (Blackler) Concepts (Cook & Brown)	Objectified (Spender) Encoding (Blackler) Stories (Cook & Brown)
Tacit	Automatic (Spender) Embodied (Blackler) Skills (Cook & Brown)	Collective (Spender) Embedded (Blackler) Genres (Cook & Brown)

Some comments on the matrix above:

- Upper left quadrant (individual – explicit): knowledge that is held by the individual who knows the ways to perform and use formal methods. It includes things that the individual can know, learn and express explicitly. It can, for instance, be concepts, frameworks or rules that are explicit and known and used by individuals.
- Upper right quadrant (group – explicit): knowledge that is explicit and can be transmitted without bias through language. Things that are explicit, but now it is explicit knowledge in groups, which includes success or failure *stories*, or metaphors, or phrases that only have meaning within a specific group.
- Lower left quadrant (individual – tacit): theoretical or practical knowledge that allows the individual to perform different kinds of technical, athletic or artistic skills, which is gained through training. It is tacit knowledge that the individual possesses that can be equated to a skill in making use of a concept or rules.
- Lower right quadrant (group – tacit): knowledge that is collective (routines, rules of conduct etc.). It is collectively and tacitly shared knowledge that emerges and undergoes constant confirmation and modifications as a group use them in the ongoing work. Levitt and March (1988) argue that an organization learns, not only by discriminating between different routines, but also by refining the routines. As the genres are created in the ongoing work it is possible that the same genre can have different meanings to two different teams. It is possible that “Monday meetings” mean long problem-solving meetings for one team, while it means a short informal update for another team. In each case the knowledge is shared in the team (it is organizational) and it has a specific meaning for the team without any discussion about it. Hence, it is also tacit knowledge.

It is important to note that the four knowledge typologies are not distinct forms, but instead that a company is comprised of all four categories and that these interact. However, as Spender (1996a, p. 51) notes, ‘the matrix weakness is that it tells us little about how these various types of knowledge interact and thus little about how the firm becomes a context especially favorable to the interaction of knowledge-creation and knowledge application processes’.

## Knowledge Creation

Within the area of knowledge management there are many different works (see Argote *et al.*, 2003a, for an orientating framework). In the following I have chosen to focus on the theory of knowledge creation developed by Nonaka and colleagues (1994; Nonaka & Takeuchi, 1995). One reason is the resemblance of

the different typologies of knowledge in organizations with the theory of knowledge creation. The key argument in the theory of knowledge creation developed by Nonaka and his colleagues is that knowledge is created in the interplay between both explicit vs. tacit knowledge and between individual vs. organizational knowledge. Another reason is the widespread attention and acceptance<sup>14</sup> that the theory has gained within the area of knowledge management.

A third and important reason is that the theory of knowledge creation is explicitly concerned with product innovation, which is pointed out by Crossan *et al.* (1999) in their review of the literature. The fact that the theory of knowledge creation is developed for product innovation makes it highly relevant for the present study, due to the focus on the relationship between slack and knowledge in *product development projects*.

For these three reasons I have chosen to use the theory of organizational knowledge creation developed by Nonaka (1994; Nonaka & Takeuchi, 1995), as the second part of the research framework. Before going into detail about the model in the next section, here is a short summary of the standpoints in this study:

- The relationship between data, information and knowledge is not a linear process, but instead is a process characterized by continuous feedback loops and each interacts with each other.
- Tacit and explicit knowledge are two complementary forms of knowledge at any given point in time, but over time their combination and composition can vary depending on the context and on the individual (or community).
- Individual and organizational knowledge exists in the organization and they influence each other over time.

### **A Theory of Knowledge Creation**

The aim of creating knowledge is to generate future opportunities. Knowledge creation refers to processes such as search and experimentation (Magnusson, 2000, p. 27). Organizational knowledge is created in the continuous and dynamic interplay between tacit and explicit knowledge that occurs when there is a shift between the four modes of knowledge conversion: *socializing* - from tacit to tacit, *externalization* - from tacit to explicit, *combination* - from explicit to explicit, *internalization* - from explicit to tacit (Nonaka, 1994; Nonaka & Takeuchi, 1995):

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<sup>14</sup> As discussed previously the theory of knowledge creation is not without critique. The main concern in the critique against Nonaka is the treatment of explicit and tacit knowledge as a continuum and that the two can be converted into the other over time.

- *Socialization* is the acquiring of tacit knowledge without language, but through observation, imitation and practice. The process of socialization occurs when people share their experiences that are the key to acquiring tacit knowledge. This can be made through on-the-job training, or by observing others.
- The process of articulating tacit knowledge to explicit concepts is called *externalization*. This is triggered by a dialogue among members in a project, in which metaphors, concepts or models are developed to generate an understanding of what is going to be developed.
- *Combination* is the process of combining different kinds of explicit knowledge, such as documents, e-mail, meetings or the use of Intranets. Through adding, sorting and recategorizing explicit knowledge new knowledge is developed.
- *Internalization* is the process of embodying explicit knowledge into tacit knowledge. Internalization occurs as different members share mental models and technical know-how, it is a process closely related to “learning by doing”. New knowledge is created when individual tacit knowledge is enriched with new ideas and insights. The use of documents or manuals in the internalization process is important.

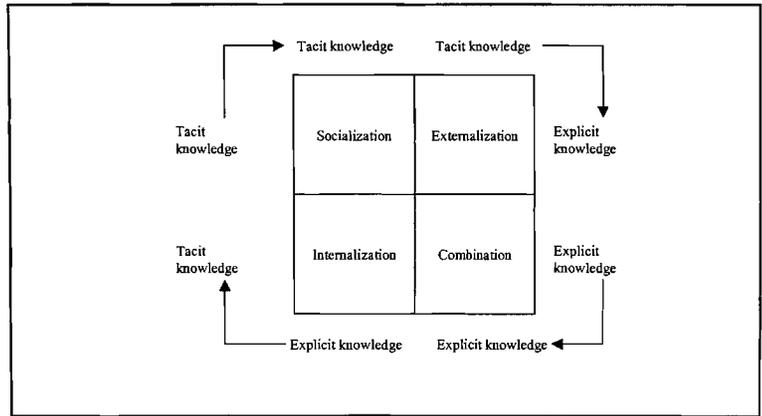
Thus, it is in the continuous and dynamic interplay between tacit and explicit knowledge, which occurs when there is a shift between the four modes of knowledge conversion, that organizational knowledge is created. There are different things that affect the changes from one form to another.

Socialization occurs through the creation of teams in which the members interact. The team makes it easier for the members to share their experiences and perspectives. The externalization process is created by the use of dialogues. The dialogue can be about what a metaphor should consist of. A third way to create new knowledge is by using the process of combination. Combination may occur when there is co-operation around the development of a new product or a service. Internalization creates new knowledge by using “learning by doing”. It can be viewed as a process where errors occur and are corrected, and concepts are modified, in order to create a better solution. Each of these four modes of knowledge conversion have been operationalized in a previous study by Nonaka *et al.* (1994). The present thesis has used the operationalization from that study in order to study each of the four modes of knowledge conversion (which can be found in Appendix I).

By managing the interplay between these four modes of knowledge conversion knowledge may be created. Knowledge is created when there is a change in the mode of knowledge conversion, i.e. tacit and explicit knowledge is integrated at different levels in the organization, such as between individuals, in a department, between departments, and within the organization.

**Figure 2:4 ▶  
Knowledge  
Conversion**

Four modes of  
knowledge conversion  
(Source: Nonaka &  
Takeuchi, 1995, p. 62)



There are five enabling conditions that must be fulfilled if an organization wants to create the knowledge spiral (Nonaka & Takeuchi, 1995). These five are: *Intention, Autonomy, Fluctuation and Creative Chaos, Redundancy, Requisite Variety.*

The knowledge spiral is driven by *intention*, which is defined as an organization's aspiration to its goals. The second condition is *autonomy*. The organization should allow autonomy to its members. This will increase the chances of something unexpected happening. This will also motivate the employees to create new knowledge. The third condition is *fluctuation and creative chaos*, which stimulates the interaction between the organization and the external environment. It is important that members faced with chaos have the ability to reflect upon their actions, otherwise there is a risk of falling into destructive chaos. *Redundancy* is the condition that enables the knowledge spiral to take place organizationally. Redundancy refers to intentional overlapping of information about business activities, management responsibilities, and the firm as whole. For organizational knowledge to be created, individuals or groups must share their information with others who may not need the concept immediately. This can speed up the learning process. A way to build this is through "strategic rotation". *Requisite variety* is the fifth condition. To maximize variety, everyone in the organization should be assured of the fastest access to the broadest variety of necessary information, going through the fewest steps. If these five conditions are present a knowledge spiral can be created that facilitates the sharing and transfer of knowledge, and from the knowledge spiral knowledge is created.

It should be noted that the focus of this thesis is not to examine the five enabling conditions described above, but instead the four modes of knowledge conversion and their relation to categories of organizational slack. That is not to say that the five enabling conditions are unimportant, on the contrary, they provide the context for facilitating the knowledge creation process. However, as

Nonaka and Takeuchi (1995, p. 73) point out: ‘what is required is another process at a higher level/.../which will lead to another cycle of knowledge creation in a larger context’, i.e. a different unit of analysis would be in focus (the organization), in comparison to that chosen in this thesis (product development projects), if I were concerned with examining the five enabling conditions.

## **Research Framework**

The research framework used in this study has defined the focus of the study, and its boundary - what was not studied. The research framework is also used for the collection and analysis of data in this study. The starting point for building this research framework is the seven categories of organizational slack identified in the literature. Perhaps most important from the review was the identification of categories of slack as a multifaceted phenomenon, i.e. slack is not only to be viewed as excess (financial) resources, there are other categories of slack as well.

However, these categories of slack are identified at the level of the firm. As this study is concerned with how different categories of slack influences knowledge creation in product development projects, a different approach is taken in comparison to existing studies on slack and innovation. There are two major differences:

- First, instead of measuring slack at the level of the firm, the aim is to identify different categories of slack at the product-development project level. This focus is a consequence of conceptualizing organizational learning as knowledge creation. Thus, the unit of analysis is not the firm, but product development projects inside the firm.
- Second, the focus on the relationship between slack and knowledge creation implies a focus on project *execution* as opposed to project selection. Knowledge is created during the development process (Nonaka *et al.*, 1994), not during project selection.

The implication of these two differences is that the categories of organizational slack identified at the level of the firm may not correspond to categories of slack at the project level. Having these two differences in mind the research framework can now be presented.

Organizational slack		Knowledge creation			
Category of slack	Explanation at the level of the firm	Socialization	Externalization	Combination	Internalization
Financial	$\Delta\text{Slack} = f\Delta(\text{RE}, \text{DP}, \text{G\&A}, \text{WC/Sales}, \text{D/E}, \text{CR}, \text{I/P}, \text{P/E})^{15}$				
Product	Is it possible to experiment and introduce new products?				
Customer	Is it possible to address new customers?				
Members	Is there a surplus of employees in the organization?				
Time	Is the time available not fully engaged in the organizations' primary product or service?				
Goals and deadlines	Is there less stringent demands on forecasted milestones?				
Governance and leadership	Is there a lax discipline in selection, ongoing support and termination of projects?				

The research framework presented above fulfilled two important roles in this thesis. First, the research framework guided the data collection. It is necessary to have a framework that guides the collection of data to avoid ending up in a situation where the evidence does not address the initial research questions (Yin, 1994, p. 20). Second, the research framework is also used during the analysis of the data, a step consisting of data reduction, data analysis and conclusion drawing/verification (Miles & Huberman, 1994, p. 10). Going into details about the data collection, reduction and analysis is the theme of the next chapter.

To summarize, the review of the literature in this chapter was carried out with the aim of identifying categories of organizational slack at the level of the product development project and their effect on knowledge creation. The motivation for the research aim is that by linking organizational slack to knowledge creation, it will increase our understanding of the relationship between organizational slack and innovation, and ultimately of the effects on innovation from programs to decrease cost and increase efficiency. Discussing the research methodology used in the present study is the task I turn to next.

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<sup>15</sup> RE - Retained earnings (+), DP - Dividend payout (-), G&A - General and administrative expenses (+), WC/Sales - Working capital as a percentage of sales (+), D/E - Debt as a percent of equity (-), CR - Credit rating (+), I/P - Short-term loan interest compared to prime rate (-), P/E - price/earnings ratio (+). A positive sign corresponds to an increase in slack; negative signals a decrease in slack (Bourgeois, 1981).

# CHAPTER THREE

## Research Methodology

*This chapter describes the case study methodology, including a discussion about the research design, the identification of a reference population, and the choice of cases. The chapter is structured as follows: first, the implications of the research design are discussed, followed by a discussion about the collection and analysis of data. The chapter concludes with a discussion about the credibility of the analysis.*

The methodology is a general approach to studying a research topic, and the choice of methodology depends on the phenomenon to be studied. A case study methodology is used in the present study. The first rationale for using a case study methodology was primarily the exploratory nature of the study. The study is exploratory because of the lack of studies linking categories of organizational slack, at the level of the project, to knowledge, and this called for a qualitative approach. By taking a qualitative approach I was not constrained by the rigid limits that exist in questionnaires and models<sup>15</sup>. Meredith (1998, p. 453) describes the difference as ‘...the explanation of quantitative findings and the construction of theory based on those findings will ultimately have to be based on qualitative understanding’. The second rationale for choosing a case study methodology, which to some extent is linked to the study’s exploratory nature, was that I needed to obtain data from multiple levels and perspectives in order to answer the three research questions in the present study.

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<sup>15</sup> It should be noted that I do see the benefits of taking a quantitative approach in other studies, where the purpose guiding the study is not exploratory in nature. For instance, the results of the present study should be tested in some sort of quantitative study in order to be verified. Saying that implies, as Glaser and Strauss (1967, p. 3) point out, that the concepts in the present study must be clear enough to facilitate an operationalization in quantitative studies.

# Case Study Methodology

According to Meredith (1998, pp. 443-444, emphasis in original) there are three outstanding strengths with the case study approach:

*(1) the phenomenon can be studied in its natural setting and meaningful, relevant theory generated from the understanding gained through observing actual practice; (2) the case method allows the meaningful questions of why, rather than just what and how, to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon; and (3) the case method lends itself to early, exploratory investigations where the variables are still unknown and the phenomenon not at all understood.*

In particular, the last two of these three reasons are applicable in the present study because of the exploratory nature of the study. In addition to the reasons put forward by Meredith (1998), a case study methodology is appropriate when the researcher has little control over events and when the goal is to describe incidence or prevalence of phenomena (Leonard-Barton, 1990). A third argument in favour of the case study methodology is that case studies are an appropriate approach when data is obtained from multiple levels and perspectives. Using case studies implies that past and current phenomenon are studied from multiple sources of evidence (Leonard-Barton, 1990).

Having chosen the case study methodology the researcher has to choose between four different types of case studies (Voss *et al.*, 2002, pp. 197-198). A case study can either be exploratory, theory building, theory testing, or theory extension/refinement. The choice depends on the research purpose guiding the study. Thus, differences in the research purpose lead to different research structures.

The present study can be classified as a theory building study, according to the category discussed by Voss *et al.* (2002, pp. 197-198), since the purpose of the present study is to identify and describe key variables (i.e. organizational slack and knowledge), and identify their linkage. To have a fit between the research purposes of the present study a case study methodology with few focused case studies has been chosen. In the case study methodology the unit of analysis is the case study. And as a consequence different cases from the same company can be used to study different issues, or the same issue can be researched in a variety of contexts in the same company (Voss *et al.*, 2002, p. 201).

## Research Design

Having chosen to use a case study methodology the next step is to single out the plan for the research, or the research design that will guide the study. The research design will help, i.e. work as an action plan for how the researcher should go from the initial questions and/or purposes that guide a study to the

conclusions (answers) to these questions and/or purposes (Yin, 1994, p. 19). The research design involves making a number of decisions about whether to use single or multiple cases, if the case or cases should be studied longitudinally or retrospectively. However, prior to answering these questions a decision has to be made concerning the reference population from which the case/cases should be identified. In the present study a theoretical sampling has been conducted in order to identify a reference population of companies. The theoretical sampling used in the present study is discussed in the next section, followed by a discussion about this study's choice of using multiple cases and a longitudinal approach.

### Finding a Reference Population – Theoretical Sampling

The objective of using theoretical sampling is to find cases that can be expected to replicate or extend emergent theory. Eisenhardt (1989, pp. 536-537) argues that the aim of theoretical sampling is to find a reference population, assuming that the cases are not chosen randomly. Glaser and Strauss (1967) have a slightly different view of theoretical sampling to that held by Eisenhardt. According to Glaser and Strauss (1967, p. 45), theoretical sampling 'is the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes his data and decides what data to collect next and where to find them'.

Thus, Glaser and Strauss are concerned with the process, while Eisenhardt focuses on the actual selection of a reference population. Initially the work by Eisenhardt will be used, while I shall return to Glaser and Strauss as the focus shifts from finding a reference population to the data collection, data reduction and analysis. The reason for using the work by Eisenhardt (which is more narrow in focus in comparison to Glaser and Strauss) is in an attempt to reduce extraneous variations and relate the findings to a specific well-defined domain, which is possible by specifying a research population using different sampling criterions. Again, the reference population in this study consists of companies, but the companies are not the same as cases. The cases are product development projects inside the companies (Voss *et al.*, 2002, p. 201). As a result it is possible to have more than one case inside one company.

Four different criterions were used in order to find the reference population: 1) listed companies, 2) clockspeed, 3) existence of R&D, and finally, 4) number of employees. The sampling criterions and their operationalization are summarized in table 3:1 and are developed below.

**Table 3:1 ▼**  
**Sampling Criteria**

Summary of the four sampling criteria used to identify the reference population and the resulting number of companies.

Criterion	Description	Number
1. Listed	Listed companies on the Stockholm Stock Exchange on June 30, 2001.	379
2. Clockspeed	Information Technology, Telecommunication and Media and Entertainment, following standard classifications.	119
3. R&D	Companies that have entered an amount for their R&D expenses in their income statements (i.e. this excludes companies that have included their R&D expenses in employee expenses).	30
4. Employees	Companies with 1 000 employees or more have been included.	7

### **Sampling Criterion 1 – Listed Companies**

Only listed companies are included in the reference population for two reasons: 1) economic short-termism, and 2) information. *Economic short-termism* is the dilemma where the best course of action in the short term is not desirable, because it is sub-optimal in the long run (Laverty, 1996). This is a dilemma facing companies under pressure from the stock market to maintain and increase year-to-year or quarter-to-quarter profit (Hayes & Abernathy, 1980). The purpose of organizational slack is to allow the organization to forego short-term gains in favour of long-term outcomes (Bourgeois, 1981), which is the opposite of economic short-termism. Listed companies are also compelled to provide a minimum amount of *information* due to stock market rules and are more visible in the press, as they are analysed and commented on. This provides background information that might be difficult to find for unlisted companies<sup>17</sup>.

To briefly recapitulate the debate on short-termism introduced in the first chapter, there are two views on short-termism. Advocates for the existence of short-termism argue that managers prioritise short-term profits due to the shortsighted stock market (Hayes & Abernathy, 1980; Hayes & Garvin, 1982; Segelod, 2000). The advocates against short-termism claim; (a) that there is little empirical evidence of short-termism (Bruce & Taylor, 1991), and (b) efficient markets exist for the long run (Jensen, 1989; Pickins, 1986). There is, however, one common theme combining the two conflicting views; both views agree that companies are under pressure from the stock market.

It is becoming more common that companies are owned by large institutional investors, and not by public shareholders. Institutional investors seem to be most concerned with bottom-line results and less faithful to the company. If a company does not produce good enough results, then the stock is sold and the price of the stock falls. This does not happen for unlisted firms where the

<sup>17</sup> Glaser and Strauss (1967, pp. 176-180) discuss the benefits of being able to carry out a careful literature study – benefits I took advantage of in the present study. These benefits and how I used them are elaborated upon in the section called 'Field Data Collection'.

owners can have greater patience. Thus, listed companies need to produce value for the owners. In order to maximize the profits, these companies may try to reduce unnecessary resources, i.e. reducing slack. For this reason only listed firms will be included in the reference population.

Another reason for having listed firms as a first sampling criterion is that they have to follow the rules of the stock market exchange where they are listed. They are obliged to provide a minimum amount of information to the public, e.g. annual reports and firm web pages. In addition, listed firms are more visible in the press since they are analysed and commented on, e.g. in business journals and magazines. As a result there will be a lot of information about the firms that can be used as background information, information that would not be available if unlisted firms were chosen.

Only companies listed in Sweden were included in the study, due to ease of access and research budget constraints. The sample includes companies listed on the Stockholm Stock Exchange and the NGM Equity Market, on the 30<sup>th</sup> of June 2001. Companies that are listed on other markets are not considered due to low turnover in these markets. Neither have companies that were listed after June 2001 been included in the reference population.

### **Sampling Criterion 2 – Clockspeed**

Clockspeed refers to the speed of change in the business environment (Fine, 2000; Mendelson, 2000; Mendelson & Pillai, 1998). Choosing fast-clockspeed industries is related to choosing cases where progress is transparently observable (Pettigrew, 1990). Biologists who want to learn about human evolution often study fruit flies, a species with a short life cycle. The fruit flies' fast rate of evolution enables rapid learning for scientists who can then apply this understanding to slower-clockspeed species, e.g. humans. Fine (2000) argues that a researcher can learn a lot by applying the ideas of clockspeed to industries. In industries with fast clockspeed, the rate of change in the external environment, such as technology development, consumer preferences and market conditions, exceed that of other industries. The opportunity to study an industry that repeats its cycle of change rapidly provides the researcher with the opportunity to develop theories about the cause and effect of changes (Christensen, 1997). By studying rapidly evolving or fast-clockspeed industries it is possible to anticipate development in other industries.

Three different industries were considered to match the criterion of having rapid changes in the external environment, consumer preferences and market conditions. The choice of industries followed the classification in *Affärsvärlden*, (one of the leading weekly business magazines in Sweden). Three different fast-clockspeed industries were identified: Information Technology (76 companies), Telecommunication (29 companies), and Media and Entertainment (14 companies).

**Sampling Criterion 3 – Research and Development**

The existence of R&D in the company was a third criterion in finding the reference population, since the study is concerned with examining the relationship between organizational slack and knowledge in product development projects. Only companies that have entered an amount for their R&D expenses in the annual report for the year 2000 were considered. The logic behind this criterion is that the company should have an idea about how much they spend on R&D and not include it in other expenses as an overhead cost. Another motive is that companies that only do consulting should not be included. No limit was set on the R&D expenditure as a fixed percentage of the total turnover. The reason is that many companies had already been excluded on the basis of whether or not they had R&D expenditures.

**Sampling Criterion 4 – Employees**

The final sampling criterion was the number of employees in the company. To be included in the sample the company must have *at least 1,000 employees*. The generalizability of the results found in a company with less than 1,000 employees is limited for various reasons, such as they may only sell and develop one product or they may not produce the products they develop. There will also be only a few product development projects to choose between.

As the four sampling criteria are considered, seven companies remain as the reference population. Four of these were contacted and two agreed to participate in the study. The two companies are made anonymous at their own request and are called Support Inc. and Communication Ltd. (in which I studied the division Communication Supplier). As has already been emphasised, the companies in the reference population are not cases in themselves. Rather it is product development projects inside these companies that are the cases in the study, since these projects are the unit of analysis. Consequently it was possible to identify more than one case within each company.

**Table 3:2** ▼  
**Research Sample**

Information about the two companies and the six projects

<b>ERP Inc.</b>	<b>Communication Ltd.</b>
Global company developing software based products	Develop, markets and manufactures communication products worldwide
4 product development projects	2 product development projects
<ul style="list-style-type: none"> <li>▪ 3 platform and 1 derivative</li> </ul>	<ul style="list-style-type: none"> <li>▪ 1 platform and 1 derivative</li> </ul>

**Multiple Cases and a Longitudinal Approach**

Multiple cases were used in the study in order to avoid the limitations of using a single case, such as limits in generalizations and other potential biases (Yin, 1994, pp. 45-46), but also to produce more robust results (Pettigrew, 1990). As the unit of analysis is the product development project, it was possible to

identify more than one case within each company. After initial discussions with Support Inc. and Communication Supplier, six cases were chosen (four in Support Inc. and two in Communication Supplier).

### **Single or Multiple Cases?**

The advantages in using a single case study are: (a) the opportunity for depth of observation (Voss *et al.*, 2002), (b) a critical case for testing a well formulated theory, (c) an extreme or unique case, or (d) a revelatory case (Yin, 1994, pp. 38-41). However, by using a single case there is a risk that results are subject to limits in generalizability and several other potential biases, such as misjudging the importance of a single event (Leonard-Barton, 1990). Multiple cases on the other hand may not have the same depth as a single case study. But by using multiple cases it is possible to avoid observer biases and increase the external validity (Leonard-Barton, 1990). Yin (1994, pp. 45-46) points out that using multiple cases produces more robust results than a single-case approach. However, to be able to have multiple comparison among the cases it is necessary that the cases are chosen according to theoretical criteria (Glaser & Strauss, 1967).

The purposes of the study called for a qualitative approach, as discussed above. To avoid drawing conclusions from a single case, with potential biases, multiple cases are used. In addition, by using more than one case the generalizability of the study is strengthened. After initial discussions with Support Inc. and Communication Supplier, six cases were chosen on the premises that the cases should be of polar types (Pettigrew, 1990), considering things such as size, people, budget, type of product, and importance to the company. All of the six projects were on-going projects at the outset of the study. However, the histories of the projects have also been reviewed to gain a deeper understanding of the projects.

### **Longitudinal or Retrospective Cases?**

The researcher must, as a second choice, decide on whether to use current (longitudinal) or retrospective cases. As Voss *et al.* (2002) points out, this may be an artificial distinction. In many longitudinal case studies the researcher usually collects archival and/or historical data. The advantage of using retrospective cases is that the case selection can be more controlled; the researcher can identify either success or failure only in retrospect.

The major difficulty with using retrospective cases is that the participants often have trouble determining cause and effect from reconstructed events. Leonard-Barton (1990) points out that post-rationalization is a problem and that the interpretation of events after they have happened, may differ to the interpretation of events made at the time they happened. Correspondingly, the findings in archival data, such as notes, may not reflect the whole truth, since difficulties or controversial items may not be recorded (Voss *et al.*, 2002).

In a longitudinal, real-time, study the internal validity is strengthened by enabling the researcher to track cause and effect. The researcher is able to do so since the problem is studied over a longer period (Leonard-Barton, 1990). However, the major drawback of using longitudinal case studies is that they have long elapsed time and may be difficult to do. An additional problem when conducting longitudinal research is the problem of access (Karlsson & Åhlström, 1995, 1997).

All things considered, I used a longitudinal approach to avoid the negative effects such as participants not recalling important events. As has been pointed out above, I studied clockspeed industries. This implies that the product development projects have shorter time duration than those projects I may have encountered, for instance, if I had studied product development projects in the pharmaceutical industry. This made it possible to follow the development of a project through to its finish, which could have been difficult in another industry.

### **Case Selection**

To some extent the case selection has been described above, in terms of the theoretical sampling to identify the potential companies that could be included in the study. However, as the choice of companies and the associated agreement of their participation had been secured, a second step had to be taken; that of selecting which cases to use from the two companies. Choosing a multiple case approach implies a decision concerning the selection of cases. Since multiple-case studies are time consuming it is necessary that:

*Every case should serve a specific purpose within the overall scope of the inquiry. A major insight is to consider multiple cases as one would consider multiple experiments.*

(Yin, 1994, p. 45)

By using multiple cases it means that a previous developed theory is used as model to which the empirical results are compared. Each case is chosen so that it “either (a) predicts similar results, or (b) produces contrasting results but for predictable reasons” (Yin, 1994. p. 46).

Glaser and Strauss (1967, pp. 49-52) suggest that the selection of cases<sup>18</sup> should be guided by their *theoretical relevance*, implying that the cases should have “enough features in common” with the other cases. To be excluded, a case must show a “fundamental difference” from the others. For generalizations to be made from a study, the diversity of group types examined needs to be increased, ranging from different groups in a department, to the comparison of different

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<sup>18</sup> Glaser and Strauss are primarily discussing *groups* and not *cases*, however, as the true meaning of, and how they describe, the word *groups* in their text, is the same as the meaning of *cases* in the present thesis, I have chosen, for the sake of clarity, to discuss *cases* in the following.

types of cases within different larger groups in different nations. However, that is not to say that all possible cases should be included in a study. Instead it is important to note that choosing the number of cases to be included in a study must be determined by a *conscious* choice in which the cases are selected against some specified criterion(s).

In addition, the researcher can choose to maximize or minimize the differences and the similarities among the comparative cases. Minimizing the differences among cases enables the researcher to define a set of conditions under which a category exists. To maximize the differences among cases it is possible to identify underlying themes and more robust conclusions can be reached (Glaser & Strauss, 1967, p. 55-58). In a similar vein, Pettigrew (1990) argues that if a limited number of cases are to be studied, it is best to choose cases that are of polar types. This will highlight the differences being studied.

For the reasons and advantages of having polar cases, as discussed above, the goal at the outset of the study was to identify polar cases, trying to capture the widest possible coverage of types, conditions, strategies, etc. However, as I had little knowledge of the various projects being conducted at Support Inc. and Communication Ltd., I had to rely on the knowledge of the Vice President of Technology<sup>19</sup> in each company when it came to the choice of cases. It was the VP of Technology who helped me identify and chose the projects to be included in the study.

Therefore, at the first meeting with the VP of Technology in each company, a significant amount of time was spent explaining the study's focus and aims, and the importance of having polar-type cases. All in order to make sure that the cases included in the study were as different as possible, whilst still being within a specified domain. To make it easier for the VP of Technology to identify potential cases, it was chosen to maximize the differences among the cases' easily-identified attributes. These included financial size, number of project members, the type of product being developed, and the importance of the project to the company. As the cases are selected from within the Research and Development Division in each of the two companies, it is believed that the cases have "enough features in common" to be compared with each other.

The result of these discussions was an identification of six cases, which could be included in the study. As the study evolved over time, and after the field work had been conducted, it is my belief that the six cases included in the study are indeed of polar types. The polarity of the cases was not only traceable to the differences discussed above, but also to other factors such as the support and guidance of the project from top management.

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<sup>19</sup> The Vice President of Technology was the first person I met at each company and the person who helped me identify the cases that should be included in the study.

## **Implications of the Research Design**

The choice of a case study methodology guided the research design. Naturally there are strengths and weaknesses with the research design chosen in the present study. These are discussed at length in the section on the quality aspects of the study. However, prior to that discussion it is necessary to say something about the managerial view taken in the present study.

### **Taking a Managerial View**

Choosing a managerial view is, to a large extent, a heritage from my background as being part of the Centre for Innovation and Operations Management at the Stockholm School of Economics. At the Centre there are basically three different research programs: (1) the dynamics of technological development and technology strategies, (2) management of innovation and product development, and (3) production strategies and operations management. In terms of these three streams of research the present study can be positioned in the second stream.

In each of these research streams there are some underlying logics that guide studies conducted at the Centre. Most important is that the research is interdisciplinary (issue-oriented) and has an applied managerial orientation. The consequences are that the research is often conducted over long periods of time in close collaboration with various types of organizations. Often a clinical research approach is used, where the researcher actively takes part in the change process (e.g. Åhlström, 1997). The overall aim guiding studies at the Centre is that the research should be of mutual benefit, not only to the academic world, but also to the industry, thereby making a contribution to the academic knowledge, but also to profitable improvements in practice.

The present study follows the tradition of the research conducted at the Centre in that it clearly has an interdisciplinary approach. That is, the focus is on answering the research questions, from a variety of perspectives and different strands of the literature. The managerial orientation is somewhat given from the overall problem guiding the study - trying to find an answer to the question of whether companies can downsize and still be innovative (and if so, how?), or whether these two are organizationally incompatible? Taking a managerial view does not imply that I am unconcerned with the views of other people in the organization. On the contrary, to be able to find an answer to the purposes of the study it is necessary to gather data from multiple perspectives. But still, it was important for the success of the study to get access to the top level of both organizations. If I had not been given access at the top level it would have been difficult to select the cases included in the study (as discussed in the previous section 'Case Selection').

However, in comparison to other studies at the Centre, the present study differs to some extent. First, previous studies have not used theoretical sampling in order to identify the reference population from which the companies and cases could be identified. The implication of using a theoretical sampling is linked to the second difference between the present study and previous studies at the Centre. Whereas prior studies have been more actively involved in some sort of a change process in close co-operation with the companies (i.e. a clinical research approach), the present study did not take such an active role. Instead of studying one case in great depth, it was decided, in the present study, to look at more than one case. The rationale behind studying more than one case was to decrease the risk of wrong interpretations from a single case, and instead have the possibility to make comparisons across cases.

## **Data Collection**

There were two main methods used in data collection: interviews and documents. In addition to official material from the two companies, articles in the business press were also part of the data collected in the study. The interviews were the primary source of data collection. The sampling criterions for identifying the potential companies to be included in the study have already been described. After the theoretical sampling I sent an invitation to four of the companies targeted at the Vice President of Technology, or R&D Manager<sup>20</sup> in each company.

After the invitation was sent, it was followed up with a telephone call to ascertain whether a possible meeting could be set up. In three companies myself and Pär Åhlström<sup>21</sup> were invited to introduce ourselves and the study. At this first meeting in each company we were both present. After these three meetings two companies agreed to participate in the study. In these two companies the Vice President of Technology identified the projects that either matched our ideas about being innovative and having a lot of resources, or projects that were the opposite, in order to make sure that we could study polar cases. In the following section the field data collection is described, followed by a discussion about the difficulties in data collection.

### **Field Data Collection**

Prior to the interviews the first step in the data collection was to develop a case-study protocol (see Appendix II) that contained the research variables to address. The research variables in focus were; (1) organizational slack – building upon

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<sup>20</sup> Each company had their own job titles, but for the sake of clarity I have in the following used Vice President of Technology.

<sup>21</sup> Pär Åhlström was my thesis supervisor at the time the study was initiated, and took an active part in setting up the agreements with the companies, making sure that access was given to me in each of the companies.

the categories that were identified from previous literature on slack and that are featured in our research framework, (2) knowledge creation - in particular I used the work by Nonaka *et al.* (1994) because they have operationalized the four different modes of knowledge conversion (see Appendix I for a more comprehensive discussion about the operationalization), (3) innovation, and (4) project information (e.g. size, budget, timeframe, type of project, etc.).

In addition, prior to the interviews, in order to become familiar with the two companies, I reviewed the business literature and annual reports. This made it possible to focus on the research variables from the beginning of the study, without having to spend unnecessary time on issues outside the focus of the study. Doing a careful literature study is advocated by Glaser and Strauss (1967, pp. 176-180) who argue that library material is gathered with little *effort*, it is done at a low *cost*, and it can be undertaken at a high *speed* (interviewing and field work are relatively time-consuming activities).

In the case-study protocol some of the questions on each of the research variables overlapped, for instance, it was possible to have answers from the respondents on innovation while asking a question on the project and vice versa. This is a consequence of using semi-structured interviews during data collection. As this research is exploratory, I wanted to have the possibility of following up leads in directions other than those which formal research variables indicated. This approach enabled a better understanding of the history of the companies and the respective projects as well as the practices used. However, the main focus was on the formal research variables.

In addition to the interviews, data was also gathered through different project protocols. Finally, a continuous review of information about the companies in the business press and company documents was made before, during and after the study to gain an understanding of the companies' context. The purpose of using multiple data collection methods was to achieve triangulation to enhance the confidence in the findings (Eisenhardt, 1989; Jick, 1979).

## **Interviews**

As briefly mentioned above, the main source of information was semi-structured interviews. A total of 46 hours of 30 semi-structured interviews, with 21 respondents (11 at Support Inc. and 10 at Communication Ltd.), was conducted (see Appendix III for a list of interviews). The respondents had different backgrounds and came from different levels, ranging from the Vice President of Technology to project members. The number of respondents was determined using the criteria of theoretical saturation (Glaser & Strauss, 1967, p. 61-62). Saturation implies that no additional data are being found and that the researcher sees the same instances over and over again, which makes the researcher confident in the findings. Thus, I kept on adding interviews until I

had reached a level where additional interviews did not add anything to the characteristics of the emerging constructs.

I conducted 3 interviews at Support Inc. and 3 interviews at Communication Ltd. together with Pär Åhlström. During these six interviews I had the main responsibility for asking the questions. The reason Pär Åhlström also participated was because these interviews were perceived as important for the success of the rest of the interviews, e.g. we were both present during the first interview at Support Inc., as this interview would serve as securing future access to Support Inc.

The interviews were conducted at basically three points in time. The rationale was that I wanted to capture the unfolding of the projects over time. It became natural to end the interviews as the projects reached a closure. The first interviews were conducted with members on the top level of the two companies and the leaders of each of the six projects. After that followed interviews with, members of the projects, but also project leaders. The last interviews conducted were once again with the top level and the project leaders. These last interviews, were to some extent, more open compared to the previous interviews, and the preliminary results were discussed during these interviews, in particular with the members at the top level in each of the projects.

As a starting point for each interview the respondents were asked to describe the project they were part of. This was then complemented with questions based upon the research variables. As I completed more interviews, my understanding of the context of the projects and the companies changed. Consequently the initial, rather formal, case-study protocol changed.

At the same time, I read a thesis by Peter Hägglund (2001). The way Hägglund prepared and conducted the interviews made an impact on me, and as a consequence I followed Hägglund's ideas during the last 11 interviews. In his thesis Hägglund describes how he prepared for the interviews by using a case-study protocol consisting of two sides. The right-hand side included some information about the person to meet, what to ask, what to think about during the interviews, and finally the main questions. On the left-hand side were the more precise questions for the interview. During the interview the paper was folded so that the right-hand side was not shown to the respondent. This course of action enabled Hägglund to prepare for as long as possible, but also to discreetly return to his preparations. I followed Hägglund's ideas about the preparations and the case-study protocol, i.e. not showing the right-hand side during the interviews. Just as Hägglund did, I also found it advantageous to have the possibility to prepare for as long as possible and have the main ideas and

thoughts summarized on the right-hand side<sup>22</sup>. One example of a case-study protocol is given in figure 3:1 below.

**Figure 3:1** ▼  
**Interview Preparations**

<p><b>Karin – feedback – questions – confidentiality</b></p> <ol style="list-style-type: none"> <li>1. What has happened since last time we met?</li> <li>2. Tell me about your new role in the organization?</li> <li>3. Tell me about the creation of goals and schedules – who? How? Changes at the end of the project?</li> <li>4. What resources have changed during the project? Compare with 2001.</li> <li>5. When will the project be terminated? What happens then?</li> </ol> <p><b>PROJECT</b></p> <ul style="list-style-type: none"> <li>▪ Contact with other parts in the organization?</li> <li>▪ Cooperation with Alpha – how is it working? Anything different?</li> </ul> <p><b>SLACK</b></p> <ul style="list-style-type: none"> <li>▪ Internal customer – Is there any external customer? Influence?</li> <li>▪ Change of number of people – influence?</li> <li>▪ Can deadlines be changed or missed? Has there been any?</li> <li>▪ Top management governance – has it changed?</li> <li>▪ Events which has changed the conditions for the project? How?</li> <li>▪ What are the key resources in the project? What is in your control?</li> <li>▪ Has the goals changed over time? How? By whom?</li> <li>▪ Beta project a success? Why?</li> </ul> <p><b>KNOWLEDGE</b></p> <ul style="list-style-type: none"> <li>▪ Contact with old members?</li> <li>▪ Solidarity in the project – how created? After-work events?</li> <li>▪ Comprehensive understanding – Changed at the end of the project?</li> <li>▪ Documentation of experiences – where?</li> <li>▪ Post-project audits – why? By whom?</li> </ul>	<p><b>Preparations before the interview with Karin</b></p> <p>In the interview today the goal is to give feedback to Karin, but also to find out what has happened since the last time when we met. I also have some complementary questions I need an answer to.</p> <p>I do not know what Karin expects. I am examining the balance between short-term and long-term and its influence on innovation. Based on this question I have seen the following so far.</p> <ul style="list-style-type: none"> <li>▪ <b>Good.</b> The CC-meetings, change is dangerous until you know more and becomes curious.</li> <li>▪ <b>Bad.</b> The distance between projects to be integrated. Ambiguous top management governance, resulting in indistinct priority lists that also grows. No customer, no focus of delivery, wants to build a "perfect" product. New members replacing old members can take time.</li> <li>▪ <b>Change.</b> The link to other parts of the organization must be clear. Gather ideas and create short activities. New things in a new project. Develop a general understanding for the project for all members.</li> </ul> <p>I am not sure how these changes would affect Karin and her role in the company, I will ask Karin to describe the development in the project since we last met. Tell her that we will take the feedback as it comes naturally during the interview.</p>
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At the beginning of the study all interviews were tape recorded and transcribed. At the 12<sup>th</sup> interview I tried to do the interview without tape-recording it. This resulted in an interview where I got more information than I had been given during previous interviews. As a consequence, I decided to try some more interviews without the tape recorder and the same thing happened. I got better results in terms of the interviews being more open and with more critical information being given to me (cf. Hägglund, 2001). Therefore, I decided to skip the tape recorder for the rest of the interviews. I took detailed notes during the interviews, (that applied to all interviews, whether they were tape recorded or not) and as soon as possible after each interview the notes were transcribed. If there were any questions regarding unclear answers, I called the respondent to get a clarification of what had been meant. In some cases the transcripts were sent back to the respondents to get a verification of the interview. In these cases the respondents only wanted to make minor changes to the transcript.

<sup>22</sup> Translated from Swedish. Karin is not the person's real name. It should be noted that during the final interviews I became more focused, not gathering data on the issues where I had enough data to satisfactorily address the research questions. Thus, the example of the case-study protocol could (and most likely) would have looked different for another interview in a different project.

## **Documents**

A continuous review of information about the companies in the business press and official company documents (e.g. annual reports, and company websites) was made before, during and after the study, to gain an understanding of the companies' context. The purpose of using multiple data collection methods was to achieve triangulation in order to enhance the confidence in the findings (Eisenhardt, 1989; Jick, 1979), but also for the reasons of *effort, cost, and speed* (Glaser & Strauss, 1967, pp. 176-180) as discussed above. I also got access to documents concerning the projects. These documents gave additional and complementary views of the development of the projects and I cross-checked the documents with the information given in the interviews where possible.

## **Difficulties in the Field Data Collection**

Collecting the data was not always as easy as I had wished for. There are several reasons for the difficulties. Perhaps most significantly, the support found at the top level of the companies, i.e. the Vice President of Technology, was not communicated internally to the extent I would have hoped for. As a consequence the interviews which were most difficult to arrange were those at the lowest level of the companies. In addition, during the course of the study, both companies had quite a tough time financially. Thus, another explanation for the difficulty I met in arranging for, and conducting, the interviews could be that it was difficult for people to set aside time for activities outside the ordinary daily activities. In particular, this could be the case when a person felt that he or she had to deliver something to the company, and were not sure of the benefits to the company of sitting down for one or two hours with a doctoral student.

Another difficulty in the collection of data was that the Vice President of Technology promised access to a wide range of documents. However, it was difficult for me to get hold of these documents. One reason for this was the lack of a contact person who could easily get hold of the documents for me. As it now turned out the Vice President of Technology wrote an e-mail to a wide range of people. Almost all of whom I had to remind more than once to get hold of the documents, and in some cases I did not manage to get hold of the documents at all. This might suggest that I did not get hold of the right, or enough data, for making the analysis. However, that is a misunderstanding.

Glaser and Strauss (1967, pp. 66-67) discuss how the data collection techniques used should be those that can best help the researcher obtain the information desired. However, in a study there might be several constraints coming from structural conditions, such as who is available to be observed, talked with, interviewed, and at what times. To overcome these obstacles Glaser and Strauss suggest that the researcher should try to obtain as much as information as possible by contrasting the data obtained from various sources.

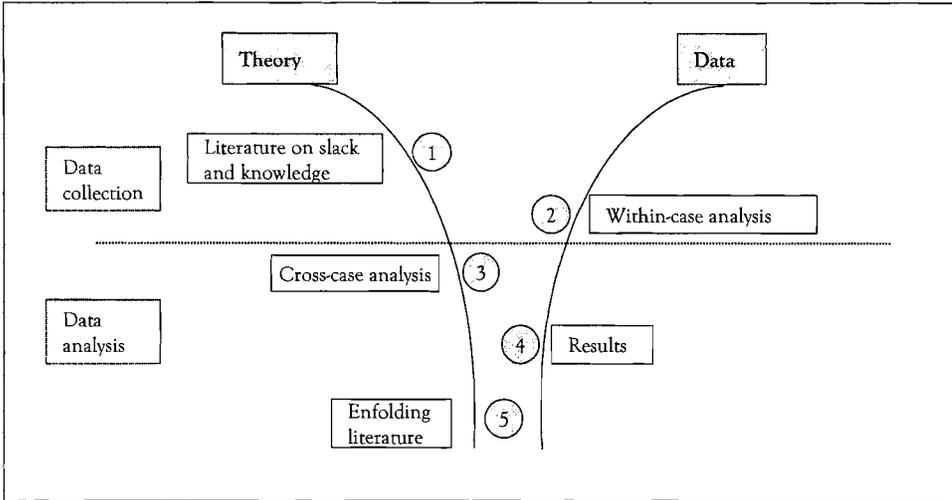
In the present study I have tried to overcome these obstacles by taking the following steps. First, the knowledge gained from studying literature on each of the two companies was particularly helpful as it increased my knowledge about the companies and gave me an understanding of their histories and of what they were doing. Second, I put a considerable amount of time, prior to the collection of data, into the development of the case-study protocol, making it possible to capture the research variables right from the start of the study. Third, I tried to meet people in the organization from different levels to get different perspectives on the research variables. The final measure taken to analyze the data was to use a method of joint coding and analysis in order to make the analysis process more systematic (Glaser & Strauss, 1967, p. 102).

## **Data Reduction and Analysis**

This section describes the process of data reduction and analysis. Data reduction is the preliminary stage of the analysis and consists of selecting, focusing, simplifying, abstracting and transforming the data that appears in written-up field notes or transcriptions (Miles & Huberman, 1994, p. 10). After data reduction, the analysis is taken one step further by searching for cross-case patterns, in order to go beyond initial impressions (Eisenhardt, 1989). Since the research conducted in this thesis is exploratory and theory building, the analysis process contained a constant interplay between theory and data.

Glaser and Strauss (1967, p. 102-105) describe the process of having joint coding and analysis as the constant comparative method, a method in which the focus is to generate or extend theory, not to test previous theory. The constant comparative method is concerned with generating and plausibly suggesting many categories and hypothesis about general problems - which is in line with the purpose of the present thesis. In addition, the constant comparative method requires only saturation of data, it need not consider *all* data, which corresponds to the field data collection in the study, where the number of interviews was determined by using the criteria of theoretical saturation. The interplay took place through a five-step data reduction and analysis process that is summarized in figure 3:2 below.

Figure 3:2 ▼  
**The Interplay Between Theory and Data in the Data Reduction and Analysis Process**



The starting point for the study (step 1), was previous literature on organizational slack and knowledge. Building upon the categories of organizational slack identified in the literature, and the framework on knowledge conversion modes by Nonaka and colleagues (1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995), input was given to the case study protocol that guided the interviews (of course the case protocols contained other complementary questions concerning information about the respondent, the company, the project, and innovation). During the data collection case write-ups were developed which were used for within-case analysis (step 2). In the data analysis the focus was on analyzing cross-case patterns (step 3), after which it was possible to identify the results of the study (step 4). As a final step these findings were validated by contrasting them to the existing literature (step 5).

### Data Documentation and Coding

Every researcher doing qualitative research knows that it can be difficult to analyze the quality of the data because the methods are not well formulated (Miles, 1979). Furthermore, there is a risk that the amount of data being analyzed is overwhelming, resulting in, as Pettigrew (1990, p. 281) strikingly describes it, ‘death by asphyxiation – the slow and inexorable sinking into the swimming pool which started so cool, clear an inviting has now become a clinging mass of maple syrup’. To avoid sinking into the maple syrup swimming pool, I tried to avoid being captured in what is referred to as “industrial tourism”, i.e. visiting many organizations without a clear idea about the purpose of these visits (Voss *et al.*, 2002, p. 196). Below, I have reported the steps taken to ensure that the research process in the present study was rigorous.

## **Documentation**

Preceding the analysis of the data is the documentation and coding of the data. As pointed out above, prior to the interviews I reviewed official material given out by the companies (e.g. annual reports, advertisements) as well as analysis made in newspapers and business magazines. The secondary information about the companies was mainly used to form my overall understanding of the two companies, their markets, and the overall problems they faced.

It should be noted that the information found in these sources could not be used directly in the study as it was concerned with a different level of analysis. However, the material gave me valuable background knowledge about the companies which increased my overall understanding of them and their external surroundings. The reviews were summarized as overall case study write-ups (Voss *et al.*, 2002). New material concerning the companies which occurred during and after the study was also included in the case study write-ups on each company.

As described above, the interviews were all transcribed as soon as possible after each interview. The motive for a rapid write up was that I wanted to make sure I recalled things correctly, and if there were gaps, that I could get clarification from the respondents. The need to write up every interview immediately after it had been conducted became more important when I did not use a tape recorder. In some cases the case protocols were sent back to the respondents to increase the accuracy of the documentation.

The case protocols developed after each interview formed what Voss *et al.* (2002) calls the case narratives, or case write-ups. In addition to the interviews I was also given written material from the two companies. This material contained detailed information concerning the projects (planning and evaluation done by the companies themselves), as well as information on the overall product development process used in the companies.

## **Coding**

A central feature in doing qualitative research is the coding of data. Miles and Huberman (1994) stress that it is important to reduce data into categories. The rationale for categorizing the data is to find patterns, in terms of the answers given by the respondents. The analysis of the data followed a two-step sequence. First, the analysis was coded based upon the research framework guiding the study, i.e. the focus was on categorizing the data according to the three main categories of organizational slack, knowledge and innovation, complemented with information about the respondent, company information, and information about the project. After categorizing the data it was possible to develop a within-case analysis. The second stage in the analysis implied an analysis across the case, i.e. a cross-case analysis, where I was searching for cross-case patterns. Each of these two steps are described in more detail in the following two sections. The

coding was facilitated by the use of the qualitative software text-analysis program Q.S.R. NUD\*IST Vivo, Revision 1 (often referred to as N-Vivo).

It should be noted that the background data (e.g. annual reports, articles in newspapers, were not coded into the database. The reasons are (a) the large amount of data, and (b) the format of the data not being computerized. However, this is not to say that the data from these sources were not used. On the contrary, the data was used as I developed case write-ups on each of the two companies in the within-case analysis. This is described in the following section.

### **Within-case Analysis**

As the data was gathered it was entered into N-Vivo. At the outset the categories used in N-Vivo were similar to the ones used in the research framework (organizational slack, knowledge and innovation) and complemented with the information about the respondent, the company and the project. By coding the data after each interview, it was possible to identify patterns as several respondents discussed similar issues. Since the interviews took place over time it was also possible to follow up areas not identified at the outset of the research, or to verify or discard possible patterns found. Another consequence of coding the interviews soon after they had been conducted was that new categories had to be added to the ones originally developed in N-Vivo. These steps are taken in order to secure, in the meaning by Glaser and Strauss (1967), a theoretical sampling, from which it is possible to obtain a theoretical saturation. At the end of the study I had developed 7 main categories and a total of 71 subcategories (coded in different levels – see Appendix IV for details).

During the data collection and the coding of the data I conducted a within-case analysis (step 2 in the data reduction and analysis process), which implies developing detailed descriptions for each case. The case write-ups were developed for each of the six cases, as well as for the two companies, which meant that in total I had eight case write-ups. The case write-ups enabled me, not only to see unique patterns through becoming intimately familiar with each case (Eisenhardt, 1989), but also to see information on the same theme from different sources (data triangulation) (Jick, 1979; Yin, 1994, pp. 91-93). It should be noted that these case write-ups not only contained the information obtained in interviews, but also the information from the written material that I had access to, as well as written material from official sources, e.g. company website and newspapers. The development of the case write-ups used two logics.

First, I developed a case write-up using the case study protocol as a template, i.e. it was a description of each case following the main research variables: organizational slack, knowledge, innovation and project information. This enabled me to put statements by different respondents together. To a large extent, the first step is the same as the coding in N-Vivo. The rationale for developing a case write-up was due to the difficulties of reading the information

in N-Vivo and to get a comprehensive overview. Second, I also created case write-ups for each case in chronological order, making it possible to identify sequences of events in the cases. In particular, the chronological case write-ups formed the basis for the empirical chapters (four and five) in this thesis. The case write-ups were each around 20 pages long. After developing these case write-ups it was easier to search for cross-case patterns, as I had a deeper understanding of each case.

## Cross-case Analysis and Enfolding the Literature

Step 3 in the analysis process meant going back to the literature and the research framework. Here I compared the categories of slack, identified in step 1, with my findings in step 2. However, as step 2 only contained a within-case analysis it was necessary to go deeper into the analysis and search for cross-case patterns (step 4). As indicated in Figure 2, steps 3 and 4 were highly interrelated and were performed iteratively, a constant interplay between theory and data (cf. the constant comparative method Glaser & Strauss, 1967, pp. 102-105).

In step 4 of the analysis process I developed cross-case analyses. In this step I searched for cross-case patterns, which helped me to go beyond the initial impressions (Eisenhardt, 1989). I conducted the cross-case analysis using Excel as a tool. Using the case write-ups, built upon the research categories, each case was broken down in two steps. First each part identified as belonging to one of the 6 main categories (project, innovation, knowledge socialization and externalization, knowledge combination and internalization, knowledge transfer, and organizational slack) were coded into respective category. Second each case was further broken down and the respective parts were coded into subcategories. All together the 6 main categories had 27 subcategories. Thus, a clear reduction in the total number of categories compared to the dataset in N-Vivo. It was now possible to compare and analyse across the cases and identify patterns.

A concrete example from conducting the cross-case analysis is the analysis of organizational slack. The seven categories of slack identified in the previous literature were used as the point of departure. However, as I analysed the cases I found that all seven categories of slack could not be identified across all of the projects. The analysis showed that the categories that were present in all cases were: *customers, goals and deadlines, governance and leadership, and members*. In addition, the type of *product* that the projects were developing turned out to be important. These categories of slack identified at the level of the firm then formed the basis for the identification of the categories of slack at the level of the project.

In the fifth and final stage, the results from the analysis process were compared with, and related to, other theories. The purpose of this step was to help increase the general nature of the findings and also to help explain them. For

instance, as the categories of slack at the level of the project were identified, I used both previous theory on organizational slack and other parts of the literature to increase the validity of the findings.

## **Judging the Credibility of the Analysis**

To be able to judge the credibility of the analysis it is necessary for the researcher to be as explicit as possible about the process leading to the results and conclusions in the study. Prior to discussing the credibility of analysis in terms of reliability, validity and generalizability, it is necessary to discuss the choice of using a qualitative methodology as opposed to a quantitative methodology.

### **Qualitative Methodology versus Quantitative Methodology**

A qualitative approach has different terms and categories of quality than quantitative research. Quantitative research assumes that the reality is a concrete, measurable phenomenon. It stresses reliability, validity, and accurate measurement before research outcomes can contribute to knowledge. A qualitative approach is more concerned with the meaning, rather than the measurement, of the phenomenon (Daft, 1983).

However, it should be noted that a qualitative methodology and quantitative methodology are not mutually exclusive, the difference between the two are located in the overall form, focus and emphasis of the study (Van Maanen, 1979). Silverman (1993) elaborates on the issue of the difference between a qualitative versus a quantitative methodology, arguing that methodologies cannot be true or false, only more or less useful. The consequence of choosing either a qualitative methodology or a quantitative methodology is that the methods - the techniques, e.g. interviews, observations - take on a specific meaning according to the methodology in which they are used. Thus, a qualitative methodology is to be seen as an approach rather than a set of techniques (Morgan, 1980).

As the present study is exploratory, trying to identify categories of slack, the relationship among these categories, and their linkage to knowledge creation, it implies a focus on the meaning of an organizational phenomenon (Daft, 1983), calling for a qualitative methodology. Using a qualitative methodology does not mean that research can be conducted without rigor and that no standards exists. On the contrary, qualitative research is no less scientific than quantitative research (Silverman, 1993). By systematically collecting, analyzing and reporting on data, qualitative research can be measured against scientific criterions. The concepts of reliability and validity are used by both qualitative and quantitative researchers. The difference is that they have to be modified depending on the methodology chosen.

## Qualitative Methodology – Judging the Credibility of Analysis

According to Glaser and Strauss (1967, pp. 228-233), the overriding problem in judging the quality of a qualitative study is in conveying its credibility. This consists of three parts. First, is to make sure the reader understands the theoretical framework. Second, is the importance of describing the data in the study so that the reader can almost literally see and hear the people in the study. Third, is the importance of using a codified procedure for analysing the data to make sure the reader understands how the analyst obtained the results from the data.

Steps are taken in the present study to try and answer the concerns raised by Glaser and Strauss. The first step taken, concerning the theoretical framework, was taken in chapter one, where the overall problem of the research was introduced. This is to make the reader familiar with the setting of the study. From the overall problem it was possible to dig deeper and uncover the central problem examined in the present study: the relationship between organizational slack and knowledge creation. In chapter two a thorough literature review was conducted addressing the two research variables in focus (organizational slack and knowledge creation), before arriving at the research framework guiding the analysis of data in chapters six, seven and eight.

Thus, by, literally, taking the reader on my “research train”, which relatively quickly passes by the overall problem, to then slow down in order to see the details, before coming to a complete stop as the train arrives at the station called ‘research framework’, it is my belief that the reader should be able to understand the theoretical framework.

The second step taken to ensure that the reader understands what I have met with during my collection of data, is the presentation of data in chapters four and five. It has been a challenge to reduce the data given to me in interviews, impressions as I have walked the corridors of each company, and the information about the companies in business press, annual reports and so forth. I have been careful in trying not to reveal the identity of the two companies, but still give an introduction to the context in which each company is working prior to the introduction of the cases. To make the reading of the chapters easier, I have used the same structure in describing each case. Whether or not these steps are sufficient, must be left to the judgement of the reader, since I am to some extent, blinded by my own text and extensive knowledge, which cannot be reflected in a limited number of pages. However, I hope that the presentation of data “speaks” to the reader.

Whether or not it is clear to the reader how the conclusions in the present study have been reached, is the third concern raised by Glaser and Strauss. In this several steps are taken. First, I have used multiple cases, in order to go beyond

first impressions and the risk of misjudging the importance of a single event (Leonard-Barton, 1990). Second, I have tried to be as explicit as possible as to how the data was collected, and the interplay between theory and data in the research process, to make sure the reader can reach the same conclusions as I have.

Having addressed the conveying of credibility in order to judge the quality of the present study, it is now time to address, not only validity, but also reliability and generalization which can all be discussed when using a qualitative approach (Yin, 1994, pp, 32-38). The credibility of the analysis is set in different phases of the research process. Figure 3:3 below shows a summary of the different tests, used in the following sections, to assess the quality of the study.

**Figure 3:3** ▼  
**Reliability and Validity in Case Research (after Yin 1994, p. 33)**

Test	Case study tactic	Phases of research in which tactic occurs
Construct validity	▪ Use multiple sources of evidence	▪ Data collection
	▪ Establish chain of evidence	▪ Data collection
	▪ Have key informants review draft case study reports	▪ Composition
Internal validity	▪ Do pattern matching	▪ Data analysis
	▪ Do explanation building	▪ Data analysis
	▪ Do time-series analysis	▪ Data analysis
Generalization (external validity)	▪ Use replication logic in multiple-case studies	▪ Research design
Reliability	▪ Use case-study protocol	▪ Data collection
	▪ Develop case-study data base	▪ Data collection

### **Validity**

Construct validity is about whether or not the instruments measure what they are supposed to measure, while internal validity is concerned with establishing casual relationships. However, since internal validity is only to be used for explanatory or causal studies (Yin, 1994, pp. 33-35), it will not be discussed further here. As a consequence, construct validity will be referred to in the following simply as the validity of the study.

By using multiple methods and sources, often referred to as triangulation, of data it is possible to validate qualitative data (Silverman, 1993). If multiple sources of evidence yield similar results, the validity in a study is strengthened (Leonard-Barton, 1990). The present study has used interviews as the primary source of data, complemented by documents.

As the interviews were conducted focusing on the research variables guided by the research framework, there is a risk that my general view of the company and the projects could have been limited. To avoid being limited in my view, several measures were taken. The background knowledge about the companies gained from the literature study helped me create an overall view of the company, which was not limited to the research framework. By identifying and interviewing respondents at different levels of the organization, it was possible to get complementary views on the research variables. In addition, by following the projects as they evolved over time, it gave me the possibility to follow up needs for clarification. These steps are all attempts made at increasing the validity of the study.

It has been discussed in the literature that by letting key informants study the case report the validity can be further increased (Yin, 1994). Unfortunately it was not possible in the present study to get feedback from the key informants since they did not have the time (or perhaps did not prioritize) reading through the protocols. Instead, it was decided to give feedback of the results (the preliminary findings), at the last interview with the VP of Technology. This to some extent increased the validity of the study.

### **Reliability**

In quantitative research, reliability means that if another researcher replicates the study, similar findings and conclusions will be obtained (Silverman, 1993, pp. 145-149; Yin, 1994, p. 36). This puts demands on the researcher to make the research process as explicit as possible. For that reason I have tried to be as explicit as possible about the research methodology and the methods used in carrying out the research, attempting to make the research process as transparent as possible. In particular there are a number of steps taken in the study, and in the thesis, to try to increase the reliability.

- First, the categories used in N-Vivo to codify the data from the interviews are shown in Appendix IV, in order to make it easier to follow the reduction of data in the study.
- Second, I have tried to be as explicit as possible about the analysis process and the steps taken in the process of the interplay between theory and data.
- Third, as I work closely with colleagues at the Centre for Innovation and Operations Management I had the opportunity to have a constant dialogue about the interpretations of the results in the study. This helped me go beyond initial impressions and instead (hopefully) draw more reliable conclusions.

It should, however, be noted that I have conducted most of the empirical collection, documentation and interpretations on my own, implying that the

research process, and how I have conducted the practical work, is still to some extent a black box. Nevertheless, it is my belief that as I have tried to make the research process transparent, the reliability of the study is increased.

### **Generalizability**

Generalization in case studies is not the same as generalization in a quantitative setting, where demand is put on generalization outside the case. In case study research, generalization is made against theory and previous studies, referred to as analytical generalization (Yin, 1994, p. 36). This implies that a study strives to generalize the results towards some broader theory, in particular regarding a specific phenomenon or setting.

Thus, the choice of using a qualitative methodology limits the generalization of the findings. Yet, on the other hand, the ambition in the present study, to shed some light on the relationship between organizational slack and knowledge, is not something unique to the six projects examined in the study. Parallels might be drawn to comparable organizations in similar situations, and to that extent the results of the present study offer some generalization.



# CHAPTER FOUR

## Communication Ltd. – Two Cases

*In this part of the thesis the empirical data from Communication Ltd. and the Processor and the System projects are introduced in more detail. The chapter begins with a summary of the development and changes in the market which Communication Ltd. operate in, followed by an introduction to Communication Ltd. After a short summary of the cases, a description of the technical background to the two projects is given. The chapter concludes with a summary of the two projects, describing how they evolved over time.*

### Market Changes in the Clockspeed Industry

During the last decade there have been rapid changes in clockspeed industries<sup>23</sup>. One reason for this development is the increased integration of various components into one system. Consider for instance the telecommunications industry where the introduction of the second generation (2G) mobile systems, not only improved the capacity and coverage, but also made mobile communications accessible to a great many people. At the same time as improvements were made in capacity and coverage, there was a deregulation and privatisation of the previously government-owned telecommunications market. This deregulation gave rise to a number of new private operators, resulting in increased competition (cf. Adler, 1999; Westling, 2002). However, development did not stop there.

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<sup>23</sup> Recall from the previous chapter that clockspeed industries refer to the speed of change in the business environment (Fine, 2000; Mendelson, 2000; Mendelson & Pillai, 1998), and that clockspeed industries are those industries where the rate of change in the external environment exceeds that of other industries. Three industries are considered as clockspeed industries in the present study: Information Technology, Telecommunications, and Media and Entertainment. In the following, these three industries will be referred to as: the clockspeed industry to preserve the anonymity of Communication Ltd.

The latest trend is towards an increase in the usage of mobile data per subscriber, creating a need for more capacity. A trend which has pushed the network operators towards upgrading their networks from 2G to 2.5G technology (e.g. GPRS), and later on to 3G technology, in order to be able to offer a greater performance to subscribers and greater profitability for themselves.

With the development of the 3G technology, the classification of companies into Information Technology, Telecommunications, and Media and Entertainment, has to some extent become obsolete. Instead, the three industries are all active in a clockspeed industry characterized by rapid changes in the business environment. But, and perhaps more importantly, the three industries have been forced to create interfaces between each other to meet the demands from customers. For instance, by using a mobile telephone it is now possible to see video clips, download music, take pictures, and get access to e-mails, internal web sites, and documents, even when a person is not physically at the office. Thus new developments are towards integrating previously separate products into one product.

The development in the clockspeed industry has, however, not been straight forward up. Until the year 2000 there had been confidence and faith in the clockspeed industry, with an emphasis on expansion. In particular, the focus was on developing products for the third generation mobile systems. However, during 2000 the market did not grow as much as expected, instead the clockspeed industry faced a period of lower volumes and drastically reduced profits. As a consequence, the expansion strategies from 2000 were replaced with short-term bottom-line thinking in 2001 and 2002<sup>24</sup>. For many companies the downturn in business has resulted in divestment of non-core business areas and downsizing of personnel. Another implication of the increased focus on costs is that the previous focus on generating solutions with high technical performance is given less attention.

## **Introducing Communication Ltd.**

This part introduces Communication Ltd.<sup>25</sup>, and discusses the company's product development. The Communication Supplier division is also described, as it was here the Processor and the System projects were conducted.

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<sup>24</sup> The development of the clockspeed industries during 2003 and 2004 is to a large extent omitted as they belong to the period after the data collection was concluded.

<sup>25</sup> It should be noted, that due to reasons of anonymity, the description of Communication Ltd. and its product is kept to a minimum. However, it was perceived as important to give some sort of background to the company - following the suggestions by Glaser and Strauss (1967, pp. 228-233) who discuss the need to involve the reader, by - as explicitly as possible - describing the data gathered.

Communication Ltd. is a global company in the clockspeed industry. Since the foundation of Communication Ltd., the company has grown both in terms of technical complexity in products and number of people in the company. Communication Ltd. has moved from developing and producing single products to offering more complex compound products.

Today Communication Ltd. is present all over the globe through subsidiaries and distributors. Traditionally the US has been the most important market. However, over the last few years the focus has changed, and is today more on the European market. Communication Ltd. have traditionally had many customers and today no one customer accounts for more than 10 percent of the total revenues.

During a twenty-year period (from the early 1980s up to 2003) Communication Ltd. grew almost tenfold in terms of the number of people employed. However, Communication Ltd. has not been unaffected by the recent downturn facing most companies in the clockspeed industry. Because of the increased focus on showing a positive cash flow and profit, the company have had to focus and make priorities among product development projects, as well as downsize the personnel. Due to the strong focus on costs in the company, projects that do not show a positive cash flow, or have a potential of doing so in the near future, are often closed or put on hold until the market changes. Divestments of non-core business and a reorganization of the company are other measures taken to increase the profit in Communication Ltd.

An example of the downsizing in Communication Ltd. is the reduction of the R&D budget which has, from its highest level reached in 2000, been reduced and in 2003 was around two-thirds of that<sup>26</sup>. The focus today is on R&D investments that give returns, thus correlated to profits, something that the CEO of Communication Ltd. explained in the annual report 2002:

*R&D investments have a direct correlation to profits. You deliver innovation for customers, not for innovation's sake alone. In this way, your R&D is an investment in profitability.*

There have been a couple of reorganizations within Communication Ltd. during the last few years. However, one business unit has basically been unaffected by these changes; Communication Supplier. For that reason it was chosen to conduct research in Communication Supplier. The reasons why Communication Supplier could continue to work as if nothing had happened to the organization were that; (1) the business units were relatively autonomous with few formal or informal overlaps between the different divisions within

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<sup>26</sup> The attentive reader will notice that the R&D budget is reduced at the level of the firm. The implication of the reduction of the R&D budget for the project level will become more evident as the two projects are discussed in more detail.

Communication Ltd., and (2) the respective business units were situated at different physical locations.

## Communication Supplier

Communication Supplier is the largest division within Communication Ltd. To meet the demands of keeping costs down, Communication Supplier reduce production costs by using manufacturing facilities in low-cost countries. Another way to assure that costs are kept down is by developing products and solutions based on design modules that can be reused and modified to fit new applications.

Within Communication Supplier there are three product areas (i.e. different lines) and within each of these product areas, different projects are conducted. The personnel belong to different product areas depending on their competence. Every person is usually assigned to one or more projects at the same time, but if a person is not assigned to a project, he or she belong to the line and are supposed to work on individual competence development or work focusing on the long-term. To be able to understand the difference and link between, on the one hand, the projects, and on the other hand the various product areas, it is necessary to describe the product development at Communication Supplier.

### **Product Development at Communication Supplier**

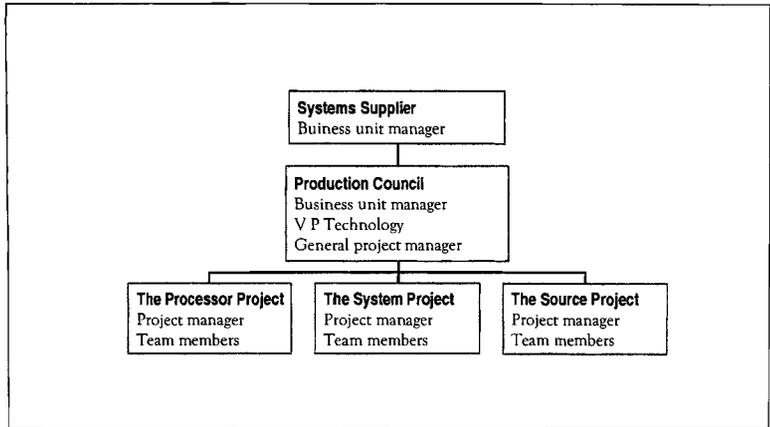
Over the years, Communication Supplier has used many different product development models, without finding a specific model which could be used in all product development projects. The lack of consensus between different product development projects is perceived by the top management at Communication Supplier as having decreased the efficiency of the work with product development activities. As a consequence, Communication Supplier decided in the spring of 2002 to launch a new product development model to be used in all new product development projects.

The new model of product development had, however, little influence on the Processor project or the System project. These two projects continued working as they had done previously, i.e. without having a specific role model for how the work should be carried out. This is not to say that the work in these two projects (and others) did not have some important issues and goals that the project tried to attain, on the contrary, there were goals, budgets and follow-ups, but they was not always systematic in nature, and they differed from project to project. The focus below is to describe the product development at Communication Supplier and how it was supposed to work prior to the implementation of the new product development model. The new product development model was not implemented or used in the Process or the System project.

At Communication Supplier, product development projects begin with either an internal initiative, or an external initiative. An internal initiative is when someone in the company identifies a need on the market for a new type of product, or a need to update an existing product. An external initiative is when a customer – existing or potential – comes up with a request for either a new product, or a new version of an existing product. The projects coming from internal initiatives are usually projects aimed at the long-term, as they are often projects to help make Communication Supplier stay in front of technological developments, i.e. aiming at more radical innovations. These projects are often independent from the customers, and the focus is to produce a standard product that can later be re-designed for a specific customer. Projects originating from customer requests are, on the other hand, naturally customer specific and tend to be towards incremental innovations. The balance between technological advancement projects and customer specific projects is decided in budget negotiations each year.

At Communication Supplier it is the business unit manager who has the final word on product development organization and the one who decides on how to prioritise between different product development projects. The business unit manager, together with the VP of Technology and the general project manager, are the production council. The production council is the forum where the overall practical details of the projects are handled. Each division at Communication Supplier has their own production council. All product development projects report their progress to the production council in their respective divisions. Within each project there is a product manager and team members. The project manager from each project reports to the general project manager, who in turn presents this information to the production council. The figure below illustrates the role of the production council handling more than one project at a time. In the figure the production council monitors three different projects, but in reality the production council monitors more than three projects.

**Figure 4:1 ▶  
Communication Ltd.  
Product Development  
Organization**



When a project is initiated the project leader assigns available people with a specific competence from the line to the project. Thus, practically there is a difference between line and project. However, in reality this difference is not very significant, as most of the time people move from one project to the next without coming back to the line. It is also quite common for people to be assigned to a second project before the first is finished. As a consequence many projects have difficulties finishing, if the relevant competence is assigned to another project. Additionally, there is no time for individual competence development or work with long-term aims.

Traditionally, work within the product development projects continued until some sort of prototype was developed. Once a prototype was developed, the projects were expected to finish. However, as there were often questions from production on the functions of the prototype and how it should be produced, the projects often continued for some time, without having a clear and specified end-date.

## **The Processor and the System Project – A Summary**

Before going into details about the Processor project and the System project, a short summary is given of the two projects. The purpose is to introduce the reader to them. This is done by first describing the background, and then explaining why they were initiated and the customers that were targeted. Then the time and duration of the projects is introduced, and the technical background is briefly commented upon. The two projects are summarized in table 4:1 below.

Table 4:1 ▼  
Summary of the two Projects at Communication Supplier

	The Processor project	The System Project
<b>Product</b> (Platform or derivative)	Derivative, upgrading a previous product	Platform, a totally new product for the whole organization
<b>Duration</b>	About 1 year	About 2 years
<b>Customers</b>	External, the goal was to make a standard product and then get customer specific input	External, the goal was to make a standard product and then get customer specific input
<b>Members</b> (numbers and experience)	10 project members. Previous experience of the product	30 project members. Little previous experience of the product
<b>Top management</b> (Production council) <b>governance</b>	Miscellaneous. Initially little, then increased, to be reduced again in the end	Little governance throughout the project.

## The Processor Project

Communication Supplier has a long tradition in developing various forms of processors. It is possible to trace the initiation of the Processor project back to 1995 when the first processor was developed at Communication Supplier.

In the beginning of 2001 the production management group made a business case in which they identified a market for processors in various 3G applications. At the same time, the sales department had identified the need for an upgraded version of the existing processor solution offered on the market. In August 2001 the Processor project was launched. By that time the overall goal in the project was to earn money by making the product as cost-efficiently as possible, whilst still fulfilling the needs of the customers. Another goal in the Processor project was to use previous knowledge from earlier versions of processors, as these products had been successful for Communication Supplier.

All 10 project members in the Processor project had previous experience from developing similar products, which was in line with the goal of using previous knowledge in the organization. At the outset, the Processor project was given a great deal of freedom by the production council. The project, with this great amount of freedom, worked in developing a standard processor that could easily be retransformed according to a specific customer need. However, when a customer was signed halfway into the project, the production council began to monitor the development of the project more closely and pushed the project towards delivering a product. However, the customer cancelled the agreement, and the production council lost interest in the Processor project.

## The System Project

The initiation of the System project was the result of an ongoing discussion which had begun in the middle of the 1990s. This discussion focused on what type of product was needed to replace the existing system product, a product

which could not be used in the future due to technical limitations. However, as the old system product was to a large extent dissimilar to the new system product, in terms of interfaces with other products and overall complexity, there was no previous knowledge within the organization regarding what the new system product should look like and what features it should have.

Communication Supplier therefore had a choice of either developing a product totally new to the organization or stay out of the market. The top management chose to go on and the System project was launched in August 2000. The goal at the outset of the System project was to develop a competence around these types of system products within Communication Supplier, and to be able to show that the company could manage to develop a product compatible with the 3G technology.

As the System project was a new project at Communication Supplier there was little previous experience among the project members. Consequently, a lot of time was set aside at the beginning of the project to make sure that every project member understood what the design of the final product should be and what features it should have. The System project was a prioritised project from the view of the top management. The product being developed was perceived as being important to their future product portfolio. However, the top management did not monitor the project closely; instead they gave a lot of freedom to the project manager of the System project to decide on deadlines and the design and features of the product.

Both the Processor and the System project were targeted at external customers. At the outset of each project no customer was present, but there was a general belief within the two projects and the top management that it would not be difficult to find one or more customers. The idea was to develop a standard product, or prototype of the product, that could be shown to customers and then when a customer was signed, it would be possible to draw up more detailed specifications.

### **Duration and Technical Complexity of the Two Projects**

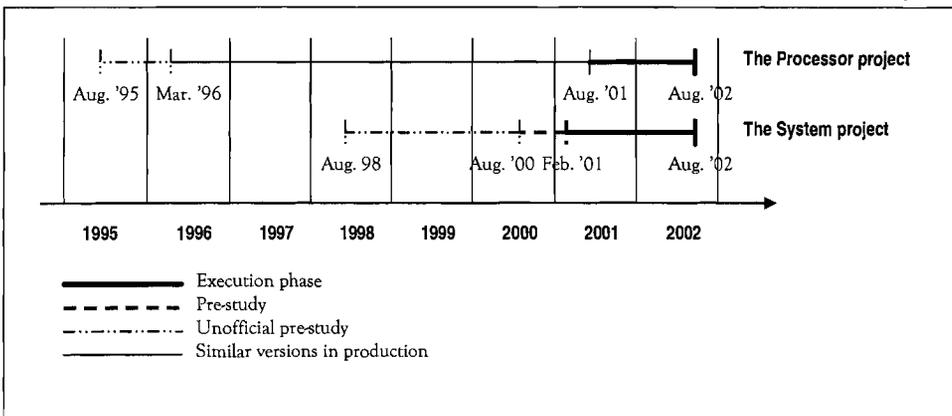
The Processor project was executed between August 2001 and August 2002. However, as the Processor project is part of a product family in which Communication Supplier has developed a great deal of knowledge over the years, it is possible to trace the roots of the project back to August 1995. In August 1995 the first discussions concerning the development of a processor began, and in March 1996 the first version of the processor was brought into production.

The System project, on the other hand, does not have such a long history within the organization. Discussions around the System project began in August 1998.

But it would take over two years before a pre-study was conducted. The pre-study ended in February 2001 and resulted in the development of a prototype. After this the project ran for nineteen months. The System project was finished in August 2002.

Both projects were discussed or developed during the end of the 1990s, an era characterised by ambitious plans and high-flown ideas about the future. However, as the projects were executed they faced another reality. Instead of a focus on profits in the future, the focus moved towards efficiency and downsizing, both at an overall firm level, but also within the two projects. The two projects have some things in common. Neither made it to the market, with no customers willing to buy the products, they did not go into production. Instead, both projects were cancelled due to negative cash flow.

Figure 4:2 ▼  
Time and Duration of the Two Projects



In order not to reveal the real name of Communication Supplier, it is not possible to give an extensive introduction to the technical background of the two projects. What is worth noticing, however, is that there are differences in the technological complexities facing both projects. The Processor project is a derivative<sup>26</sup> product using knowledge from previous projects and similar products in the organization. It is a project with fairly low technological complexity. The System project, on the other hand, is a platform project, with a high level of technological complexity. Comparing the two projects is like comparing Intel and Dell. Intel develops a small part, a processor, which can be used in a larger system put together by Dell. The same can be said of the

<sup>26</sup> For a thorough discussion on the difference between derivative and platform projects the reader is encouraged to read Wheelwright and Clark's (1992, pp. 92-97) excellent description of the two. In the present thesis a derivative project is a project in which small changes are made. A platform project on the other hand is a project involving significant changes, representing a new "system" for the customer.

Processor and the System project. The Processor project is similar to Intel as it provides a product which is part of a larger whole, while the System project is similar to Dell - by making all parts work together.

## **Characteristics of the Two Projects**

In this part of the thesis the two projects are introduced in more detail. The focus is on describing how the two projects evolved and critical issues in the projects emerging over time. The initial phase of product development, the mid-phase, and finally the end-phase are described.

In the Processor project, the initial freedom given was taken away as a customer was signed to the project. Once a customer was signed it made the production council take more interest in the project. However, as the customer cancelled the contract, the focus in the project was lost along with the interest from the production council. The project ended in August 2002 as no new customer could be found.

When the System project was initiated there was a lot of freedom given to the project group in order to get consensus on what the project was supposed to develop. The project then moved into execution and developed a prototype. However, as no customer was signed to the project a positive cash flow did not exist and the project was given fewer resources. Finally it was decided to end the project.

### **The Processor Project**

The Processor project was initiated by the production council of Communication Supplier who made a business case, identifying that earnings could be made from a processor developed for 3G applications. But, in order to get these earnings there was a need to get a large volume of the product into production. At the same time as the top management group saw the potential for a new product, so too did the sales department of Communication Supplier who had received questions from the market about a new processor product for 3G applications. Thus, there were both internal and external forces pushing for the initiation of the Processor project. When the Processor project began in August 2001 there were 7 members in the project, over the duration of the project 10 people had been directly involved in the project.

As Communication Supplier had previously developed similar products, the goal was to develop a new product but with a different design to that of previous versions of processors. With a new design it was supposed that a cheaper and more efficient production could be achieved. From the viewpoint of the members in the Processor project, there was no focus or emphasis from the top management on developing a product that had a better performance compared to that of earlier versions. Instead project members believed that the focus was

on creating a product that would be easy and cheap to produce. This implies that the product would not be any better than the old version of the processor, only cheaper.

### **Initial Phases: Initial Freedom**

At the beginning of the project there was no customer. Without a customer it was possible for the project group to decide on the design and various specifications by themselves. From the members of the Process project's point of view it was perceived as both positive and negative to work without a customer present at the outset.

Positive, as it was a perceived freedom to be able to discuss different choices in the project group and then select the best choice (according to the group). This made the work of generating a construction prototype with good performance, fast and easy without too many problems.

Negative, as the freedom sometimes caused confusion with no one really knowing what the customers wanted. This caused two problems in the group. First, in cases where no agreements could be reached on what was the best solution the members of the group continued to work on parallel solutions, something the members of the group felt took time and energy. Second, as long as no customer was signed to the project, the members felt uncertain about the future of the project (if it would continue or if it would be closed). This sometimes made it hard for the members to motivate themselves. There were also some members in the project that were assigned to other projects, and as long as these other projects had a customer, they were prioritized over the Processor project.

### **Mid-phase: Signing of a Customer**

In the end of 2001 the continuous search for finding a customer paid off as an initial agreement with a customer was signed. Once again it is possible to identify positive and negative aspects of working closely with a customer. On the positive side, the customer had clear demands on what features the product should have and what it should look like. In comparison to other customers, this customer had very detailed specifications on the processor being developed. To have specifications to work against made the project more focused, and there were fewer discussions in the project group as to what the solution should look like. When the customer was signed the top management assigned more resources to the project, in terms of assigning fulltime members to the Processor project. To have more members fully committed to the project was perceived as very valuable in the project group as work could progress faster. Yet, there were some doubts in the project group about the decision to sign a customer at this stage in the project.

- First, the standard prototype was finished to 90 percent, and with the prototype it would have been possible to reach more than one customer. As the customer was signed, the work to develop a standard prototype that could be offered to many different customers came to a stop. Instead, the focus moved to producing a product specific to the needs of the signed customer.
- Second, during the autumn there had been many discussions about the interface of the processor in comparison to other products and a solution had not yet been chosen. As it turned out, the choice of the solution became highly influenced by the customer's specifications, not the project groups' evaluation of different alternatives.
- Third, the contract with the customer was not an incoming order for a specified amount of products. Instead, the contract signed was only an agreement that the Processor project had the right to offer a product to the customer, a product that would be compared to competitors' solutions.

#### **End-phase (1): The Customer Cancelled the Contract**

During the spring of 2002 the customer who had signed to the Processor project decided to radically change what they wanted the processor product to look like. Of course, not without implications for the development work conducted in the Processor project. The single most important change the customer made to the specifications of the product was in mechanical design.

In the Processor project the mechanical engineers had always been few, and often considered a scarce resource. Because of this shortage in competence, even from the outset, the Processor project had difficulties in meeting the deadlines agreed upon with the customer. Therefore, the demand of changing the mechanical design was a significant challenge for the Processor project. In addition, the customer also wanted a cheaper product than the one the Processor project offered, which seemed, from the Process project's point of view, a difficult challenge. However, the Processor project also faced the challenge of handling the demands put upon the project from the top management of Communication Supplier, that of focusing on decreasing the overall costs in the project.

The combination of a lack of resources (mechanical engineers), pressure to offer a cheaper product and a focus on costs internally made the Processor project compromise on performance of the product being developed. Members in the project felt that the product was not as good as it could have been, had more time been given for development and with more people in the project.

During this phase in the development process, the Processor project decided to focus on costs and the re-building of the product according to the needs of

customer. However, the consequences were that the Processor project focused less on the customer's deadlines for delivering the product. In addition, during this period there was little communication with the customer on how the work in the Processor project was developing.

The lack of communication and interaction with the customer in explaining how the development work was proceeding and the missed deadlines, resulted in the customer cancelling the contract. The official reason was that the Processor project had failed to meet agreed deadlines. However, the general project manager in the production council believed that it was more due to the lack of communication with the customer.

### **End-phase (2): Development Without a Customer**

When the customer decided to quit the collaboration with the Processor project it was decided by the top management at Communication Supplier to continue the work in the Processor project. Development without a customer implied a change in focus, and once again the emphasis was on developing a standard prototype of the processor which could be offered to as many different customers as possible. It was the belief of the top management that there was a need to have a processor product for 3G applications. In addition, the top management felt that it needed to find a customer for the processor product as a lot of money, time and energy had been put into the project.

The Processor project group, with its 7 members, was considered more as a change project. But as there was no customer signed to the project the moral and motivation to work on the project was low and members in the Processor project could be moved to other projects, which had a customer, on short notice. This led to a further deterioration of moral in the project. The top management's view, that work should be continued on developing a standard prototype, was not a view shared by everyone. In May 2001 the project manager gave voice to the skepticism that the project felt about the future:

*We are late compared to our competitors, and there is a great risk that no customer wants to have our product. There are also many other competitors in the same situation and this creates a downward pressure on prices.*

Despite these skepticisms in the project, the top management wanted to continue with the project. They felt that Communication Supplier had a good reputation and that the processor product was worth its price compared to competitors. The work to develop a standard prototype continued during the spring and summer of 2002. In August the project had produced some different standard prototypes with different features and performance. These could be used for marketing to customers. However, no customer could be found during this period. And as a consequence, it was decided in August 2002 that the project should end, or rather, be put on hold. The top management believed that if there were one or more customers that were interested in the processor

product, then it would be possible to ramp-up production quickly as there basically was no development work left to be done.

The work in the Processor project – without a customer – during the final phase of development, can be characterized by low motivation, but with a lot of freedom. There was skepticism about whether a customer would ever be signed to the project. This lack of a goal to work for (i.e. competing for a contract with a customer) made the members of the Processor project look for other alternatives in terms of projects to work in. The freedom of not having a customer that demands things in terms of features or deadlines, and not being pushed by the top management, was not experienced as something positive. On the contrary, the members of the Processor project felt that they did not have a clear focus, they lost their tempo and sometimes the project was pushed into the background in relation to other projects with a positive cash flow. These other projects could, with little advance planning, demand the transfer of people from the Processor project to their own project.

## The System Project

The System project had been discussed among the top management of Communication Supplier since the middle of 1998. The most important reason for the discussions was that one of the most profitable products Communication Supplier had in its portfolio was not compatible with 3G applications. More specifically the goal was to replace the old product with a more complex product – a system product – which would be essential for many different 3G applications. Another goal was to develop more systems competence in the company, and not only be limited to specific applications.

Before the project began there were many discussions as to whether or not Communication Supplier should develop the product. Opponents to the project argued that it was a high risk project as no one knew if there would be a market for the system product in 3G applications. In addition, it was a complex product that required a lot of investment (both cash and time), and competitors had already been working on the product for many years without any success. Advocates to the project on the other hand argued that it was necessary to get the system product out to the 3G application market as Communication Supplier had no such product and it was believed by the proponents that the system product could generate a lot of profit in the future. In the beginning of 2000 the market for 3G applications seemed to become a reality for the near future, and as a consequence there became more advocates for the System project and it was decided to launch the project.

In August 2000 the System project officially began and a pre-study was conducted. The System project is unique in comparison to many other projects, not only at Communication Supplier, but also at Communication Ltd.

- First, the physical location was not in the same facilities as Communication Supplier, it was instead located at another other division of Communication Ltd.
- Second, the initiation of the System project was a step into developing a product that Communication Supplier had little previous experience of developing. This demanded a lot of different competences.
- Third, it was a large project at Communication Supplier involving up to 30 people. Implying that the project was a major investment for the company. Of the 30 members in the project around 15 people were considered as the core, working fulltime for the project. The other members were connected to other projects at the same time.

### **Initial phase: Initial Freedom and Getting Consensus**

Before the pre-study began a group of four people decided on the principal features and type of technology that should be used in the system product. It was necessary to reach an agreement on the issues of features and technology to be able to have a clear idea of what the overall frame should be for the System project. This set the limits to what should not be included in the product. The overall frame also served as a guide for what type of people to recruit to the project.

Once the framework had been decided upon and people had been recruited to the project, the second step was to decide, on a more detailed level, what the system product should look like and how the various parts in the system product should be connected to each other. The work on the interfaces between various parts of the system product was to a large extent done by the assistant project manager, as he was the only one with knowledge, and previous experience, of how a system product should look and what it should be able to perform.

However, in order to raise the level of knowledge in the System project it was decided that each person in the project should write an implementation proposal on his or her own part of the system product. These implementation proposals were then given to the assistant project manager, who then corrected and changed them. The goal was to combine each individual implementation proposal in order to create a 'bible', or a comprehensive implementation proposal, about the system product.

In the implementation proposal it was specified how the different parts in the system product were connected to each other, i.e. their interfaces. The work with the implementation proposal was finished in December 2000. As a result of the implementation proposal work the System project and people around the project had a clearer idea about what the project was doing, and how the work should be done. However, the implementation proposal did not specify the time frames in the project.

Before the implementation proposal was ready there were some doubts among the System project members as to whether they would be able to develop a system product. It was the production council that initiated the System project and some people in other projects, as well as in the System project itself, thought it was megalomania to conduct the project. But as the project evolved and the work on the implementation proposal came to an end, the doubts inside and outside the project, were changed into a conviction that it was a project worth working hard for.

There are different reasons for why the project members changed their minds. At the beginning of the pre-study there was no input or specifications to get hold of from customers. The System project had to solely rely on the assistant project manager's knowledge. This caused some doubts in the project as to whether or not they were developing the right thing. However, as solutions from competitors came onto the market it was possible to do reverse engineering, to get input for the design and features of the system product. Through reverse engineering, the System project saw that they were doing the right thing. There were also a lot of discussions in the project on how the different parts should fit together. Drawings and physical models were used as starting points for discussions. There was a lot of thinking being done in the project.

There were also many different discussions going on in the group. It was possible to have many informal, as well as formal discussions, without being interrupted as the project did not sit in the same physical premises as the rest of Communication Supplier. Instead, the System project was located at the end of a corridor along with the laboratory, in another building belonging to another division of Communication Ltd. The members of the System project perceived it as positive to sit by themselves, away from the rest of Communication Supplier.

- First, because the project members did not have to answer questions from previous projects they had been part of, which could often cause a feeling of being divided.
- Second, it was more difficult to be transferred to other projects at Communication Supplier, because as one member put it: 'if you are not physically present people tend to forget you'. Thus, a project member of the System project was a project member fulltime.
- Third, due to the closeness among the members it was easy to just go into the next room and ask a question. It was also easy to hear what was going on as the members ran into each other all the time. The positive experience of closeness and a high level of communication is not something unique, but has been shown in other studies (e.g. Allen, 1977).

In December 2000, by the time the work with the implementation proposal had been finished, the members in the System project had developed an understanding of what the product should look like and what features it should have. The group had a lot of freedom from the production council to come up with their own ideas and solutions. To work with a project that allows time for thinking and time for getting a consensus in the group was perceived as highly valuable among the members in the project group. As the work with the implementation proposal was finished the next step was to decide on the deadline for the first integration of the components in the system product. The deadline was set for February 2001, and at this time the prototype should be ready.

### **Mid-phase: After the Pre-Study – Moving into Execution**

In February 2001 the pre-study ended with the development of a prototype, according to the time frame previously decided upon in the project. As the work with the pre-study finished, there was a decision made to continue with the project. There was a general positive belief, especially in the System project group, that the overall structure of the system product, including its features and interfaces, was good enough to make the work continue into execution. The positive belief was based on the development of the implementation proposal on the one hand and the physical prototype on the other hand, making it easier for people outside the System project group to understand the system product.

The top management shared this positive view and decided to execute the project in February 2001. The members of the System project group agreed on the goal of having a product ready for production in October 2001. In total 30 people were involved in the System project when it moved from the pre-study to the execution phase.

It was also decided that the System project should continue to work as an independent unit, and not move to facilities belonging to Communication Supplier. Within the System project the project manager tried to work with clear goals in terms of having strict deadlines that should be met, but also in terms of having clear specifications of what should be ready for these deadlines. To reach agreements on these goals, project members first discussed these issues in small groups to gain a general understanding. Then the issues were discussed in the project group as a whole. The members in the System project perceived it as important that everybody agreed on the goals, but also that everybody understood what these goals were. The need to create a general understanding was due to the fact that the System project was concerned with a new technology, a technology that Communication Supplier had little experience of.

As there was no customer signed to the System project at this stage, the project enjoyed continuous freedom in setting their own deadlines and in what was to be ready at these different points in time. In September 2001 the System project

realized that the product they were working on did work, but that it did not have the performance that they wanted the product to have. As a consequence, it was decided to move the deadline. At this stage the project felt that it was better to have a finished product instead of a product that did not have the performance wanted.

### **Mid-phase (2): A Prototype Developed, But No Customer Signed**

In November 2001 the System project had developed a prototype of a system product good enough to show to the market. Comparing this prototype and its specifications to the one first developed and finished in February 2001, revealed that only small changes had been made. It is on a detailed level that it is possible to identify changes. However, the journey from a specification to a prototype had not been as straightforward as it first seemed. In the beginning of the execution phase the specifications for the product were changed, as no one believed it would be possible to develop such a product. But as time moved on, the project members realized that it would be possible to develop such a product and the original specifications came into use once again.

As the first version of a system product had been developed it became more important to sign a customer to the System project as soon as possible. One reason being that a lot of money had been put into the project, and now the top management wanted to see some returns on the investment. Another reason was that the project members in the System project wanted to have better specifications from a customer, so that they could focus their work in one direction, instead of only building a standard system product. It was decided that the System project should participate in a large fair in March/April 2002. The goal was to demonstrate the existing system product, showing potential customers that it would be an easy task to transform the existing system product to meet the specific needs of the customer. After the fair the goal was to sign a customer and then begin the production of the system product in the second quarter of 2002.

### **End-phase: Still No Customer - Fewer Resources**

During the spring of 2002 it was clear that the System project had not managed to sign a customer, and as a consequence the product would not be in production as soon as it was planned for. There are different reasons for why no customer had been found for the System project. Perhaps the most obvious reason is that the System project did not manage to have a good enough product ready for the fair in March/April 2002. The reasons why the product was not ready in time for the fair were a move to new facilities and a reduction of resources.

During the end of 2001 it was decided that the System project should move into the facilities belonging to Communication Supplier. One reason why top

management decided to incorporate the System project under the same roof as other projects conducted at Communication Supplier, was that the facilities the System project had previously used belonged to another division of Communication Ltd., which was going to be sold. Another reason for the move was that the project members of the System project were needed in other projects as well. And it would be easier to move people in and out of the System project if they were in the same building as the other projects at Communication Supplier. The move of people between projects was taken as positive for the overall organization (i.e. Communication Supplier).

The System project perceived the move into Communication Supplier facilities as very negative. It was also perceived as negative having people move in and out of the System project. For about one and a half years the members of the System project had been in close contact with each other; sitting in the same hallway and having their own laboratory. They did not have to bother about the general situation at Communication Supplier, but could work on their own project and set the pace themselves. After the move, not only did they have to share the laboratory with a lot of other projects, causing a lack of laboratory equipment for testing and similar tasks, they also had to work on other projects at the same time as the System project was moving into (what the project members believed to be) the final phase of the project. As the project members began to work on other projects the continuity of the work in the System project deteriorated. As a consequence the work could not proceed as fast as expected.

It is necessary to understand the reason for why members of the System project had to move between projects. As described above, the vivid plans for the launch of 3G applications had come to a halt and most companies in clockspeed industries were experiencing a downturn in the number of incoming orders. At the same time there was a pressure from the stock market for companies to show a positive cash flow. In the annual report for the year 2001 the CEO of Communication Ltd made the following comment:

*The top management is committed to significantly improve the result and achieve a positive cash flow to regain the confidence from the stock market. Every investment in product development has to be well motivated and give a positive return in the future.*

Thus, there was an increasing pressure from the top management of Communication Ltd. to prioritize projects that had a positive cash flow. In concrete terms this meant that projects that did not have a positive cash flow had to stand back for projects that were generating money. As the System project did not have a customer, and hence no money coming in from the project, it was not given priority. Consequently, project members were moved to other projects. However, it was not enough to move project members. The top management of Communication Supplier also reduced the budget for the project. This meant that the consultants who had been signed to the project

were removed. In addition, the total number of people in the project was also reduced from 30 to 10-15. In reality there were even fewer people in the project as not all of these people were working fulltime in the project.

The combination of a smaller project group, people moving in and out of the project and the lack of laboratory resources made it impossible to reach the deadline for the fair. Instead of having a product ready to 100 percent, the product that was taken to the fair was only ready to 80 percent. Right after the fair the System project had some contact with one customer. However, at the end of the spring 2002 the customer decided that they did not want the system product that Communication Supplier offered. As this negative response came from the customer the top management decided to put the project on hold. After the summer of 2002 it was decided to stop working on the project.

# CHAPTER FIVE

## Support Inc. – Four Cases

*This part of the thesis summarizes the empirical data from Support Inc. and the four projects. First, the development in the clockspeed industry is examined, followed by an introduction to Support Inc and its product development and the research and development division respectively. This is followed with a short summary of the cases, before a more detailed description of the four cases and how they evolved over time concludes the chapter.*

### **Market Changes in the Clockspeed Industry**

The previous chapter described the development, or rather market changes, in the clockspeed industry. In particular the trend to integrate many different features (e.g. camera, music, e-mail) into one product (e.g. mobile telephone) was discussed as an example of the complexity facing companies involved in development work in the clockspeed industry. Additionally, the changes in terms of the overall financial situation for both companies were also discussed, emphasising the change in the industry from vivid expansion plans in the beginning of 2000, to the emphasis on cost-reduction and belt-tightening activities just one and a half years later.

### **Introducing Support Inc.**

Support Inc. is a company which is difficult to classify into any of the three industries Information Technology, Telecommunications, or Media and Entertainment which make up the clockspeed industry, because the products the company is offering can be used in all three industries. For that reason Support Inc. can be thought of as a clockspeed company working in a business environment characterized by rapid changes.

Support Inc. develops and produces various types of software based products, and is one of the larger in its industry, with a large export share. However, to call Support Inc. a global company is a relatively recent phenomenon as it was only a

couple of years ago Support Inc. decided to increase its operations in, first, Europe, and, second, in the rest of the world. The reason for expanding the company was to strive at gaining larger sales volumes, which would finance the increased product development costs. The rapid expansion and transformation from a small, local company into a global player was fairly unproblematic as long as the market was growing.

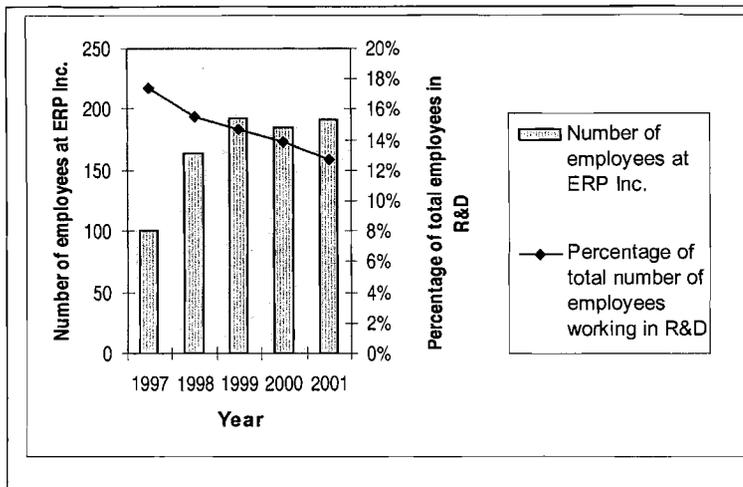
However, the organization was too big for the slower growth of the market since 1999 and the excess capacity damaged earnings in both 1999 and 2000. Facing a worsened cash flow situation, Support Inc. had to change focus from an emphasis on growth to generating a positive cash flow in order to increase the profitability of the company. Today<sup>28</sup> the focus is still on cash flow and profits at Support Inc. and the top management have decided that the organization will not be expanded until earnings and cash flow have made an upturn. The long-term objective of the company is to ensure solid and sustainable profitability and then grow as fast as is possible whilst still maintaining a positive cash flow. As part of achieving a positive cash flow Support Inc. has initiated a cost cutting program in order to increase the profits in the company. A re-organization of the company has also been initiated in order to have a more efficient organization.

However, it was a general belief among the different respondents in the present study that Support Inc. cannot make any more cuts from the organization if they are to develop products at the same rate as before. Instead, they argue that more efforts must be put on the marketing of existing products in order to boost the sales of these products. Worth noticing is the fact that the number of employees at Support Inc. has remained largely unchanged during the last few years. But the proportion of employees working with R&D has been reduced in relation to the total number of employees at Support Inc. This underlines the argument that it is difficult to develop as many products as previously when there are fewer people available to do the work.

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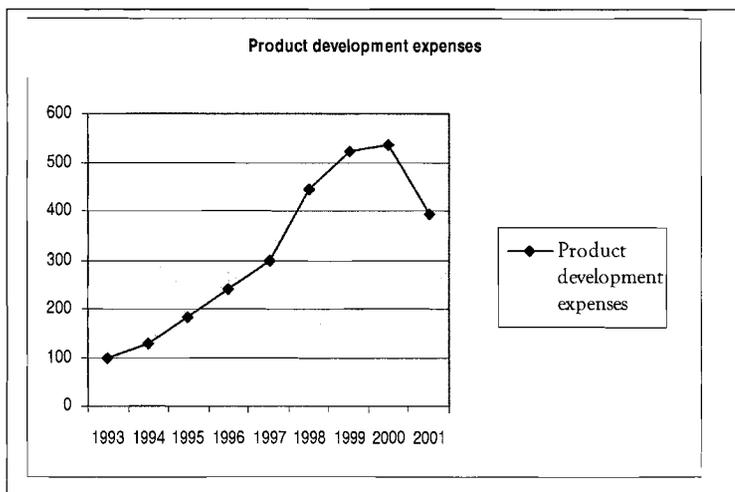
<sup>28</sup> Note that today refers to the situation at the time of the present study, i.e. up and until the end of 2002.

Figure 5:1 ▶ Support Inc. Statistics<sup>29</sup>



Looking at the product development expenses for the same time period, two things can be noted. First, the total product development expenses have increased five-fold since 1993. Second, the expenses were significantly reduced in 2001. The reason for the reduction of the product development expenses was the implementation of a cost cutting program. Additionally, the reason for the increase in product development expenses and the simultaneous reduction of personnel in R&D is that the product development projects have become longer and longer, but also that the equipment used for product development projects is more expensive.

Figure 5:2 ▶ Product Development Expenses<sup>30</sup>



<sup>29</sup> To preserve anonymity the total number of employees has been changed and the marginal increases or decreases have been re-calculated using an index of 100 using 1997 as a starting-point.

<sup>30</sup> To preserve anonymity the product development expenses has been re-calculated using an index of 100 using 1997 as a starting-point.

## Product Development at Support Inc.

At Support Inc. the product development is organized in a separate division within the company; Support R&D<sup>31</sup>. Within Support R&D around 150 projects are initiated and concluded every year. The average time for a project is nine months, but differs of course depending on the product being developed - from small incremental projects of a month or two, to radical projects which can last one or two years. Today projects are done using Java as the code base.

Support R&D is divided into two divisions (Research and Development), each with a different focus on the types of products being developed. The Research Division focuses on long-term, often more radical innovations. The personnel working at the Research Division can be characterized as young, with a lot of knowledge about the latest developments in technology. However, they have little knowledge of Support Inc. and its culture, because most of them have only been working at Support Inc. for a few years.

The Development Division is concentrated on the support and development of existing products. Thus, the focus is more on incremental innovations and the short-term. The support at the Development Division is not to be confused with regular customer support, as another division at Support Inc. handles customer support. Within the Development Division it is common to gather various forms of inputs from customers that can be put into new releases of the product. These different releases later on form the base for new versions of the product<sup>32</sup>. The personnel at the Development Division have often been with Support Inc. for a long time and know a lot about the culture and business concepts at the company.

### **Comparing the Development and the Research Division**

The Development Division is perceived as being more businesslike than the Research Division, which is better on technology. Therefore, the Development Division is supposed to take over projects and products from the Research Division and bring them to the market. Consequently most of the projects at the Research Division are internal projects with no external customer present. Instead, the receiver is often a project or a person sitting in the Development Division. However, there have been difficulties in transferring projects from the Research Division to the Development Division. Transferring projects has been difficult because of; (1) the different focus on the types of products (radical innovations versus incremental innovations) being developed, and (2) the time frame (long-term versus short-term). To overcome these problems and to get the

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<sup>31</sup> To preserve anonymity an organizational chart of Support Inc. and the different divisions is not presented.

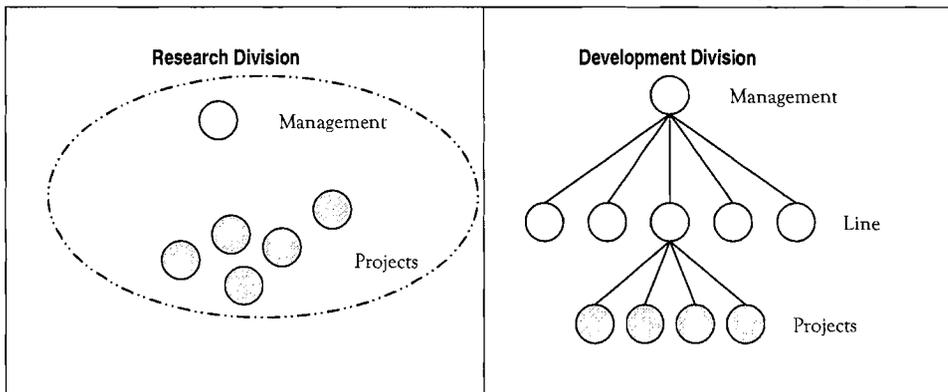
<sup>32</sup> A new product is called a *version* (1.0). *Small corrections* and updates of this product are called *releases* (1.1, 1.2,...,1.4). As there are *many corrections* or a *change* in the design made to the product a new *version* (2.0) of the product is released on the market.

product out onto the market, the Research Division has been forced to have customer contacts as well.

However, it is not only the focus in the two organizations that differs. The structures of the two organizations are also different. The Research Division is a project organization in which there is no line function. All people in the Research Division belong to a project, which is experienced as positive by most people at the division. The disadvantage of having a project organization is that the project leader handles all personnel issues, which is not always perceived as positive as many project leaders have little education in personnel issues.

At the Development Division the projects and the line is, on the other hand, divided and it is the line that takes care of personnel issues. Within each line there are different line managers that fill the projects with people. Sometimes, for various reasons, the projects are given extra members from the line. In figure 5:3 the organizational structure of each organization is illustrated.

Figure 5:3 ▼  
Product Development at Support R&D



The two divisions have different ways of initiating projects, which is partly an inheritance from the different structures in the two divisions. At the Research Division it is common that projects are initiated internally by a group of people who have got an idea by looking at competitors, or from partners to Support Inc., or from the Internet. Sometimes input to new projects come from the sales department at Support Inc. The sales department tries to understand what the customers want and need in the future and then communicate this to the Research Division. As discussed earlier the Research Division focuses on radical innovations, thus, most of the projects initiated at the Research Division are platform projects.

In the Development Division, on the other hand, the focus is much more on incremental innovations, creating derivative projects. Input to projects comes to

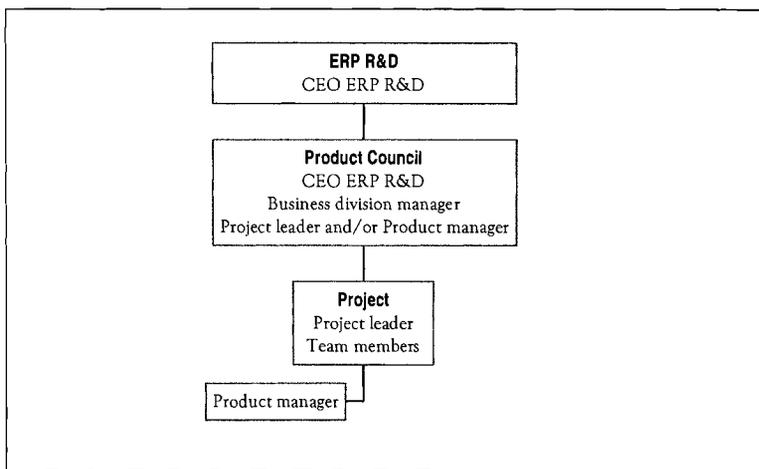
a great extent directly from customer suggestions on how the products can be better, more user-friendly etc. Other reasons may be that the product has some sort of fault in the design, which can be detected either internally or externally.

Despite the fact that the two divisions have different kinds of organization the actual work in the product development projects is quite similar. The standard procedure at the outset of a project is that the project leader or the product manager puts together a business case for the project. The reason for this is to have a defined frame within which the project is supposed to work. A preparation project then follows. The combination of having a business case and a preparation project is supposed to avoid the uncertainty that would otherwise characterize a project.

After the work with the business case and the preparation project is concluded the project leader or the product manager presents the results to a product council. The product council then decides on whether the project should proceed or not. If the decision is to continue with the project, the role of the product council is to govern the project until it ends, including decisions on resources given to the project.

Each project has its own unique product council in terms of the number of people and their competencies, there are, however, some people and roles that are always present. In each product council the CEO of Support R&D is present as well as the respective business manager for either the Research Division or the Development Division. In addition the project leader and/or the product manager are also part of the product council. It should be noted that not all projects have both a project leader and a product manager. The difference between a project leader and a product manager is that the project leader is the one who governs the project, making it move forward. The product manager is the person who is in contact with the customer and other parts of the Support Inc. organization.

**Figure 5:4 ▶**  
**Support Inc.**  
**Product**  
**Development**  
**Organization**



As a project evolves over time it delivers different versions of the product. The first delivery of a product in a project is often called a beta version. A product can go through several beta versions before it becomes a CA - Control Availability - product. A CA product is delivered to a number of selected pilot customers who run and test the product and then come with feedback to the project. As errors are discovered and corrected the product becomes a GA - General Availability - product. A product reaching a GA status is offered to all existing and future customers of Support Inc.

As Support Inc. has begun working with Java as a code base the product development model described above has become obsolete. This resulted in the development of a new product development model, a development work that was finished in September 2001. In the new model one goal was to make Research Division and Development Division more integrated and to make the work in the project more related to the needs of the customers. Not orientated towards the technological solutions, as was often the case in the old model. Another goal was to become better at re-using existing products and previous solutions. The new product development model was to be in use by December 2002. Thus, the new product development model was not in use by the time the present study was finished. For that reason no further emphasis will be put on the development and implementation of the new product development model. In addition in all four projects included in the study no project made any attempt at integrating the thoughts and details of the new product development model in advance.

## **The Four Projects – A Summary**

It is now time to introduce the four projects at Support R&D. The introduction to the cases is structured as follows: First, the projects' backgrounds are described. This includes a description of why the projects were initiated. Second, the time and duration of the projects are introduced, which also includes a description of what happened before the official start of the projects. A summary of the cases is given in the table 5:1 below.

**Table 5:1 ▼**  
**Summary of the Four Projects at Support R&D**

	<b>Component project</b>	<b>Integration project</b>	<b>Message project</b>	<b>Java project</b>
<b>Support R&amp;D division</b>	Research Division	Research Division	Development Division	Development Division
<b>Product (Platform or derivative)</b>	<b>Platform</b> , developing a tool for enterprise application systems	<b>Platform</b> , developing a tool for enterprise application systems	<b>Platform</b> , developing a new product for enterprise application systems	<b>Derivative</b> , changing the code base in an existing product
<b>Duration</b>	About 1½ year	About 2 years	About 1½ year	About ½ year
<b>Customers</b>	<b>Internal</b> , the goal was to produce a tool for enterprise application systems	<b>Internal</b> , the goal was to produce a tool for enterprise application systems	<b>External</b> , the goal was to produce a component in enterprise application systems for new and existing customers	<b>External</b> , the goal was to change the code base of an existing product
<b>Members (numbers and experience)</b>	<b>15 project members</b> . Little previous experience of the product	<b>10 project members</b> . Little previous experience of the product	<b>10 project members</b> . Varied experience in the project group	<b>15 project members</b> . Varied experience in the project group
<b>Top management (Product council) governance</b>	<b>Miscellaneous</b> . Initially little, then increased towards the end	<b>Miscellaneous</b> . Initially little, somewhat increased towards the end	<b>Fairly tight</b> all through the project	<b>Tight</b> all through the project

## The Component Project

In January 2001 it was decided to make a fusion between the Alpha project and the Beta project. The result was the creation of a new project: the Component Project. The decision to make a fusion of the two projects was based on the fact that the two projects were similar. Both projects were developing a tool for the enterprise application system. The tool (i.e. product) being developed was a document system. Both projects had little experience of developing the product. Therefore, it was believed that the fusion of the two projects would result in greater knowledge sharing among the members and a greater level of competence. The two projects were equal in size and in total around 15 members have been involved in the Component project. The product council, i.e. top management, did not pay much attention to the project initially. However, towards the end of the project their interest increased and they monitored the project more carefully when a customer implemented and tested the product.

## The Integration Project

The initiation of the Integration project in January 2000 can be traced to the hype in e-business. It was decided that Support Inc. should create an e-business solution and the Integration project was one part of the work trying to achieve

that goal. In the end the product being developed by the Integration project was a message broker. However, at the outset there were few guidelines on what the project should do. And as a result the development of a prototype took almost half a year longer than expected. Besides the vague guidelines, the members of the project had very limited experience in developing this kind of a product. After the initiation of the project the product council did not pay much attention to it, and as a result the project had a lot of freedom in setting different forms of frames (deadlines and deliveries, etc.) for the project. Towards the end the project council monitored the project a little bit more carefully. But still the project enjoyed a great deal of freedom.

## **The Message Project**

In the spring of 2000 the product council decided that Support R&D needed a product that could improve the input and output in enterprise application systems. Other similar products had difficulties selecting a specific kind of data, and as a consequence it was not uncommon that a lot of extra unnecessary data were given as output data. To create a product that could limit the amount of output data from an enterprise application system was perceived as important. This was the beginning of the Message project. Some of the 10 members in the Message project had previously worked with a similar, older version, of the product, while other members lacked experience. As the Message project had some resemblance to the Integration project the two projects formed a partnership in April 2001. During the autumn of 2001 the Message project worked hard to develop a product for the first customers to the project. When a customer was signed to the project the product council monitored the Message project more frequently.

## **The Java Project**

The Java project at the HR-group was part of a larger decision to implement Java as the code base in all products offered from Support Inc. As the Java project was part of a larger whole, the product council gave the project highest priority and monitored the project closely from beginning to end. The project was scheduled to last for three months, but it took almost half a year to finish. The delay can be traced to the differences in experience of the project members. About five of the members knew Java very well, but had little knowledge of the HR area. These members did not work in the HR area, but in the other areas of Support Inc. For the other members in the project it was the other way around: little Java knowledge, but great knowledge of HR issues, as they were part of the HR-group at Support R&D.

The product being developed, or rather changed incrementally, was an existing PA-product used in enterprise application systems, in which the existing code

base of the product was changed into Java<sup>33</sup>. The product had a Java code base after three months, as initially agreed upon. However, there were many small errors in the product related to HR issues. This was due to the lack of knowledge and competence among the members in the Java project that did not belong to the HR-group.

### Duration of the Four Projects

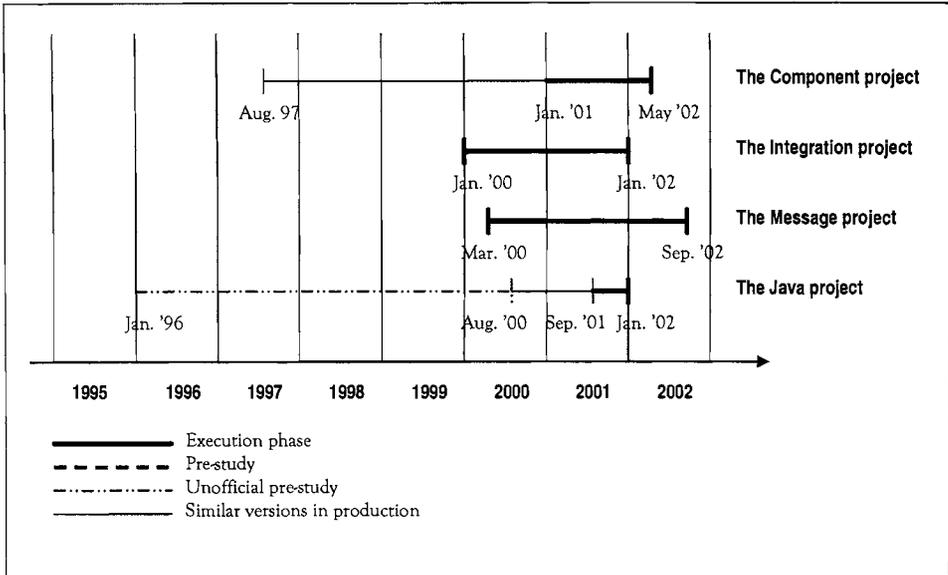
In comparison to other projects conducted at Support R&D the projects in the present study were fairly large, in terms of budgets, but also in that they were conducted over longer periods of time compared to the average project.

- The Component project was executed between January 2001 and May 2002. However, recall that the Component project was a result of a fusion between project Alpha and project Beta. Of these two projects project Alpha is the oldest and was initiated back in August 1997.
- The Integration project began in January 2000 moving directly into an execution phase. However, as there were uncertainties in the project concerning what the project was actually supposed to be, the execution phase, in reality, began in September 2000.
- The Message project also moved directly into an execution phase. The Message project did not have the difficulties that the Integration project had in terms of knowing what the focus of the project would be.
- The Java project at the HR-group was initiated in September 2001 and was supposed to end in November 2001. But due to many small errors that needed to be taken care of the Java project did not finish until January 2002. The Java project at the HR-group was part of a larger project in which the focus was to have all products at Support Inc. using Java as the code base. The larger project, of which the Java project was a part, began in the Development Division at Support R&D August 2000. It should be noted that the use of Java as a code base was as a result of a discussion started in the middle of the 1990s, and the Research Division had experimented with the use of Java since the beginning of 1996.

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<sup>33</sup> Due to reasons of anonymity the previous code base is not revealed.

Figure 5:5 ◀  
Time and Duration of the Four Projects



## Characteristics of the Four Project

The following part introduces the reader to the four cases in more detail by describing the background to the cases, how they evolved and critical issues in the projects. The Component project was a project that began with a fusion of two projects and ended in May 2002. The Integration project had initial problems, as the focus of the project was unclear. But, after half a year the focus became clearer and a partnership began with the Message project. The Message project was initiated by the top management at Support R&D and almost immediately began working with the Integration project. Both the Integration and the Message projects ended during 2002. The Java project was officially only a three-month project at the HR-group, but closer inspection reveals that the project continued for a few months more.

### The Component Project

The Component project is a fusion of two individual projects (project Alpha and project Beta). The reason for the fusion was that the two projects had similar products and background in the organization. The Component project began officially in January 2001. But as the Component project is a fusion of project Alpha and project Beta it is important to look briefly at both projects to understand why the Component project developed as it did.

#### Pre-project Phase: Project Alpha and Project Beta

Project Alpha can be traced back to the end of the summer 1997. However, in the present study the focus has been on the project as it evolved from the work

of the third version of the product, which began just after the millennium. The reason for not including earlier versions was due to difficulties of getting access to data from the actual start of the project until the millennium. In addition the focus for analysis is not on the Alpha project nor the Beta project, but the Component project.

In project Alpha the goal was to create a solution where technical solutions and customer problems could be modularised into a tree structure, and then related to the processes in the customer's company. Thus, the goal was to develop a new product that would help customers more easily implement new data, as the tree structure would show how new modules fitted together and where it was necessary to upgrade parts of the product.

Project Beta began in the middle of 2000. Initially the project was an internal development project. The goal was to develop a product that could work as a document and information system. Previously Lotus Notes had been used for the document and information systems. But due to the difficulties of finding project documents and other documents in Lotus Notes, project Beta was initiated. The first goal in project Beta was to label and re-categorize the documents in order to make them accessible to everyone. With the help of a more user-friendly and more structured system it was believed that a more efficient workflow would be created. In itself the product was of little value, but when connected to other systems such as an enterprise application system, the value of the product appears. For instance, in a specific phase of a project or a process it is necessary to find previous experiences and getting access to such knowledge is made easier with the help of the product developed in project Beta.

Project Alpha and project Beta were quite similar. Project Alpha was developing a product to show how business data, or modules, could fit together and which later on could be implemented in the enterprise application system. Project Beta was developing a product characterised as a documentation system to be used in the enterprise application system. As the projects lacked both competence and people, and the fact that both projects were quite similar in many respects, it was decided to fuse the two projects. The goal with the fusion was to have classifications and a tree structure in the product that would overlap and in this way show synergies. Another goal was to disseminate knowledge to more people and have a greater level of competence in the two projects. In January 2001 it was decided to create the Component project.

### **Initial Phase: Initiation of the Component Project**

At the beginning of the Component project some attempts were made to bring the project members at project Alpha and project Beta closer together. One attempt was to have a mutual project meeting; another was that the project leaders (there was two project leaders in the Component project; one coming

from the Alpha project, one from the Beta project) discussed what the Component project should do. However, these attempts were not successful and within the Component project the two previous projects continued to run pretty independently of each other.

The only thing that tied the projects together was that the Component project had some specific phases and deadlines for when they were supposed to deliver things. The two previous projects now also had a mutual customer. The timeframes in the Integration project were connected to the resources in the project, as well as the market potential for the product. The five different phases in the Integration project were as follows:

**Table 5:2** ▼  
**Phases in the Component Project**

Phase	Iteration	End date	Name	Deliverable
Construction	1	18 December 2001	Pilot 1	Beta P1
Construction	2	01 February 2002	Pilot 2	Beta P2
Construction	3	08 March 2002	CA	Beta P3
Construction	4	14 April 2002	GA Beta	Beta P4
Test	5	17 May 2002	GA	Version 2.0

During the early phases there was a constant trade-off between adding new activities to the product and to actually developing something. This was an inheritance from the beginning of the Component project when the project had a lot of freedom to develop a new product with little influence from customers or top management. Besides having freedom to set goals in the project, there was also a lot of money invested in the project, with little demands from the product council on getting the investment back. The combination of freedom and money created a project where the solutions did not always fulfil the requirements of creating a product with a market need.

#### **Mid-phase: A Pilot Customer Signed**

During the summer of 2001 the Component project signed a pilot customer and the first deliveries to this customer were made in November 2001. Because a customer was signed, the project had to become more focused on deliveries instead of just adding new features. Instead of just adding these new features to the product, it was decided that these new ideas should be gathered and included in later versions of the product. Despite the fact that the Component project had signed a customer it still had difficulties reaching the deadlines and making the deliveries as promised. Therefore, in December 2001 it was decided to reduce the scope of the project. Missing deadlines and deliveries had reduced motivation in the project. In February 2002 the Component project was able to make the goal of delivering a second beta version to the pilot customer. This

increased motivation within the project which was very important for the end-phase, as the pressure to deliver increased.

### **End-phase: Reduced Scope**

From the third iteration in the beginning of March 2002, the project experienced a drastic change in what they were doing. From that point in time it was apparent that the project needed to deliver a product. The two project leaders began to emphasise delivery and deadlines in the project – something not that common earlier in the project. Previously the project could change the delivery and/or deadlines pretty much as they wanted. Additionally, there was an increased emphasis on making the members of the Component project work together as a team, instead of having project members sitting by themselves and not thinking of the project as a whole. The Component project was successful towards the end as the project had managed to stick to the agreed upon deadlines and deliveries.

During the project the interaction with the product council had been through reports and development meetings held every third or fourth week. In these meetings there had been discussions on the focus of the project, what was to be prioritised and what delivery dates the project should have. During the product council meetings the balance between time, quality and resources was also discussed. It was the project leaders who collected the material and came up with suggestions for the future, prior to the meetings. It was on the basis of these reports that the product council made its decisions. It was uncommon for top management to make any changes to the project manager's suggestions. During the last sixth months (January – May) of the Component project the product council took more interest in the project and were more concerned with what the project was doing and when it was delivering. Thus, the pressure to deliver was stronger and a greater emphasis was put on the result of the project.

### **Difficulties in Component Project**

In the Component project there were around 15 members. Half of them came from project Alpha and the other half from project Beta – most of the members in each of the two projects had been relatively newly recruited to each of the projects. Therefore at the outset of the Component project the members had little experience with developing the kind of product that the Component project was supposed to work on. The most experienced project member had less than a year's experience of working with similar products. Few members in the Component project had any comprehensive understanding of the product the project was supposed to develop. In order to raise the competence level in terms of getting everyone to fully understand the type of product the project was supposed to develop and why, discussions were initiated.

At the outset of the Component project there was, however, little time set aside for planning and development of the new joint project between the Alpha and

the Beta projects, and as a consequence all time frames were broken. In addition, there was a lack of a long-term goal in the Component project. The result was that no one knew exactly what was expected from the project, neither the members of the project, nor other members in the Support Inc. organization.

Another problem in the project was that there were a lot of administration issues that needed to be solved. Two different project documents - from project Alpha and project Beta - needed to be combined into one single document. It was also difficult to co-ordinate different parts in the Component project as the two old projects continued to work a lot on their own even after the fusion. The reason for why the two projects continued to work quite independently was the fact that there was no direct link between project Alpha and project Beta, besides making the integrations work. It was difficult to create a common feeling between the two projects as they could work quite independently as long as they did not have to think about the integration of two products into one. It was, however, necessary to integrate the two projects as they were in fact dependent upon each other.

To overcome the difficulties of not working together the project leader and the product leaders of the Component project decided it was necessary to avoid the competitive situation between the project members from the old Alpha and Beta projects, and increase the teamwork between the two. It was perceived as a risk if the Component project was in reality two projects going under the same name. Therefore the project leaders of project Alpha and project Beta tried to integrate the project as much as possible and create a sense of a common goal and an understanding of each other's project. However, it was difficult to make the Alpha and the Beta project work together as one united project due to the fact that the two projects did not sit in the same physical location. The solution was to use videoconferencing at projects meetings once or twice per month.

Over time there was an increased understanding and acceptance that the Alpha and the Beta project no longer existed and that all members were part of the joint Component project. As the work in the Component project proceeded there was little rotation of members in the project and the members recruited to the Component project stayed in the project until it was concluded. Input from outside the project was limited to: (1) a few newcomers in the Component project, all of whom had limited experience of similar products, and (2) to contact with colleagues who had previously been working with the Alpha and the Beta projects respectively.

## **The Integration Project**

The Integration project began in January 2000 when one person working with the technology in an enterprise application system identified a need for sending and transmitting business messages in enterprise application systems. The input

to the idea came from a new e-business solution that Support Inc. was developing. It was apparent that the e-business solution needed a product that could facilitate the sending of different forms of business messages. When the project was formed the goals were vague and according to the project leader the project was given these instructions: 'We were told to do something that had to do with standards'.

As a result of the ambiguity, four of the members in the Integration project sat down and tried to understand what they were going to do. It was decided that the Integration product had something to do with B2B; what it meant and how that influenced the solution to be built. It was decided that B2B in the Integration project meant two things. First, technology - the problems of handling data must be solved, i.e. systems integration. Second, layout and structure - an invoice looks different in different enterprise systems, how do we make different systems communicate with each other.

### **Initial Phase: Initial Confusion**

After a while the four members in the project group came to understand what type of product the Integration project was to develop. The product to be developed would make it possible to communicate between different enterprise application systems, filing information into different parts in a larger system. Such a product is called a message broker. A message broker develops, makes interpretations and sends information between different systems. One example of when a message broker is of crucial importance is if a company buys another company and wants to have the acquired company's data and information transferred into their own systems. Another example is if companies in the value chain want to transmit data and information between themselves, with the help of a message broker it will be possible to communicate messages.

It is the work of the integration product - or message broker - to file different kinds of information into different folders. By filing information it is easier to know where the information is and get access to it. The integration product is the re-categorization of various forms of external information to a common internal format following a standard structure. By using this standard structure for the categorization of input it will be easier to get a specific output from the system. In many old enterprise application systems the unstructured input came back in an unstructured format, making it difficult to get the specific kind of information needed. In order to send business information it is necessary to have an infrastructure. The Integration project would develop this infrastructure by developing a message broker.

### **Initial Phase (2): Little Development**

In the spring of 2000 the project manager realized that the project was bit making any progress, and it was decided to bring top competence into the project. It took these people three months to bring forward a prototype, which

was ready in the summer of 2000. Recall that at Support R&D new product development projects should have a business case and a preparation project prior to the decision to initiate a project - a decision taken in the product council. Thus, the prototype is something that should have existed before the decision to launch the project.

As it now turned out there was a feeling in the project that the decision to execute the project had been taken too fast, and with too little analysis. The consequence was that the project had to take a step back and conduct a new pre-study involving top competence instead of going into an execution phase. Another consequence during these three months was that the members of the Component project were not directly involved with the overall development of the product and had little to do as they were waiting for more detailed instructions.

During the spring the members of the Integration project realized that the message broker by itself did not add any business value, it being only a tool that was part of a process. Therefore it was necessary to connect the message broker to a product that could add some sort of business value. At the same time, in the spring, the Development Division had initiated the Message project. The Message project was supposed to handle the input and output of documents in enterprise application systems.

However, the Message project had no infrastructure that could support the solution the project was developing. Thus, the Message project faced the opposite problem to that which the Integration project faced, that is the Message project had a product giving business value, but no infrastructure on which the product could be built, whereas the Integration project had an infrastructure but no product. As neither the Integration project nor the Message project had a product they could offer to the market, it was decided to make a partnership between the Integration and the Message project. The partnership solved two problems:

- First, the message broker would have a business value as there was a useful product related to it.
- Second, the Message project would have an infrastructure that they could build the Message product solution on.

#### **Mid-phase: Partnership With the Message Project**

After the summer of 2000 the partnership between the Integration project and the Message project was formalized. At the beginning the partnership between the two projects did not work smoothly. One reason was that the Message project was putting demands on the Integration project. The Integration project felt that they did not have time to implement all changes or demands they received from the Message project. There was a feeling of irritation in the

Integration project as the Message project was always ahead of them, not understanding that things took time.

Another reason for why the partnership had difficulties originated from the fact that the Message project and the Integration project had different origins in the Support R&D organization. The Message project was initiated in the Development Division, while the Integration project was initiated in the Research Division. Due to the different business logics and focus in each division, the two projects had difficulty understanding each other. The Integration project felt that the Message project did not understand the technology. On the other hand, the Message project felt that the Integration project did not understand the needs of the business and that it lacked a customer focus. In order to overcome these difficulties it was decided that the two projects would make an effort make things easy. One project member recalls that: 'We had to develop a baby language in order to understand each other'.

### **End-phase: From Beta Prototype Version to a Final Product Version**

In October 2000 - three months after the prototype had been developed - the Integration project was able to deliver a first beta version of their product. The beta version was delivered to a customer who thought they were getting a product that had a GA standard (i.e. being a final product). But no one at Support Inc. told the customer that they were in fact being used as a pilot customer. Fortunately for the Integration project the product worked pretty well and the customer was satisfied with the solution.

After the delivery of the first beta version it took almost a year before the project was able to deliver a CA product. In June 2001 the work with the CA product was finished. From that point in time the Integration project went into a new phase, focusing on consolidation and stabilization. During the autumn of 2001 the focus in the Integration project was to create a product that would work in industries other than the one it was originally developed for. The Integration project was officially finished in January 2002, as the project delivered version 1.2 of the Integration product.

After January 2002 the focus and goal of version 2.0, which was a new project, was to have a user-friendlier product, where things that did not work before would be taken away. It was, to a large extent, a consolidation of the previous product. The work focused on creating products which were easy to use, but also to create solutions which would work internationally. It also had the aim of making the Integration product work together with other parts in the enterprise application system.

### **Difficulties in Integration Project**

The first goal, or rather belief from the product council, was that the Integration project would come up with a product within three months. However, as it

turned out it was an impossible task, particularly since no business case or preparation project had been developed. The lack of a thorough pre-study prior to the initiation of the Integration project meant that the project members did not know where to start, neither did they have a frame of reference. Having no frame of reference at the beginning of the Integration project meant that members had to try to get all the details together themselves. This work took a long time and meant that the project moved forward very slowly. In addition, not all members participated in this work and those who did not participate, had nothing to do.

The people involved in the Integration project all agreed that if the project had been run differently it would have begun with a three-month pre-study. The pre-study would have created better material for making a decision in the product council as to whether or not to conduct the project. In addition a pre-study could have determined the goals and the framework surrounding the project, allowing the members of the Integration project to have a more comprehensive impression of the project and its goals.

Another difference would have been to deliver a smaller version of the Integration product to one or two customers in order to gain input, prior to developing the end product. However, this was not done as the scope of the project was too great and there were no clear goals. As it turned out, the initial connection to the market was weak and the project worked on without any input from the market.

### **Comparison Between the Integration and the Component project**

Both the Integration and the Component project were executed within the Research division and there are many similarities between the two projects. First, both projects were based on a single person's idea, and it was these individuals who initiated the projects. Second, prior to the initiation of the two projects there were few internal discussions at Support R&D concerning whether or not there was a market need for the product. Third, the projects had difficulties communicating the needs and features of the products to the market. Thus, there was a lack of communication both internally and externally.

One reason for the lack of communication was that the members in the two projects were concentrating on the construction of the product, instead of trying to explain to others what they were developing. Another reason was that there was little governance of the two projects from the product council. Closer governance from the product council could have changed the projects' focus from only working on construction to include communication, both internally at Support Inc. and externally to customers. As there has been little internal communication few people knew what the two projects were developing. Because of the lack of internal communication it was difficult to re-use

properties of the product developed, but also knowledge generated in the projects, into other products and projects.

Yet another similarity between the two projects was that during the execution phase, both projects had too few people working in them. This caused low moral in the projects. A consequence of the low staffing was that the projects had difficulties reaching the deadlines and goals in the projects. Another consequence was that some key people in the projects had to do many different tasks at the same time, such as being project leader, product manager and architect. This affected the development of the two projects.

## The Message Project

The Message project began in the spring of 2000. The project was a result of a decision taken by the top management at Support R&D to produce a product that could send business information in files. This is called output management and the product would be used in enterprise application systems. The product gives the user the possibility to ask for certain information, which is then collected from the system. The difference when compared to previous products is that the new product would make it possible to collect a more specified output. Previous products had a problem in selecting what type of information they would focus on. As a consequence they often collected far too much unnecessary data.

In the Message project the goal was to replace the old Message messages product with a new product: the NBM (New Business Messages) messages product. The problem with Message messages was that they follow many different standards and therefore it was difficult to get a limited and specified amount of information from the system. NBM messages, on the other hand, were more flexible as they did not follow a specific standard, making it is possible to more carefully select the information needed from the system.

### **Initial Phase: Partnership with the Integration Project**

The Message project was part of the Inter Operability Management Group (IOM-group). The IOM-group was working with input and output from enterprise application systems. In order to get the requested output there was a need to: (1) have a product that collected and sent the right data, and (2) a product that made sure that the data could be collected. Combining these two demands it was necessary for a company to have two types of products:

- The first product was the type of product being developed in the Integration project, i.e. a message broker.
- The second product was what the Message project was developing - a NBM message product.

Due to the complementary properties in the two products being developed in the Integration and the Message project respectively, it was decided that the two projects should form a partnership. This partnership was organized within the IOM-group.

At the outset of the partnership there were three project leaders involved in the work with the Integration and the Message project. Initially these three project leaders met every second week to discuss the goals and timeframes for different activities. As the projects had different origins in Support R&D, the aim was to set aside time for these activities. But the project leaders found it difficult to set aside time for education and other activities that took resources from the project. It was also difficult to set aside unplanned time in the projects.

During the autumn of 2000 the work in the Message project focused on generating a beta solution for a pilot customer. The solution was implemented in the pilot customers' enterprise application system in January 2001. After the implementation and feedback from the customer there was more confidence in the project. The project members felt that they had a good product. After the successful implementation, the goal in the Message project was to develop a product that had a GA standard, so that the product could be offered to other customers.

#### **Mid-phase: Confusion in the Message Project**

In April 2001 there were confusions in the Message project. The project members knew that they would have to create a new message standard to replace the old Message standard. They had been successful in developing a few messages for the pilot customer in January. But now they did not know what type of messages they should continue to develop. Nor did they know what the future architecture in enterprise application systems should look like. Another difficulty was that the Message project did not know how they would use the message broker that the Integration project was developing. To solve these problems the Message project group sat down and discussed and evaluated different solutions. They had to decide which was the most advantageous and possible to build, and what the impact would be on different enterprise application systems and the message broker respectively.

During these discussions the Message project also realized that they did not understand the needs and demands of the customer. At the outset of the Message project there had been a much clearer understanding of the business needs. But due to the demand that all products should be built on a Java code base, a lot of changes had been made to the original specifications. Therefore the Message project group had to reach a consensus in the group on what they were going to offer to their customers.

At this point in time the relationship with the Integration project was intensified and became more formalized. During the spring of 2001 the Message

project sent different kinds of solutions to the Integration project for revision and feedback. The feedback and revisions always came at specified dates, usually once a month. This work continued during the summer. During the summer, version 1.2 was also finished and the project stopped the development in order to audit the project. Previously in the project the goals had been quite loose and the solutions developed had been based, to a large extent, on the competence and deadlines that had existed within the project. At this point in the project there was not only more knowledge among the members, but also more knowledge on what the product was doing and what the customers wanted. This resulted in the goal to make the product user-friendlier, to function more consistently and to solve previously unsolved problems.

### **End-phase: Getting the Product Out on the Market**

The partnership between the Message project and the Integration project continued. But from September 2001 there was no time available to wait for formal feedback and monthly reviews. Instead there was a continuous flow of input and output between the two projects. The reason for this change in feedback and revision was that both projects felt a need to get the product out on the market, instead of only working on the development of the product.

During the autumn of 2001 the work intensified in order to create a product that had a CA status for the customers signed to the project. At the end of the first quarter of 2002 this work had been finished. The Message project managed to come up with a product having CA status during the spring. Thereafter the work continued in the Message project and the goal was to produce version 3.0 of the product. This 3.0 version of the product would be the same as creating a GA version of the product.

In the autumn of 2002 the Message project finished working with the project and the GA standard, version 3.0 could be released to the market. The decision of releasing or not releasing the product was a decision for the product council. In the Message project there was a feeling of having produced a good product, though there were still things that needed to be done such as documentation of the product. Nevertheless, it was decided to release the product to the market.

## **The Java Project**

The Java project differs from the other three projects at Support Inc. in different aspects:

- First, the Java project had highest priority from the beginning from the top management at Support Inc.
- Second, it was a project that was considerably shorter in comparison to the other three projects.

- Third, the Java project members had very different experiences of working with the product.

The reason for giving high priority to the Java project was because it was part of the overall project at Support Inc. to change all enterprise application components and the enterprise application system, and use Java as the common code base. The decision to implement Java at Support Inc. is a decision that has a long history, and it is outside the scope of this thesis to examine all the details that existed prior to the decision. The Java project in focus in this research is the implementation of Java at the HR-group in the Development Division.

The overall Java project at the Development Division began in the spring of 2000, but it took almost one and a half years before the HR-group began working with the Java implementation. The implementation of Java in the HR-group was one of the last implementations at the Development Division. It was an implementation perceived as highly important, as a new version of the enterprise application system fully based on Java would be released at the end of 2001. As it was perceived as very important to be early to the market with a Java code based enterprise application system the top management gave the Java project at the HR-group highest priority.

#### **From Initial Phase to the End-phase: A Tight Project**

In the Java project at the HR-group the goal was to have a product finished by November 2002. As the project began in September 2002 it meant that there was little time left for other activities and during this period other projects in the HR-group had to take a backseat. This was especially evident as other projects did not get the resources they needed in terms of project members, due to the fact that the prioritised Java project involved most of the members in the HR-group.

In order to finish the Java project in time, the top management gave priority to the project. As the HR-group did not have enough resources (people) to handle the project they had to bring in people with expert knowledge of Java from other parts of the organization. Compared to other projects running at the HR-group, the Java project was given a much higher priority and had a much tighter deadline.

The positive side of having other people in the group was that they had knowledge about Java. To involve the people in the HR-group and keep them updated there were some meetings between the group of experts and the members of the HR-group. In order to keep the project on track it was necessary to run it tightly, and as a consequence there were constant controls over the results produced in the project group. In November 2002 the Java project was finished and everyone involved were highly satisfied with the results achieved in the project. No one had believed that the project would be able to produce so much in such a short period of time.

### **Difficulties in the Java Project**

However, a while after the project was finished it became obvious to the members of the HR-group that the Java project was not as successful as it had first seemed. The Java project had not succeeded when it came to the quality of the product. The product had many small errors that took time to detect and then correct. Many of these mistakes came from the hired project members and their lack of knowledge and competence in the HR area. As a consequence it was decided that the HR-group would re-do many of the parts in the product. The work to make the corrections was finished in January 2003. Two months after the original deadline. Another drawback of the Java project was that it used most people in the HR-group, and all other projects came to a halt.

Normally the HR-group is an autonomous group that handles their own projects and manages the relationship with the customers, HR being an area governed by many laws and regulations. The initiation of the Java project was something that decreased the autonomy of the HR-group and this made the Java project somewhat different from other projects in the group. The main lesson learnt in the HR-group was that it was difficult to take in external members, who lacked knowledge in both the basic, general HR issues, and the more specific issues facing the HR area. Extra time was needed in order to correct the errors in the enterprise application system relating to the HR area. On the other hand, the Java project was also a lesson in what could be achieved under time pressure, but with prioritisation and support from other parts of the organization. It was also perceived as successful to have meetings at various times in order to increase the understanding in the project group.

# CHAPTER SIX

## **Categories of Slack at the Product Development Project Level**

*The previous two chapters included a description of the empirical data. In this chapter the first step in the analysis is taken, as different categories of slack are analysed and related to each other. The chapter is divided into two parts. In the first part an analysis is made following the research framework. In the second part the analysis is taken a step further and four different categories of slack and their relationships are identified and discussed.*

### **Identifying Categories of Slack at the Product Development Project Level**

In this chapter the first two research questions in the thesis will be answered, which were presented in the first chapter of the thesis. The first research question is to 'identify different categories of slack at the product development project level'; the second research question is 'to relate the different categories of slack to each other'. To answer these two questions it is necessary to divide the analysis into four-steps.

The first step in the analysis is to use the research framework and the seven categories of slack identified at the level of the firm. Before proceeding to the analysis, it is important to recall why a research framework was used, and how it is related to the research questions guiding this study. The research framework is the tool that guided the gathering of the empirical data. It also sets the frame for the amount and type of data gathered, i.e. it defines the heart of the study, but also defines the edge of a case: what will not be studied (Miles & Huberman, 1994, p. 25).

The seven categories of slack identified at the level of the firm were, as a second step in the analysis, operationalized at the level of the product development project. This was in order to examine whether the seven categories of slack could be used as is, needed modification, or could not be used at all. As the six cases were analysed it became apparent that the seven categories of organizational slack identified at the level of the firm could not be identified at the level of the project, without significant changes being made in the operationalizations.

Therefore it was necessary to take the analysis a step further, and try to identify categories of slack at the level of the product development project. In this, the third step of the analysis, four categories of slack were identified, which corresponds to the first research question in the present study. Each different category of slack was discussed in relation to theories on organizational slack, but also to other theories that contribute to knowledge in these four categories of slack. In the fourth and final step of the analysis the relationship between the four categories are analyzed and discussed, corresponding to the second research question in the present study.

The chapter is structured as follows. Firstly, the seven categories of organizational slack identified at the level of the firm are discussed, which corresponds to the research framework developed in chapter two. Secondly, each of the seven categories are operationalized at the level of the project and analysed using the six cases in the study. From this it was evident that there was a need to take the analysis further and, so thirdly, four categories of slack at the level of the project are identified. These four categories of slack differ in some respects to the categories of slack at the level of the firm. Fourthly, and finally, the relationship between these four categories of slack are analysed and discussed.

### **Four Steps are taken to Identify Categories of Organizational Slack at the Level of the Project and Their Relationship**

Recall from the discussion in chapter two that organizational slack has been dominated by research trying to relate slack to financial resources. However, as pointed out in the review of categories of slack, there are other views of organizational slack (Geppert, 1996; Lawson, 2001; Meyer, 1982; Nohria & Gulati, 1996; Sharfman *et al.*, 1988). For the purpose of this thesis the arguments put forward by Meyer (1982), that different categories of organizational slack exist, is of particular importance.

From the literature on organizational slack it was possible to identify seven categories of slack that a company can use to adapt to changes. These changes can be external to the organization, such as environmental jolts – sudden and

unpredictable events (Meyer, 1982). The changes can also come from inside the organization, in the form of internal pressure for adjustment (Bourgeois, 1981).

It is important to note that these seven categories of slack were identified from previous literature and research on organizational slack conducted at the level of the firm. Taken together, these seven categories of slack make up the first part of the research framework used in this study. For each one of the categories of slack at the level of the firm, the literature offers an explanation for the category of slack. These explanations are used as a starting point in the analysis in order to examine if all seven categories of slack at the firm level can be applied at the project level, or if there is a need to refine the categories of slack at the project level.

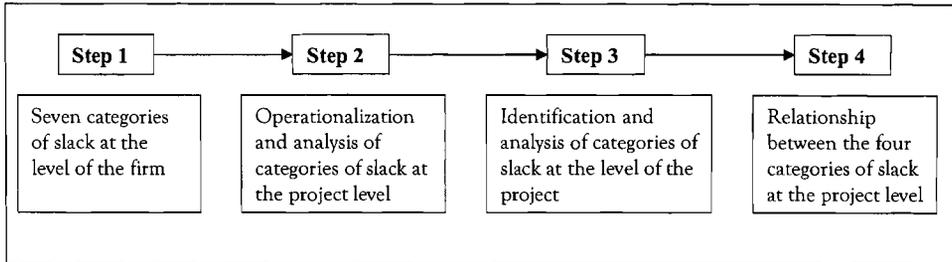
Since the aim is to examine whether the categories of slack at the firm level can be identified at the project level, the operationalizations of categories of slack at the project level have been based on the explanations at the firm level. The goal has been to make as few adjustments as possible in order to have as much correlation to previous literature on organizational slack at the level of the firm as possible. It was perceived as important to have as much correlation as possible between the explanations at the firm level and the project level as, to some extent, it increases the reliability of the study by making it easier for other studies to follow in the present study's footsteps.

The drawback of trying to get a high correlation between the explanations at the firm level and the project level is that some of the operationalizations were a little bit ungainly. It was possible, already early on in the analysis, to identify that the operationalizations would not fit the reality of the projects. For that reason it was necessary to take the analysis a step further and refine the categories of slack at the level of the firm so they could apply at the project level. In the third step of the analysis it was possible to identify four categories of slack. Below a graphical explanation is offered as to how the four categories of slack at the level of the project were identified.

1. The categories of slack at the level of the firm and their explanations were used as input to the operationalizations of categories of slack at the level of the project.
2. The analysis of these seven categories of slack at the level of the project revealed that it was necessary to take the analysis a step further.
3. In this step of the analysis it was possible to identify four categories of slack at the level of the project. These four categories are to some extent a refinement of some of the categories of slack at the level of the firm, but also a result of the cross-case analysis, as they were the ones that remained. The four categories of slack are expressed in the form of propositions.

4. Finally, the categories of slack at the level of the project are linked to each other and their relationships are discussed.

Figure 6:1 ▼  
Four Steps in the Analysis



The four-step analysis process above may seem like a step-by-step process. However, it is important to recall that the research process was characterised by interplay between theory and data. For that reason it was evident quite early on in the analysis process that the seven categories of slack at the level of the firm were not the same as the ones at the level of the project. For that reason it was necessary to take the analysis a step further and identify categories of slack at the project level. The need to take this step should not come as a surprise considering the remarks by Glaser and Strauss (1967, chapter 1) who point out that it is difficult to force data into “square categories”, which in the present study corresponds to the research framework. Instead, it is important that the researcher continuously and actively looks for emerging categories, so as not be limited to previous theories.

## Categories of Organizational Slack at the Firm Level

In the review of the literature on organizational slack conducted in chapter two, I identified seven categories of organizational slack at the level of the firm (italicised in the text below). These categories of slack are briefly reviewed before I arrive at the operationalizations of these categories of slack at the level of the project. The first one is *financial resources* which is by far the most common category of organizational slack in the literature (Bourgeois & Jitendra, 1983; Bromiley, 1991; Cheng & Kesner, 1997; Geiger & Cashen, 2002; Greenley & Oktemgil, 1998; Kuitunen, 1993; Palmer & Wiseman, 1999; Riahi-Belkaoui, 1998; Singh, 1986). Most of these studies have used financial information from annual reports in their analysis of slack.

Yet, there are other categories of slack discussed in the literature. Bourgeois (1981) views slack as a facilitator of creative behaviour, creating room for the organization to experiment with new strategies. For instance, developing and

introducing new products, or entering new markets and segments, i.e. targeting new customers (Hambrick & Snow, 1977). As a consequence, the characteristics of the *product* and its *customer* are identified as important categories of slack. Meyer (1982) discusses another category of slack as being human resources, a discussion that Nohria and Gulati (1996; 1997) have continued as they argue that a firm can have a surplus of employees (Nohria & Gulati, 1996, 1997). Therefore the *members* can be identified as an important category of slack.

A fifth category of organizational slack is the availability of *time* that is not fully engaged in the current delivery of the organization's primary product or service (Geppert, 1996; Lawson, 2001). To adapt to environmental changes and to be innovative, the members of an organization need time to reflect, analyze and discuss, in order to learn from experiences (Lawson, 2001, pp. 126-127). It is difficult to learn if the members are hurried or rushed. However, learning does not happen automatically just because time is available. The organization must give its members room to develop and collaborate (Stewart, 1996).

The availability of time is closely related to *goals and deadlines* (Cyert & March, 1963/1992; Nohria & Gulati, 1996). Goals and deadlines are often influenced by the exercise of *governance and leadership* by top management (Cyert & March, 1963/1992). Organizational slack can result in less stringent demands to meet forecasted deadlines, resulting in more freedom being given to individual projects. But it can also be the other way around - the governance of a project can increase, when there is little slack (Nohria & Gulati, 1996).

The seven categories of organizational slack at the firm level, identified in the literature, serve as an important starting point for identifying categories of slack at the level of the project. Perhaps most importantly, the review reveals that slack is not only to be viewed as excess (financial) resources, there are other categories of slack as well. The seven categories of slack and their respective explanations at the level of the firm are summarized in figure 6:2 below, and as can be seen in the figure, the area of interest in this chapter is on the left hand side.

**Area of attention in Chapter 6**

Organizational slack		Knowledge creation			
Categories of slack at the level of the firm	Explanations at the level of the firm	Socialization	Exter-nalization	Combi-nation	Inter-nalization
Financial	$\Delta\text{Slack} = f\Delta(\text{RE, DP, G\&A, WC/Sales, D/E, CR, I/P, P/E})$				
Product	Is it possible to experiment and introduce new products?				
Customers	Is it possible to address new customers?				
Members	Is there a surplus of employees in the organization?				
Time	Is there time available not fully engaged in the organizations' primary product or service?				
Goals and deadlines	Is there less stringent demands on forecasted milestones?				
Governance and leadership	Is there a lax discipline in selection, ongoing support and termination of projects?				

However, these seven categories of slack are identified at the level of the firm, not at the level of the project which is the unit of analysis in this study. This is why it is necessary to develop operationalizations of these seven categories of slack at the level of the project. The categories of slack are operationalized at the level of the project and the goal has been to have as much correlation with the explanations at the level of the firm as possible. This is to make it easier to follow the steps taken in the analysis process, instead of beginning to discuss the categories of slack at the level of the project. Thus making the analysis process as transparent as possible and increasing the reliability of the study - by making it easier for other studies to follow in the present study's footsteps.

Table 6:1 ▼

**Operationalization of Categories of Slack at the Level of the Project**

**Organizational slack**

Category of slack	Explanation at the level of the firm	Operationalization at the level of the project
Financial	$\Delta \text{Slack} = f(\Delta (\text{RE, DP, G\&A, WC/Sales, D/E, CR, I/P, P/E}))^{33}$	The possibility to increase expenses in the project is interpreted as a category of slack
Product	Is it possible to experiment and introduce new products?	Is it possible for the project to introduce new products?
Customer	Is it possible to address new customers?	Is it possible for the project to address new customers?
Members	Is there a surplus of employees in the organization?	Is there a surplus of members in the project?
Time	Is there time available not fully engaged in the organizations' primary product or service?	Are there possibilities for project members to have discussions in the project?
Goals and deadlines	Is there less stringent demands on forecasted milestones?	Is it possible for the project to change or miss deadlines?
Governance and leadership	Is there a lax discipline in selection, ongoing support and termination of projects?	Is there little governance of the project?

These seven categories, now operationalized at the project level, are used as a starting point in the analysis. Each of the seven categories will be dealt with individually and discussed in relation to the cases in the study. From the analysis it is evident whether or not a category of slack, explained at the firm level, can also be identified at the project level. The findings are summarized in the table (6:2) below.

It is important to point out that the analysis of categories of slack at the project level is not aimed at measuring organizational slack. In other words, there is no attempt to identify whether a project has X percentage of slack, while another project has Y percentage of slack. Instead, the view in the present study is that slack is a dynamic phenomenon, always present in an organization, to a greater or lesser extent. To be considered as a category of slack at the level of the project it is necessary to be able to identify changes (reduction or increase) in the level of slack over time.

Taking this view it implies that slack is a potential resource which can be used deliberately by the company. This a view of slack is closely related to the one held by Judge *et al.* (1997) who argue that it is the continuity of slack that is important. Companies experiencing significant disruptions or discontinuities of slack were identified as less innovative. However, in comparison to the present

<sup>33</sup> For a comprehensive discussion about each of the selected indicators please see Bourgeois (1981, pp. 37-38)

study Judge *et al.* (ibid) say little about different categories of slack. Instead, they treat slack as a unified phenomenon to be studied at the level of the firm.

Compare the view of slack in this thesis to an accordion. The accordion is an instrument that gives no sound if it is either squeezed together completely or if expanded completely - it is only when the accordion is played just right, not too contracted or too expanded, that it gives a sound. When played it is possible to observe changes in how much or how little the accordion is squeezed. The same goes for slack - over time it is possible to observe changes, though not necessarily possible to measure the exact amount.

**Table 6:2** ▼  
**Indication of Organizational Slack at the Project Level**

<b>Category of slack</b>	<b>Possible to identify<sup>35</sup></b>	<b>Comments</b>
Financial	No	Difficult to separate a specific project from the rest of the organization
Product	No	At the project level it is difficult to identify slack. There are underlying reasons such as decisions on a company level
Customer	Yes/No - modifications have to be made	The possibility to address new customers is more a result of discussions at a higher level than the project level. However, the customer influenced the projects in their interaction with the projects
Members	Yes/No - modifications have to be made	To think about a surplus of members in the project is not enough. It is also necessary to consider the knowledge and competence of the members
Time	No	The possibility for discussions in the project is influenced by the technological complexity and the presence of a customer
Goals and deadlines	Yes	The presence of a customer reduces the possibilities to change or miss a deadline
Governance and leadership	Yes	A loose governance of the project from the top management implies a lax discipline in the projects

## Financial

Information about the financial resources of a firm is often obtained from a firm's annual report, and organizational slack has often been measured by using this information. In particular, most studies of organizational slack at the level of the firm have associated organizational slack with financial resources, such as excess liquidity (e.g. Cheng & Kesner, 1997; Greenley & Oktemgil, 1998; Kuitunen, 1993; Singh, 1986). The operationalization of slack as a financial resource at the project level corresponds to the possibility to increase expenses in the project over time. Thus, to identify slack, and changes in the level of slack, it is necessary to track the expenses of the project over time.

<sup>35</sup> Possible to identify according to the operationalizations made above.

However, to get information on the financial resources, i.e. the project budget in each of the projects in the present study was not possible, since the companies did not want to reveal the budget in each project, and how it changed over time. For that reason it was necessary to get input from the respondents as to whether it was possible to increase the expenses in the projects. Examining each of the projects reveals an incoherent picture.

Two projects, the System project and the Integration project showed some evidence of the existence of slack, which was reduced over time. Both projects had similar backgrounds. Initially they were perceived as very important projects, which would generate profits in the future. For that reason they were given a significant amount of financial resources. However, both projects had difficulties in getting their respective products onto the market, and slowly the financial resources in the projects were reduced. Additionally, at the end of the projects there were requests for increasing the expenses in the projects, which were turned down by the management.

The other four projects in the study; the Processor project, the Component project, the Message project and the Java project, all seemed to have the same level of financial resources throughout the projects. To some extent it may be argued that the Message and the Java projects had the possibility of increasing their expenses, as for a short period of time they were allowed to hire new personnel to cover some gaps in competence. However, the two projects had some of their members working in other projects at the same time, and the net effect on the expenses in the projects was that the expenses remained at the same level, i.e. neither increased, nor decreased.

The lack of raw data made it necessary to rely on the input given by the respondents on the existence of slack. The interviews, however, did not reveal a unified picture and for that reason it is difficult to claim that financial resources is a category of slack at the level of the project. Many of the respondents also claimed that the projects were only part of a larger whole and that is was the overall situation of the company that decided on the situation in the projects, and the possibility to increase the expenses. In particular, this was evident in Communication Ltd. which suffered from stock-market pressure to reduce unnecessary costs, which in turn made it necessary for the company to reduce costs at the project level. This cost reduction influenced both the System project and the Processor projects.

Thus, it is possible to examine financial resources as a category of slack at the firm level. However, at the project level the financial resources in a project are more a consequence of decisions already made at a higher level. For that reason it is suggested that:

*The possibility to increase expenses in the project cannot be interpreted as a category of slack at the level of the project.*

Still, it is important to bear in mind that the conclusion above is based upon the interviews, and not on exact data of how the expenses in a project changed over time. This made it difficult to identify financial resources in a project as a category of slack. This does not imply that the financial resources are of little importance. On the contrary, the financial resources of a project can be crucial to its success. For instance, without the financial constraints at Communication Ltd., it might have been possible for the Processor project and the System project to increase their expenses through increasing the number of people working in the projects.

Another example is that a more positive financial situation at Communication Ltd. might have made it possible to buy more equipment to conduct tests on the products being developed, or update some of the computer equipment. However, these kinds of concerns are more related to slack at the level of the firm, and as a result, they are difficult to assess at the level of the project, e.g. what can actually be attributed to one project, and not to all projects within the company, as some things are shared by many different projects. For that reason it is difficult to think about slack at the level of the project, but appropriate to think about financial slack at the level of the firm.

## Product

In previous studies on organizational slack it has been argued that slack can be a facilitator of creative behaviour (Bourgeois, 1981), implying that slack is a resource in excess. Organizational slack creates room for the organization to experiment with new strategies, for instance developing and introducing new products (Hambrick & Snow, 1977). The operationalization of the product as a category of slack at the level of the product development project corresponds to the possibility to experiment with different solutions in the product. Thus, the presence of slack increases the possibility to experiment with different product solutions, while a reduction of slack gives a corresponding reduction in the possibility to experiment.

At Communication Supplier the Processor project and the System project both had the possibility to experiment with different solutions. The freedom given to the Processor project came from the vague goal set by the top management, which made it necessary for the project to experiment with different product solutions - indicating the presence of slack. As the project proceeded it signed a contract with a potential customer. From that point in time there was a reduction of slack in the project in terms of experimenting with different solutions. The reason was that the customer came with very strict specifications on the features and design of the product. For various reasons, the customer decided to cancel the contract, and once again the Processor project had the possibility to experiment with different solutions for the product, indicating that the level of slack had increased.

The System project faced a similar situation as there were a lot of uncertainties surrounding the project, e.g. will there be a market for our product? what is the design of the product? etc. In order to find an answer to these questions the System project developed an implementation proposal, which was a detailed description of how parts should be integrated and the design of the final product. Before the implementation proposal was ready, many different solutions had been tested, indicating the presence of slack. But after the implementation proposal was agreed upon, the focus changed and the project tried to develop a product which could be offered to customers, i.e. decreasing the level of slack from that point to the end of the project.

At Support Inc. the Integration project and the Component project were built upon the idea of, and initiated by, a single person. Prior to the two projects there had been little discussion, either internally at the Research Division, or externally with partners and customers, on the needs of either of the two products. Both projects were supposed to deliver a product soon after their initiation. As a consequence, both projects faced a tight schedule which made it difficult to experiment with different solutions in the projects. The members perceived these tight deadlines from the outset of the study as negative, because they had little idea of what they actually were supposed to do. This indicates little slack in the projects.

The Java project was similar to the Integration and the Component project as there were few possibilities to experiment with different solutions, indicating a low level of slack, though for a different reason. In the Java project the focus was not to make any changes to the actual product, but instead to only change the code base into Java – in order to follow the new Support Inc. standard where all products were to have Java as the code base.

From the analysis it is clear that the product cannot be considered as a category of slack at the level of the project as there are other reasons for why it is possible, or not possible, to experiment with different solutions to the product, which leads to the following suggestion:

*The possibility for the project to introduce new products cannot be interpreted as a category of slack at the level of the project.*

In all six cases there were different underlying reasons for the existence and changes in the level of slack, which were not related to the possibility to experiment with different solutions. Organizational slack in the product is something that may exist at a company level, looking at the full product range of a company, but which cannot be identified at the project level, as product development projects are concerned with developing one product, not having a portfolio of products.

## Customer

The role of organizational slack as a facilitator of creative behaviour – being a resource in excess (Bourgeois, 1981) – is also useful in the discussion of customers, as it makes it possible to experiment with new strategies, such as entering new markets and segments, by targeting new customers (Hambrick & Snow, 1977). This has been operationalized – at the project level – as slack changes with the possibility for a project to address new customers and segments, i.e. a high level of slack gives the project the possibility to address new customers, while this possibility is constrained if the project is facing a low level of slack.

Both the Processor project and the System project initially developed a prototype which was to be shown to potential customers. It was important to have a prototype, and not just a blueprint of the product, in order to get the customers interested in buying the product. Developing a prototype which could be shown to potential customers indicates a high level of slack in the project. As the two projects evolved it was only the Processor project that managed to sign a customer. The customer came with detailed specifications concerning the product, i.e. reducing the level of slack. Later on the customer decided to cancel the project. This forced the Processor project to once again develop a prototype, i.e. once more increasing the level of slack.

However, it was not the projects themselves that actually approached the customers to offer different product solutions. Instead, it was the responsibility of the sales department and the production council to make contact with the customers, i.e., it was a level higher than the project level. It should be noted though, that in the Processor project the signing of a customer totally changed the focus in the project from developing a general prototype, to the development of a customer specific product. Thus, the interaction with the customer greatly influenced the project, both in terms of what to deliver and when.

Both the Component project and the Integration project lacked a customer at the outset and had little connection to the needs of the market. The reason was, as has been discussed, that the projects were built upon the idea of a single person, who had not discussed the ideas either internally or externally. For that reason it was necessary for the projects to address new customers in order to survive, which had little to do with the existence or lack of slack. The Component and the Integration projects differed from projects at Communication Supplier in that they had greater possibilities to address customers on their own, but to say that it was because slack existed is a little bit far fetched. It is more a consequence of two different organizational structures.

The one project that perhaps could be said to have slack, according to the operationalization above, is the Message project, which found a customer

relatively early on in the project. The customer had no previous relationship with Support Inc., indicating that there was some slack at this point in time that facilitated the possibility of targeting a new customer. However, considering that it was at a higher level (the product council) that the decision of whether or not the Message project should target a customer was taken, the following suggestion is given.

*The possibility of the project to address new customers cannot be interpreted as a category of slack at the level of the project – it is also necessary to consider the interaction with customers.*

From the analysis of the cases it is evident that there is a need to refine the operationalization of customer as a source of slack. The analysis above indicates that it is the interaction with the customer which is of relevance (when does a customer enter a project? How and what type of interaction is it between the project and the customer? What does it imply?). From the analysis above it is also possible to identify the reasons for why there is a need to refine the operationalization:

- First, the possibility to address customers is often a decision made at a higher level than the project level.
- Second, the possibility to address customers is always present, but it may not be possible for a project to approach a customer due to the structure of the organization, e.g. the sales department handles all contact with customers.

Thus, it is not possible to identify the customer as a category of slack using the operationalization. However, as was indicated it is in the interaction with the customer, and changes in the interaction over time that seem to influence the work in the project. This is an issue to come back to later on, in order to broaden the analysis, instead of being limited to whether or not it is possible to address new customers.

## Members

Previous studies on slack at the company level have associated slack with a surplus of employees in the organization, or idle capacity (Nohria & Gulati, 1996, 1997). This is operationalized at the level of the project by saying slack is related to whether there is a surplus of members in the product development project.

Examining the six cases it was only the Integration project which seemed to have slack in terms of a surplus of members, but only at a certain point in time. At the outset of the Integration project the members had little experience with the product being developed. However, instead of involving all members in the project, in the initial pre-study where decisions concerning the features and functions of the product being developed were decided, only a few members

were involved. During this period the rest of the members in the Integration project remained passive, awaiting further instructions. For that reason the project, at this point in time, had an excess of members in the project, indicating a high level of slack. As the project finished the pre-study and decided on the features and functions of the product, the Integration project became more focused and each member in the project had a task to fulfil. On completion of the pre-study, the initial presence of slack in terms of having a surplus of employees was reduced, and remained at a low level until the Integration project was finished.

In the rest of the projects in the study the common theme was that either they had just enough members to make the work proceed according to plan, or they did not have enough members, making the project move slower than expected. In particular, the Processor project lacked members with competencies in mechanical engineering and as a result the work with developing a prototype took longer than expected. In addition, most of the members of the Processor project were also members of one or two other projects. Once the Processor project signed with a customer, it was prioritized by the members who were also working with other projects. But as the customer cancelled the project, the members did not put the Processor project as their first choice when choosing between which project to engage in. This in turn made the progress of the Processor project slower than it could have been, had its members been solely dedicated to the project.

Two other examples are the System project and the Component project, in which the number of members remained almost constant throughout the whole project, but the competence among the members varied greatly.

Towards the end of the System project, the members had to work part-time in other projects. There were two reasons for this: first, the System project moved back into the facilities belonging to Communication Supplier, which made the members of the System project visible to other projects who required the competence these members had. Second, the fact that the product did not reach the market made it difficult for the members and the project manager to convince other parts of the organization that they needed so many project members. Thus, to some extent the level of slack in terms of having an excess of employees slowly deteriorated.

At the Component project the absolute number of members remained the same until the project had reached an end. However, some of the most experienced members were transferred to other projects and were replaced by newcomers. For this reason the Component project did not lack members in absolute terms. But the aggregated competence and knowledge of the members in the Component project had deteriorated. Thus, looking at the number of members in the project it appears as though slack remained constant throughout the

project. But considering the competencies among the members, it seem as if the slack in the project was reduced.

In comparison to the Integration project there was no point in time when one or more project members were “sitting on the bench” awaiting further instructions in the System project, the Processor project or the Component project. The analysis above would suggest that it is not the number of members in a project that is the main issue, but rather the competencies of the members. And it is suggested that:

*The possibility to have a surplus of members in the project cannot be interpreted as a category of slack at the level of the project – it is also necessary to consider the competence of the members.*

Examining the presence of slack in terms of whether or not there is a surplus of employees revealed that it was not enough to think about the absolute number of people in the project. The number of employees may remain the same in a project, but the competence in the project may change a lot depending on who is finishing and who is entering the project. In most of the projects the feeling was that they had enough members, in absolute numbers, implying a sufficient level of slack. However, the project could lack important competence and knowledge in different areas making it difficult to have a fast progression in the projects, indicating a low level of slack. For this reason it is necessary to take the analysis one step further and examine the competence of the members in a project, and not be limited to the absolute number of people in a project.

## Time

Another category of organizational slack is the availability of time (Geppert, 1996; Lawson, 2001). According to Lawson (2001), it is necessary for individuals to have time to reflect, analyze and discuss in order to learn from experiences and anticipate various consequences – especially as technology becomes increasingly complex. At the project level this is operationalized as the availability of time for discussions in the projects. This is not to say that discussions are not going on all the time, the difference is how an individual perceives the possibility of being able to engage in discussions.

In the Processor project the possibility to have discussions shifted over time. The members in the Processor project were knowledgeable about the technology in the project, having worked with previous processor products, which reduced the need for discussions. Nevertheless, initially in the project it was perceived as possible to have discussions on the design and features of the product. The possibility to have discussions can be traced to the goal of making a general prototype, which meant it was important to get a consensus in the project on the basic design and functions.

However, once the project got into contact with a customer the possibility to have discussions was reduced, as the specifications given by the customer were so clear. Once the customer decided to cancel the contract there was once more time for discussions in the project. For that reason the experience in the Processor project was that development without a customer gave more opportunities for discussions, than development with a customer. This indicates that slack in terms of time for discussions in the project is possible to a greater extent without the presence of a customer.

The Component project and the Message project had similar experiences to the Processor project. Initially both projects had many discussions on the design and function of the product. But once a customer was signed to the projects, the possibilities for having discussions were reduced. The goal was to develop a product which would correspond to what the customer had been promised, and as the initial discussions had set the frame for what should and should not be done, the need for having discussions was reduced.

Initially in the Component project there was no explicit timeframes as no customer had been signed. During this period the project members had time to create different solutions, quite often outside the needs and requirements of the market. Half a year after the initiation of the Component project, a customer was signed and the project was given a time schedule by the customer. From this point onwards the possibilities for having discussions in the project were reduced.

These three projects suggest that slack – operationalized as the possibility to have discussions in a project – is reduced as a customer enters a project. All these projects seem to suggest the same thing:

*The possibility for the members of a project to do have discussions cannot be interpreted as a category of slack at the level of the project.*

The examination of the different projects reveals some similar characteristics.

- First, there are often greater possibilities to have discussions without the presence of a customer.
- Second, the more technical complexities and uncertainties there are surrounding the project, the greater the need to have time for discussions, as has been indicated in previous research (Lawson, 2001).

For these two reasons it is important, not only to consider the complexity of the product, but also to think about the relationship to the customer which can greatly influence the possibilities to have slack in time. Thus, once more the role of the customer seems to be an underlying reason as to why it is not possible to identify time as a category of slack at the level of the project.

## Goals and Deadlines

Previous studies indicate that with the presence of organizational slack, the goals and deadlines are less stringent (Cyert & March, 1963/1992; Nohria & Gulati, 1996). This is operationalized at the project level by saying that slack gives the project the possibility to change the goals and deadlines.

In the Processor project the possibility to change the goals and deadlines varied as the project evolved over time. At the outset of the project there was no customer present and the project had freedom in setting its own goals and deadlines, and as a consequence, it was also possible for the project to change and/or miss the goals and deadlines without resulting in negative consequences. Once a customer was signed, the feeling of freedom was reduced in the project and instead replaced by a pressure to deliver the product by a certain date. When the customer cancelled the agreement there was once again increased freedom in the project and the project members felt less pressure to produce a product at a certain time. This indicates that at the outset the project had a high level of slack, which was reduced as the customer entered the project, to be increased again when the customer cancelled the contract.

A similar experience to the one in the Processor project, where initial freedom was replaced by strict delivery dates once a customer was signed to the project, can be found in the Integration project at Support Inc. Initially the Integration project was able to set its own deadlines. But once a customer was signed the project had to adapt to the deadlines agreed upon with the customer, which reduced slack in terms of possibilities to change the deadlines.

Despite coming from the same company, the System project differs a great deal from the Processor project, in terms of the possibility to change or miss goals and deadlines over their lifetime. Initially both projects were given a great deal of freedom, by the production council, to set their own deadlines for the project. This made it possible for the two projects to decide when they should have deliveries and what these deliveries should include. But in comparison to the Processor project, the System project did not succeed in signing a customer. And as no customer was signed to the System project, their freedom to set their own deadlines persisted throughout the whole project. Because there was no customer the project was also able to move its deadlines or reduce what was going to be delivered, if they saw that they would not make it. This indicates that a high level of slack persisted throughout the project.

At Support Inc. the Message project and the Java project had few possibilities to change their goals and deadlines, but for different reasons. The Message project was supposed to deliver a product to the customer signed to the project, but also to make sure that the partnership with the Integration project continued to work as planned, and not be delayed by the Message project. The Java project on the other hand was part of a larger project at Support Inc., and as a

consequence, deadlines could not be missed or it would delay the whole project. For that reason the Java project was also allowed to take in extra members, experts at implementing Java as the code base in products. Thus, in both the Message and the Java project there seems to have been a low level of slack in terms of the possibility to change the deadlines.

Analysing the similarities and differences between the projects and the goals and deadlines as a category of slack at the project level, it is evident that the possibility to change or miss goals and deadlines can be a source of slack, but that it is influenced by other factors such as when a customer is signed to the project, or the freedom granted a project by the production council. For that reason it is suggested that:

*The possibility to change or miss a deadline in the project can be interpreted as a category of slack at the level of the project.*

The analysis reveals that in each of the projects the possibility to change or miss a deadline varied greatly. The single most important reason for this is closely related to the presence of a customer. A customer sets the demands upon the project and this often reduces the possibilities to change or miss a deadline. Thus, to some extent the possibility to change or miss a deadline seems to have an influence on the level of slack in the project, but it is influenced by the presence (or not) of a customer. It is also influenced by the role of the production council in monitoring the project, and this needs to be examined. Therefore it is necessary to take the analysis one step further and examine more closely what the possibility to change or miss a deadline in the project as a category of slack means.

## **Governance and Leadership**

It is not uncommon that goals and deadlines are influenced by the governance and leadership of the project, that top management often exercise (Cyert & March, 1963/1992). Organizational slack can result in less stringent demands to meet forecasted deadlines, resulting in more freedom given to individual projects. But it can also be the other way around - the governance of a project can increase, when there is little slack (Nohria & Gulati, 1996). This is operationalized at the project level as a loose governance of the project from the top management implying a lax discipline in the projects and a high level of slack. The reverse can also be the case, a low level of slack is associated with a close governance of the project. It should be emphasised that the discussion below focuses on whether or not a category of slack can be attributed to governance and leadership at the project level.

At Communication Supplier the Processor project and the System project differed from each other. The Processor project was initiated by the production council, which had put forward a business case indicating the potential for a

processor product for the 3G mobile systems. In the initial stages of the project, the production council continued to monitor the project. The governance of the Processor project was intensified as a customer entered the project. However, as the customer cancelled the contract the production council lost interest in the project, because they saw few opportunities for getting the product onto the market. This signals an increase in slack compared to the previous close governance of the project.

The System project was different because the production council gave it a lot of responsibility and freedom in deciding the details in the project. The reason was that the production council thought that the System project had good competence among the members, and it was the members that should make the project move forward. Another reason for the low level of governance was that the System project was located at another facility, away from the other projects at Communication Supplier, which made it difficult to govern the project. The lack of governance was not only present initially in the project, but throughout the whole project, suggesting that the level of slack in terms of governance and leadership remained high from beginning to end.

In the projects at Support Inc. it was also possible to identify slack, operationalized as the more lax the governance of a project, the more slack exists (or the other way around). For instance, in the Component project there was an initial freedom as the project was allowed to develop a product with little governance from the product council. It was only towards the end of the project that the governance of the project increased. The reason for the increased governance was that the product council wanted to have a return on the money they had invested in the project, which increased the pressure in the project. The time when the product council began to take more interest in the project also corresponds to when the Component project began delivering the product to a pilot customer. The product council regarded it as important that the Component project succeeded in the development of the product for the pilot customer. For that reason they controlled the project more carefully. The increased governance reduced the slack in the project.

A similar experience to the one in the Component project, was found in the Integration and the Message project. Both projects experienced an increased governance of the projects once a customer was signed, indicating a reduction in slack in comparison to the time prior to the signing of a customer. Thus, the analysis above suggests the following:

*The governance and leadership of a project can be interpreted as a category of slack at the level of the project.*

The analysis of the governance and leadership dimension reveals that the projects were influenced a great deal by the presence of the top management. As soon as the top management began to control and monitor the projects more

closely, it seems to be associated with a reduction in slack. It is also interesting to note that the top management governance seems to be related to the existence of customer, which is an issue to return to when discussing the relationship between different categories of slack at the level of the project.

### Summarizing the Findings of the Seven Categories of slack at the Product Development Project Level

The purpose of examining the six projects using the seven categories of slack identified from previous literature at the level of the firm, was to see if these seven categories could also be identified at the project level, or if there was a need to modify these seven categories. Evident from the analysis is that some of the categories could not be identified at the level of the project. In addition, for some of the categories there were underlying reasons which influenced the categories of slack, making it necessary to take the analysis one step further. But before going into details about the different categories of slack and the relationship between these categories, a short summary is made of the findings from the above analysis.

- First, the *financial resources* as a category of organizational slack could not be identified at the project level. The analysis indicated, however, that the financial resources are of importance to the company, which should come as no surprise considering the findings in previous literature (e.g. Cheng & Kesner, 1997; Greenley & Oktemgil, 1998; Kuitunen, 1993; Singh, 1986).
- Second, the type of *product* as a category of organizational slack could not be identified at the project level. The possibility to experiment with different product introductions and target new segments are decisions made at the level of the firm. In addition, the possibility in a project to experiment with different product solutions is highly related to the presence of a customer. If there is a customer in the project, then the possibility to go beyond the specifications agreed on with the customer is limited.
- Third, the analysis of the *customer* as a category of slack at the level of the project revealed that it is not enough to only consider the possibility of addressing new customers. Instead it is important to in more detail examine the relationship between the project and the customer.
- Fourth, to only consider if there is an excess of *members* in a project is not enough for considering it as a category of slack at the level of the project. Instead it is more important to consider the competencies in the project.
- Fifth, *time* as a category of slack at the level of the project could not be identified. Instead, the underlying reason for the possibility to have time for discussions in the project is related to the presence of a customer

- Sixth, analysing the *goals and deadlines* in a project it was evident that it could not be considered as a category of slack according to the operationalization made. Furthermore the analysis showed that the customer and the top management are highly influential when the deadlines are set in a project, which is an issue to come back to.
- Seventh, the analysis also showed that the *governance and leadership* of a project could be considered as a category of slack at the level of the project. But it is important to note that the presence of a customer influences the governance and leadership of a project.

To summarize the analysis above it is clear that not all seven categories of slack identified at the firm level is appropriate at the product development project level. In addition there seems to be underlying reasons and dynamic relationships between several of the categories. The analysis also showed that organizational slack cannot be thought of as a static phenomenon, but instead it is something that changes over time. The finding that slack can be deployed in various ways over time is consistent with previous research (e.g. Nohria & Gulati, 1996).

In order to go beyond the finding that not all seven categories of organizational slack identified at the firm level fit the project level, it was necessary to take the analysis one step further and identify categories of slack which are specific at the level of the project. And as a second step, identify the dynamic relationship between each of these categories of slack.

## **Categories of Slack at the Product Development Project Level**

Early on in the cross-case analysis of the cases it was evident that the seven sources of slack identified at the firm level were not suitable for the project level. As the analysis was completed, both the comparisons between Support Inc. and Communication Supplier, as well as between the projects within the respective companies, it was possible to identify four different categories of slack at the level of the product development project: 1) customer interaction, 2) top management control, 3) project deliverables, and 4) human competence. These four categories of slack were the ones which remained after the cross-case analysis was conducted. The four different categories of slack are described below, and expressed in the form of propositions, and then linked to previous theory on organizational slack as well as to other theories.

### **Customer Interaction as a Category of Organizational Slack**

A recurring observation during the study was that the nature of the interaction with customers influenced the way in which knowledge was created in the

product development projects. The more direct influence a customer had on the project, the less room there was to experiment within the project, which appears to negatively affect knowledge creation. In the Processor project at Communication Supplier the initial freedom experienced by the project team was reduced as a customer was signed. The relationship with the customer was a very close one and resulted in very strict specifications of what the product should look like and consist of. Although this did speed up the development process, project members had few possibilities to interact and experiment.

The Component project, the Integration project, and the Message project at Support Inc. were similar in the respect that initially they did not have a customer. The projects, therefore, experienced a freedom of working on the product without having to take into consideration demands from customers on delivering a specific product at a specific moment in time. This enabled members to engage in knowledge creation. Once a customer was signed, the demands to deliver a product increased and the projects experienced an increased pressure. This gave them less opportunities to follow up probes and leads in directions other than those which were in the contract with the customer, hampering knowledge creation in the projects.

The Java project was different since it had a customer from the outset, which put pressure on the project from the start of the project. The project members claimed that they had little freedom to experiment with new things and only developed what was agreed upon.

The analysis of the cases thus revealed that as a customer was signed to a project, organizational slack was reduced. As a customer was signed, the result was less freedom for the project to experiment and follow up probes, which affected knowledge creation. The key to this reduction in slack was interaction with the customer, and the customer's demands on, for instance, the final design of the product and deadlines. This finding leads to the following suggestion:

*The interaction between a project and its customers is a category of organizational slack in product development projects.*

To speed up the development process, previous research has indicated that customer involvement is positive (von Hippel, 1986; Zirger & Maidique, 1990), therefore it is important to have close contact with lead customers (von Hippel, 1986). Brown and Eisenhardt (1995) argue that external communication with outsiders, such as customers, opens up the project team to new information and viewpoints. Correctly used information will ensure that the company and the product development projects understand what the needs of the user are and that these are translated into solutions for the customer (Zirger & Maidique, 1990). These arguments seem to point in the direction of customer involvement being positively related to the productivity and pace of the development process.

However, the point in time when a customer should be involved in the process is not exactly clear (Brown & Eisenhardt, 1997). The findings from the present study indicate that the effects of a close interaction with customers go beyond productivity and pace and extend into knowledge creation. As a result of a customer being signed to a project, organizational slack is reduced, with subsequent effects on knowledge creation. A reduction in customer-interaction slack implies that there is less room for knowledge creation since the members in the project have little time to interact and experiment. This may, however, be an advantage if a project needs to become more focused and reach a closure.

A conclusion from the discussion above could be that a company should not sign a customer as that seems to hamper knowledge creation within a project. That kind of conclusion is of course naïve, since a company always needs to have customers in order to sell their products. However, what is evident from the study is that the customer influences the knowledge creation in product development projects. Therefore, as is also suggested by Brown and Eisenhardt (1997), a company or a project should be careful about when to interact with a customer. Thus, the issue of timing, of when to sign a customer, is of crucial importance. To know when to sign a customer it is necessary to take the analysis one step further and examine the relationship between customer interaction and the four modes of knowledge conversion, which is the theme of chapter eight in this thesis and also corresponds to the third purpose of the thesis.

### **Top Management Control as a Category of Organizational Slack**

Top management had an important effect on knowledge creation in the product development projects studied, through the control they exerted over the projects, or rather, through the autonomy they granted to the projects<sup>36</sup>. Four of the six projects, the exceptions being the System project at Communication Supplier and the Java project at Support Inc., exhibited similar patterns. Initially the projects were given the freedom to set their own deadlines, both in terms of when to deliver different versions, and what to deliver. Towards the end of the projects, however, top management took more control of the projects and emphasised that a final version of the product had to be delivered. This increased control corresponded highly with the entry of a customer. Thus, the loose control initially given to the projects by the top management was reduced over time.

The Processor project illustrates the observations on changes in top management control. The project had initially no customer and as a consequence top management did not follow up and control the project to any

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<sup>36</sup> In the following the view of top management will be taken and as a consequence the *control* of a project will be emphasised, not the perceived *autonomy* in the project.

great extent. Then a customer was signed and top management pushed the project towards delivering a product to the customer, i.e. increasing top management control. However, as the customer cancelled the deal, top management lost interest in the project, and the project team was once again given autonomy as the top management control decreased.

The two exceptions in the study, where changes in top management control could not be observed – the System project and the Java project – exhibit slightly different patterns, but do not contradict the observations. The System project had a great deal of autonomy from top management intervention all the time. The reason was that the System project did not find a customer, and consequently top management did not exercise strong control over the project. The Java project, on the other hand, had little autonomy from top management from the beginning, as customers were present from the start of the project.

The significance of top management control, and particularly the changes in it, is that it had strong effects on how knowledge was created in the projects. As top management increased its control over a project there was an increased emphasis on the explicit knowledge in the project. The main reason being that top management could not use the tacit knowledge that the project had developed with regard to the product or concept being developed. This finding leads to the following suggestion:

*The control that top management exerts over a project is a category of organizational slack in product development projects.*

Thus, a reduction in top management slack means an increase in the control top management exercise over a project, which corresponds to arguments found in earlier studies on organizational slack at the level of the firm. In these studies it is argued that as slack is increased more autonomy is given or conversely: little slack means more control (Cyert & March, 1963/1992; Nohria & Gulati, 1996). However, top management control should not be confused with top management support, which has been positively correlated with product development success in several instances (for a review see Brown & Eisenhardt, 1995).

Instead, the reduction of top management slack, i.e. increased top management control, is similar to a reduction of *subtle control*, which is the development and communication of a clear product concept built upon a vision (Imai *et al.*, 1985). In addition, the delegation of responsibility to a project team is also included in the term subtle control. The reduction of subtle control implies that less freedom is given to the project and the senior management does not delegate responsibility to the project. As a consequence, independence is also hampered, which reduces the motivation for creating new knowledge (Nonaka & Takeuchi, 1995). An increase in subtle control thus gives the team autonomy

that in turn will make them motivated and creative, resulting in a better development process (Brown & Eisenhardt, 1995).

The findings on top management control as a category of organizational slack is in line with the findings of Bonner *et al.* (2002), who found that if top management goes beyond a directive role into a more detailed governance of a project it creates lower team performance. And as a consequence they suggest that top management should be careful of how they intervene in project activities, since extensive involvement with many formal controls reduces the autonomy and consumes time for the product development team. However, too little control can also be negative, as the team does not get guidance and feedback from top management (Karagozoglu & Brown, 1993).

### **Project Deliverables as a Category of Organizational Slack**

In line with previous literature on firm-level organizational slack, the effect of project deadlines on the creation of knowledge in the projects was observable in all six cases. Especially salient were the effects of deadlines in the Processor project at Communication Suppliers. Initially the project had no customer signed, which meant that the project could set its own deadlines for when different versions of the product were to be delivered. However, it was relatively easy to move these deadlines, as the project had no clear customer. Once a customer was signed the situation changed totally and the possibility to change the deadlines disappeared, as the customer did not accept late deliveries. For various reasons, the customer decided to end the collaboration, which meant that the project again had the possibility to change its deadlines. The main reason for changing deadlines was an ambition in the project to create a “perfect product” for the market.

However, the observations on the role of deadlines for knowledge creation extended to the functionality of the product being delivered. An interesting pattern emerged, particularly in the analysis of the projects at Support Inc. The company had a tradition of projects promising to deliver more than they actually did. This was also the case in the projects that I studied. For instance, in the Java project the project manager told me that: ‘We saw that we could not finish the product in time and therefore we had to cut out parts of the product. It is more important to be on time than that the whole product is finished’.

At Communication Supplier, I did not observe the same type of behaviour when it came to changing the functionalities of the projects to meet deadlines. The projects did their best to deliver what they had promised and they also tried to be on time. However, should it come to a choice between delivering a complete product, or being on time, project members emphasised that it was more important to be on time than to deliver a complete product.

Both deadlines and the possibility to deviate from delivering the promised product functionality affected knowledge creation. As the pressure on a project to reach stipulated deadlines was increased, there was less room to experiment and to learn from and reflect on previous work. As there was a lack of time, the experienced project members also had little time to share their experiences with newcomers in the project, or to reflect and have a dialogue about the product being developed. In addition, little time was given to documentation of the project and to learn and experiment. Concerning the possibility to deviate on functionality, it was particularly when the possibility to deviate from the promised functionality did not exist, that we observed how teams shifted to a focus on explicit knowledge. This might imply that the project was not able to take new information and knowledge into account.

In several instances it was possible to observe how project deadlines and the possibility to deviate from promised functionality were related to each other. As there were fewer possibilities to deviate from the promised product functionality, by not delivering what was promised, project teams tried to extend the deadlines as a response. Therefore, in relation to their effect on knowledge creation, I see deadlines and functionality as part of the same concept, which I term "project deliverables". This leads to the following suggestion:

*The possibility for projects to depart from the promised deliverables, in terms of deadline and/or product functionality, is a category of organizational slack in product development projects.*

The concept product deliverables, as it is defined, thus contains two related parts. The first concerns when to deliver the product and the second concerns what to deliver. Low levels of slack in project deliverables means that there is little possibility to depart from the project deadlines and/or change the promised deliverables.

Previous research has pointed out that it is difficult for employees to learn if they are hurried or rushed (Garvin, 1993). Lawson (2001) argues that it is necessary to have time available for the members of the organization, particularly as technologies become increasingly complex. Comparing the findings of this study with the literature, the effects of the first part of project deliverables on knowledge creation is, of course, in line with existing research on the effect of time on learning. However, this is not to ignore the crucial importance of meeting deadlines and not being late to the market (Vesey, 1991).

The possibility to deviate from the promised product functionality, i.e. the second part of project deliverables, seems from the analysis to indicate that the environment in which the companies operate is of importance. MacCormack et

*al.* (2001) discuss that in dynamic and uncertain environments<sup>36</sup> significant changes might occur in customer needs, and as a consequence it is necessary to take in new information during a development project. For that reason it is important for a project to incorporate change as late as possible in the process (MacCormack *et al.*, 2001), which in terms of slack in project deliverables implies that slack is necessary to incorporate late changes in the product functionality. If there is no slack in project deliverables then the possibility to make changes to the product is reduced.

### Human Competence as a Category of Organizational Slack

A salient feature in the literature on firm-level categories of organizational slack is the importance of human resources, with organizational slack being seen as idle capacity or a surplus of employees (Nohria & Gulati, 1996, 1997). In the cases in the present study, human resources were of course also important for knowledge creation. However, the observations in the present study indicated that it was not necessarily human resources in terms of the number of people that affected knowledge creation, but rather the human competence of the members, i.e. their collective competence. The following illustrates.

All four of the platform projects studied had the same absolute number of members during the life of the project (or to be precise: the Processor had a slight decrease in the number of members towards the end). However, looking at the competence in the project teams reveals another picture. As the projects evolved over time, but before the project had reached an end, there was a tendency for experienced members to be switched to other projects and be replaced by less experienced members. As a result, the projects were slowed down or halted and the ability to experiment and be innovative was reduced, as efforts were needed to introduce the new members in the team. These findings thus indicate that not only are the absolute number of people involved in a project important, but also their competence, in order to create knowledge. This leads to the following suggestion:

*The level of the collective competence of project members is a category of organizational slack in product development projects.*

Human competence slack is thus related to the competence of the members within the project. There is much human competence slack if there are (too) many highly competent members in the project team. Conversely, if there are (too) few members, who also have little competence, then there is little human competence slack. A consequence of using this definition is that when old and

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<sup>36</sup> I follow MacCormack *et al.* (2001, p. 133, emphasis in original) who define uncertain environments as environments "in which future evolutions in markets and or technologies are hard to predict. By dynamic, we mean environments in which these evolutions occur rapidly."

experienced members are replaced with new and inexperienced project members, human competence slack is reduced, which may hamper the ability to create knowledge as efforts are directed towards introducing newcomers, instead of experimenting with new solutions. The findings in the present study are supported by Gupta and Wilemon (1990), who identified that if there are too many inexperienced project members, or the wrong mix of members in a project group, the product development process is delayed.

In addition the findings by Brown and Eisenhardt (1995) and Kessler and Chakrabarti (1999) about the influence of team tenure on process performance are also related to the findings in this study. Project teams with short longevity lack an effective mechanism for sharing information and have not developed effective patterns for working together. This limits the amount and variety of information the project members are able to communicate. But on the other hand, if the teams have a long history together they tend to become inwardly focused, neglecting external communication (Levinthal & March, 1993), i.e. the “Not Invented Here” syndrome. The highest process performance is reached when the team tenure is at a moderate level. This is the result of new project members coming in with fresh ideas and approaches, challenging and improving the scope of existing technologies and methods (Eisenhardt & Tabrizi, 1995; Katz, 1982).

### Categories of Slack – Summary of Observations

The aim of this chapter was to identify categories of organizational slack at the level of the product development project, corresponding to the first purpose of the thesis: ‘identifying categories of slack at the level of the product development project’. The intention behind this aim was to start to open up the black box linking organizational slack and innovation. The proposition underlying this chapter is that knowledge is an important mechanism for the relationship between organizational slack and innovation.

Through the exploratory case research, it was possible to identify four different categories of organizational slack that were all related to knowledge creation in product development projects. By linking organizational slack to knowledge creation, a first step is taken in the analysis in order to increase understanding of the relationship between organizational slack and innovation, and ultimately of the effects on innovation from programs to decrease cost and increase efficiency. The following four categories of organizational slack were identified at the level of the project:

- *The interaction between a project and its customers is a category of organizational slack in product development projects.*

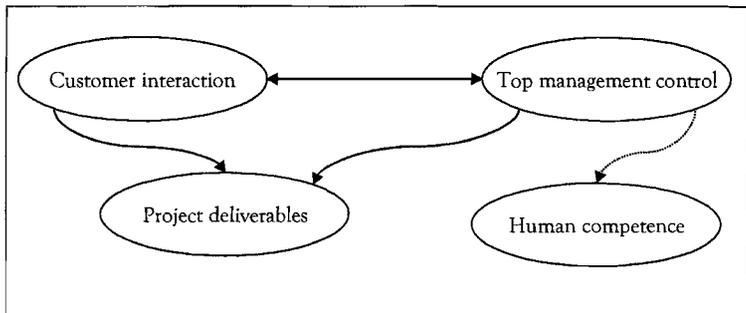
- The control that top management exerts over a project is a category of organizational slack in product development projects.
- The possibility for projects to depart from the promised deliverables, in terms of deadline and/or product functionality, is a category of organizational slack in product development projects.
- The level of the human competence of project members is a category of organizational slack in product development projects.

However, these four categories say little by themselves, as they are merely categories. It is not until the four categories of organizational slack are examined in relation to knowledge creation that they actually become useful, because then it is possible to see the consequences on knowledge creation (and eventually innovation) of activities aimed at reducing, or increasing, organizational slack. But before examining the relationship between categories of slack at the level of the project and knowledge creation (which will be done in Chapter 8) the relationship between the categories of slack is examined.

## Relationships between the Categories of Slack

The second aim of this chapter was to examine the relationship between the categories of slack identified at the level of the project, corresponding to the second purpose of the thesis: ‘examining the relationship between categories of slack at the level of the project’. In the analysis of each of the four categories of slack at the level of the project some suggestions have already been given on their relationships. Below these relationships are explained in more detail. The relationships between the four categories of slack at the level of the project are summarized in figure 6:3 below.

Figure 6:3 ▶  
Relationship between  
Categories of Slack at  
the Level of the  
Project



From the analysis it was possible to identify that as a customer was signed to a project, it was subjected to closer controls from the top management, i.e. the top management control increased. However, since the entry of a customer into a

project in some instances was the result of the work by the top management, it is difficult to discriminate between these two categories of slack. Trying to do so is analogous to finding a solution to the well-known chicken-egg problem. Therefore the arrow in the figure is shown as a two-way arrow.

The entry of a customer and the simultaneous increased top management control also had implications for project deliverables. Recall that project deliverables are comprised of two parts: first, when to deliver a product, and second, what to deliver. This is important as a closer customer interaction and the increased top management top management control influenced these two parts in different ways.

The closer customer interaction and the associated increase in top management control resulted in a focus on deadlines, and in the different projects it was of crucial importance not to miss the deadlines. However, contrary to what might be expected, a simultaneous emphasis on what to deliver did not occur. Instead in the project it was actually possible for the projects to deliver only a part of what they had originally promised to deliver. The trade-off between schedule (i.e. when to deliver) and product specification (i.e. what to deliver) has also been found elsewhere (Karagozoglou & Brown, 1993).

The explanation for the trade-off could be that the projects in the study all came from a high-velocity environment. In these environments, customer needs and technologies change fast (cf. MacCormack & Verganti, 2003), which means it is necessary to have the ability to make changes to the product during a development project. As a consequence, it can be difficult to correctly anticipate from the beginning what the exact product should incorporate.

It was not possible to identify a direct relationship between human competence as a category of slack and the other three categories of slack. One reason could be that the other three categories are to a greater degree related to the product being developed. It is something quite explicit that top management, customers and project members understand. Human competence as a category of slack, on the other hand, is more difficult to grasp especially when it comes to the competence of members. However, needless to say, top management does of course have some influence as to which members can be signed to a project. The importance is, however, to acknowledge that this kind of influence is not the same as top management control as a category of slack in terms as defined above.

In the figure above, nothing is shown about the relationship between customer interaction and the human competence. However, it is important to note that the interaction with a customer in a project group can prevent the Not Invented Here syndrome discussed above. Just as new project members can contribute with fresh ideas and approaches, challenging and improving the scope of existing technologies and methods (Eisenhardt & Tabrizi, 1995; Katz, 1982), so

too can customers. In the present study, however, the exact relation between customer interaction and human competence in a project could not be identified with any certainty. For that reason, the relationship between customer interaction and human competence is not shown in the figure above.

In order to, to some extent, put the above model into words, following the development of the Processor project can be useful as there it is strikingly clear how the categories of slack engage in a dynamic relationship. For instance, at the outset of the project the Processor project had no customer and as a consequence the top management control was loose, which resulted in quite loose project deliverables, which were set by the Processor project themselves. This points in the direction of a high level of slack in the different categories.

However, once a customer was signed to the project, the top management control increased and demands were made on the project to meet the deliverables set by the customer, who also came with detailed specifications on the features of the product. As the Processor project tried to meet the project deliverables it was evident that the project lacked some competencies. As a consequence, the project approached the production council to ask for more members with the right competencies. The top management rejected these demands and the Processor project had to continue without getting the requested help. Thus, slack in the four different categories was reduced.

Eventually the customer cancelled the contract and with that the top management lost interest in the project, i.e. reducing the top management control. Once more the Processor project was able to set its own deadlines, and what to develop (functionality). The human competence was, however, not changed and the Processor project continued to lack sufficient competence in some areas. Accordingly, the project experienced a higher level of slack in all categories except in human competence. What is perhaps most important to note is that the Processor project did not have any continuity in slack, which Judge *et al.* (1997) argues is of utmost importance if a project (or company in the view of Judge *et al.*) is to be innovative over time.



# CHAPTER SEVEN

## **Knowledge Conversion Modes at the Product Development Project Level**

*The present chapter analyses the four modes of knowledge conversion at the product development project level. The analysis is made in two steps: first each project is individually examined, and then a joint analysis of the cases is carried out. It is the second step of the analysis that serves as input to the next chapter where the categories of slack are related to the four modes of knowledge conversion.*

### **Modes of Knowledge Conversion at the Product Development Project Level**

The present chapter examines the four modes of knowledge conversion. The analysis in the chapter is done in two steps. First, an examination of the four modes of knowledge conversion (socialization, externalization, combination, and internalization) is made in each of the six projects. Second, at the end of the chapter a joint analysis of the projects is made, which serves as a starting point for the analysis in the next chapter.

The analysis of the six projects are closely related to the empirical observations; with a focus on critical incidents related to each of the four modes of knowledge conversion. Even though the works by Nonaka and colleagues (Nonaka, 1991, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995) are often referred to in discussions on theories of knowledge, there are surprisingly few studies that actually have made use of the model of knowledge creation to its full extent.

Besides Nonaka *et al.* (1994), who made a first comprehensive test of the theory of knowledge creation, there have been few followers. Among the exceptions are Paulin (2002), and Rynes *et al.* (2001). Thus, the analysis conducted in the

present chapter further advances our knowledge about the knowledge creation process as the process is examined in an environment characterised by high velocity, an environment where the theory of knowledge creation has, so far, not been examined.

## Examining the Four Modes of Knowledge Conversion

In this part of the chapter the four modes of knowledge conversion - socialization, externalization, combination, and internalization - will be discussed in relation to the six cases. In terms of the research framework, the focus in the present chapter is on the right-hand side, as shown in figure 7:1 below. The analysis will show that there is conflicting evidence for the existence of the different modes of knowledge conversion. First, the four modes of knowledge conversion could not be identified in all cases, and second, they occurred at different points in time.

Figure 7:1 ▼  
Research Framework

Organizational slack		Knowledge creation			
Categories of slack at the level of the firm	Explanations at the level of the firm	Socialization	Externalization	Combination	Internalization
Financial	$\Delta\text{Slack} = f\Delta(\text{RE, DP, G\&A, WC/Sales, D/E, CR, I/P, P/E})$				
Product	Is it possible to experiment and introduce new products?				
Customers	Is it possible to address new customers?				
Members	Is there a surplus of employees in the organization?				
Time	Is there time available not fully engaged in the organizations' primary product or service?				
Goals and deadlines	Is there less stringent demands on forecasted milestones?				
Governance and leadership	Is there a lax discipline in selection, ongoing support and termination of projects?				

Table 7:1 ▼  
**Examination of Knowledge Conversion Modes and the Six Projects**

**The six projects**

**Knowledge conversion modes**

	Socialization process	Externalization process	Combination process	Internalization process
The Processor project	Could not be identified.	Could not be identified.	Conflicting evidence.	Conflicting evidence.
The System project	Identified.	Identified.	Identified.	Identified.
The Component project	Could not be identified.	Could not be identified.	Identified.	Conflicting evidence
The Integration project	Conflicting evidence.	Identified.	Conflicting evidence.	Could not be identified.
The Message project	Conflicting evidence.	Identified.	Identified.	Identified.
The Java project	Conflicting evidence.	Conflicting evidence.	Identified.	Identified.

It is important to acknowledge, as was pointed out in the second chapter, that I have not studied whether knowledge *per se* has been transferred from one individual to another. Instead, the focus has been on identifying the existence of the processes that are supposed to lead to each of the four modes of knowledge conversion, based upon the work by Nonaka and others (Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000).

The reason for not studying knowledge is the same as the one given by Nonaka and Takeuchi (1995, p. 235, emphasis in original) who argue that "...knowledge creation fuels innovation, but knowledge *per se* does not". Thus, it is the process in which new knowledge is created that is the cornerstone of the innovative activities in an organization. For that reason the focus is on knowledge creation processes and, in particular, on the conversion of tacit knowledge into explicit knowledge and vice versa, which is the most visible and important conversion according to Nonaka and Takeuchi (1995)<sup>38</sup>.

It should also be noted that the focus has been on the knowledge conversion processes inside the projects, and not on the enabling conditions as these are processes at a higher level (i.e. a higher organizational level) than the project level (c.f. discussion in Nonaka & Takeuchi, 1995, p. 73). Recall also from the discussion in chapter three that the operationalizations of the four modes of knowledge conversion are in particular based upon the work by Nonaka *et al.* (1994), which is also complemented by other work by Nonaka (1994; Nonaka &

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<sup>38</sup> Nonaka and Takeuchi discuss other examples of conversion, e.g. an organizational conversion of bureaucracy and task force into a hypertext structure. This and other conversions are basically at the firm level, i.e. a different unit of analysis to that in the present study. For that reason they will not be discussed further in the analysis in this chapter.

Takeuchi, 1995; von Krogh *et al.*, 2000) – see Appendix 1 for a full review of the different knowledge conversion modes.

**Table 7:2 ▼**  
**Operationalization of Knowledge Conversion Modes**

Socialization process	Externalization process	Combination process	Internalization process
Tacit knowledge accumulation	Use of metaphors	Acquisition and integration	Personal experience
Extra-firm social information collection (wandering outside)	Dialogue in concept creation	Synthesis and processing	Real world knowledge acquisition
Intra-firm social information collection (wandering inside)	Dialogue about concepts and models	Dissemination	Simulation and experimentation
Transfer of tacit knowledge			Virtual world knowledge acquisition

### Socialization: From Tacit to Tacit

Socialization is the acquiring of tacit knowledge without language, but through observation, imitation and practice. The process of socialization occurs when people share their experiences. The sharing of experiences is the key to acquiring tacit knowledge, which includes activities such as sharing tacit knowledge about customer needs, or information about new technologies. The most common way to share experience is through on-the-job training, or by observing others (Nonaka, 1994; Nonaka & Takeuchi, 1995).

Underlying the socialization process is often some sort of mentoring or master-apprentice relationship, where more experienced employees share their experiences with less experienced employees, or novices. In addition to this relationship the novice gains tacit knowledge from direct observations or imitations of a task performed by the more experienced employee.

The analysis of the six projects shows that the socialization process could not be identified in all six projects. The main reason for why the socialization process could not be identified is to a large extent linked to the absence of an experienced “master”. However, the analysis also showed that a project can create the process of socialization without the master-apprentice relationship. This is done as the members jointly try to solve a task which requires members to share experiences, which facilitates the socialization process.

#### **The Processor Project**

In the Processor project the socialization process could not be identified. The main reason for this was that all members of the Processor project had previous experience of developing processor products. In addition, the goal in the

Processor project was to develop a cheaper product, i.e. an incremental product, which further limited the need for the members of the Processor project to engage in sharing of experiences - everybody understood what they were supposed to do, and how they would do it.

Despite the fact that the socialization process could not clearly be identified it is worth noticing some incidents, which to some extent, indicate the presence of a socialization process. However, not to be claimed as evidence of a socialization process since they were neither significant in terms of time or extent.

- The first incident is from the initiation of the project when the group tried to specify and understand what the final version of the product would look like, which shows some resemblance to the experiences in Honda on “brainstorming camps” (Nonaka & Takeuchi, 1995, p. 63). However, as the members had previous experience of the product, the need to engage in experience sharing was not perceived as important by the members and for that reason the meetings did not have the same depth as Hondas brainstorming camps.
- The second incident is in the interaction with the customer signed to the Processor project. The process of socialization inside a product development project is often facilitated by interactions with customers. (Nonaka & Takeuchi, 1995, p. 64). However, contrary to what could be expected, the entry of a customer into the Processor project did not facilitate the socialization process through discussions and the constant sharing of experiences, since the customer came with very detailed and specific specifications on the processor being developed. Thus, the high level of details did not make it possible to experiment with different solutions, which in turn did not lead to a socialization process inside the Processor project.
- The third incident is the development without the customer. Recall that the customer cancelled the contract due to the fact that the Processor project fell short of meeting agreed upon deliveries. This made it necessary for the Processor project to develop a general product that could be offered to many different customers. The change in focus could, or perhaps even should, have forced the Processor project to focus on the socialization process by trying to identify how each project member could contribute with their specific experience to the final product. However, no evidence for such a process can be found. The reason is that the members of the Processor project began working on other projects after the customer cancelled the contract and little time was set aside for trying to share tacit knowledge.

Summary of observations: In the Processor project no socialization process could be identified, even though there were opportunities for the project to engage in a socialization process.

### **The System Project**

In comparison to the Processor project the System project had more elements of a socialization process. In particular, it was possible to identify the master-apprentice relationship. As the pre-study in the System project was concluded, setting the overall frame of the project and identifying what people and competencies to recruit to the project, the project was officially initiated. At the outset of the project it was only the assistant project manager that had knowledge about what the new system product should look like and what it should be able to perform. For that reason it was of crucial importance for the System project that the tacit knowledge of the assistant project manager was shared with the other members of the project.

The sharing of the assistant project manager's experiences was facilitated through conducting practical experiments and by comparing different solutions. Each member of the System project had to develop an implementation proposal on a small part of the system product, a part for which the project member was responsible. As the implementation proposals were being developed by the individual members there were many discussions with the assistant project manager, but also between members of the project who were working on parts which would have an influence on each other

All of these individual implementation proposals were then combined into a comprehensive implementation proposal describing the end product and how the various parts would fit together. Among the members in the project the implementation proposal was referred to as the "bible". The "bible" was then discussed in the whole group, which formed a mutual understanding among the members of the project, and facilitated the socialization process.

The consequence for the members of the System project, of first being experts on a small part, and then having to relate that part to other small parts then understanding the interfaces between them, to finally discussing all the small details as part of a larger whole, seemed to be to increase the overall knowledge among the members of the System project. In particular, the overall understanding of what the system product was supposed to do seemed to have been facilitated by the sharing of experiences. As a result, the knowledge of the assistant project manager was no longer held by a single person, but shared among all members in the System project.

Summary of observations: Much time was set aside initially to create shared experiences among the members, i.e. the socialization process could be identified, which was necessary considering how little previous experience the project members had from developing a system product.

### **The Component Project**

As described in chapter five, the Component project was the result of the fusion of project Alpha and project Beta. The main reason for the fusion was the similarity between the products each project was developing. Due to the fusion of the two projects into a common project it could be expected that a socialization process would be identified, as the members from each of the two projects shared their different experiences to, for instance, create clear task definitions and share mental models in the Component project.

However, contrary to what could be expected, the analysis of the Component project revealed that the process of socialization did not initially occur. Just as in the Processor project, the opportunities given to members to meet and to have informal discussions in order share experiences were not utilized by the members. The result of not having a shared mental model of where the project was heading, and a lack of consensus among the members about the goals in the project, created a split in the Component project and the project members divided themselves into two fractions with little communication and interaction. For historical reasons one part corresponded to the old Alpha project, and the other part the old Beta project. The separation of the Component project was further emphasized by the fact that old members from the Alpha project and the Beta project were located in different cities.

Towards the end of the project, the two project managers in the Component project felt that having the two parts of the project working independently, while at the same time developing one product for the customer, was an untenable situation. The solution was to put an emphasis on the joint execution where project members together tried to solve the task, irrespective of where they were sitting or what project they had previously been part of. In addition to the joint execution, more emphasis was put on creating a sense of a common goal and ensuring that every project member understood what the Component project was developing, which made it possible to acknowledge the work going on in other parts of the project.

Even though these activities, to some extent, brought the two fractions closer to each other, they did not facilitate the socialization process. The activities by themselves did not include the sharing of experiences or show evidence of the master-apprentice relationship. The reasons for the lack of a socialization process are as follows:

- The Component project had to come to a conclusion as soon as possible and for that reason there simply was no time for the sharing of

experiences. The members of the Component project only had to make sure that the different parts of the product would work with each other.

- As there was no master in the project, a master-apprentice relationship was not created, which could otherwise have facilitated the socialization process.

Summary of observations: It was not possible to identify the socialization process in the Component project.

### **The Integration Project**

The decision to initiate the Integration project resulted from the development of an idea from one person (called Tomas in the following). It was decided by the production council to start the Integration project in order to get the product out onto the market. To be able to develop the product it was necessary that Tomas' idea was shared and transferred to the other members in the Integration project. The goal in the Integration project was to use a master-apprentice relationship.

However, before the Integration project and its members had got access to Tomas' knowledge, he left Support Inc. For that reason the members of the Integration project had to jointly try to solve the task. The work in the project of trying to define what the project was doing could be viewed as a sort of socialization process, as the members sat down and discussed the future of the Integration project. For various reasons the project did not make much progress and a group of experts were called in to develop a prototype, which they did, and then left the project.

Once the group of experts had finished their task, they left the project without ever having had much interaction with the original members of the project. Since these experienced experts gave no input to the less experienced members of the Integration project, the socialization process was not facilitated. In addition, there were few incidents in the project when the members of the project actively tried to get input from customers or have contact with the external experts, speaking against the existence of a socialization process in the Integration project. Thus, there is conflicting evidence on the extent to which a socialization process occurred in the Integration project.

Summary of observations: There is conflicting evidence for the identification of a socialization process. The initial discussions in the group, trying to jointly solve the task, indicate a presence of the socialization process. However, there is conflicting evidence as there were no experienced members present, and the project had little input from people outside the project.

### **The Message project**

The Message project was initiated by the top management of Support R&D because they had identified a need to develop the existing products that were offered to the market. In the project the goal was to replace the old message product and create a new product: NBM (New Business Messages). The members recruited to the Message project all had experiences with the old message product.

The initial work in the Message project proceeded smoothly. During the mid-phase of the project there was, however, some confusion. The reason being that the members in the project had difficulties in deciding how to position the new product to the future architecture of enterprise application Communication, and how the Message project could use the message broker the Integration project was developing. Additionally, the members also realized that they did not know the needs and demands of the customer.

To solve these problems the members of the Message project sat down and discussed and evaluated different solutions, which to some extent was a process of sharing experiences among the members in the project. The work of jointly discussing and reaching an agreement on the final product indicates the presence of a socialization process. During this phase the Message project also developed and deepened its relationship with the Integration project to get feedback on the product being developed, i.e. external knowledge and input were actively sought, implying the process of socialization. Yet, on the other hand, no member had previous experience with the NBM product being developed, which implies that the master-apprentice relationship did not exist in the Message project. Thus, there is some contradictory evidence for the presence of the socialization process.

Summary of observations: There is conflicting evidence of the socialization process in the Message project. The attempts to jointly solve the task within the Message project suggest the presence of the socialization process. However, there was a lack of an experienced "master" suggesting that the socialization process did not exist.

### **The Java Project**

The Java project was initiated by the top management, as part of a larger project aiming at implementing Java as the code base in all products offered by Support Inc. The Java project belonged to the HR-group, and the project was one of the last projects at Support Inc. to have Java implemented. As a consequence, the Java project had very tight deadlines in order to finish according to the overall deadlines set at the company for when all products should have Java implemented as a common code base.

The members of the Java project came from the HR-group, a group which not only lacked experience, but also people who could work with the Java project.

For that reason it was decided to bring in people from other parts of Support Inc. who had experience of implementing Java into existing products. Therefore the group of people working with the Java project did not all come from the HR-group.

The work within the Java project was initially perceived as successful, as the group of experts that had been brought into the Java project managed to finish according to the rather strict deadlines. There was, however, not much evidence of the socialization process during the work within the Java project. The reason is that the experts brought into the project prioritized changing the code base as fast as possible, and did not make any attempts to share their experiences with the members who came from the HR-group. It was perceived as being more important to have the Java project finished on time – a goal which was attained as the Java project managed to finish according to the deadlines set by the top management.

However, as the Java project officially finished, the members of the HR-group discovered that the Java project was not as successful as it had first seemed. The reason is that the developed product had many small errors that needed correction. As a consequence, the members of the HR-group had to re-do many parts of the product. The members of the HR-group learned about Java through the testing and re-working of existing solutions. Recall that the process of socialization occurs not only through observation and imitation, but also through practice. Since the members of the HR-group during the re-work clearly had to practice in order to finish the product, it is possible to claim that the process of socialization was present.

But, this is only one small piece of evidence of the socialization process, and comparing the socialization process to what the theory says (Nonaka & Takeuchi, 1995, pp. 62-64), the key is the sharing of experiences. In the re-work of the product there was little evidence of the members actively trying to share their experiences, instead, the members worked on their own small part of the product, trying to get the work done as fast as possible.

Summary of observation: There is conflicting evidence concerning the socialization process in the Java project. Initially there was no sign of the socialization process. But at the end of the project some evidence points towards the existence of such a process.

### Externalization: From Tacit to Explicit

As described in chapter two, the process of articulating tacit knowledge to explicit concepts is called externalization. The externalization process is triggered by a dialogue among members in a project in which metaphors, concepts or models are developed to generate an understanding of what is going to be developed. The output from the externalization process includes specifications

of functionality, manufacturing-process descriptions, or drawings. (Nonaka, 1994; Nonaka & Takeuchi, 1995).

According to Nonaka and colleagues, an underlying prerequisite for the process of externalization, is that the task a project is supposed to perform is ambiguous. In order to solve the ambiguity concerning the concept creation the project and its members need to develop some sort of metaphor so that they can mentally visualize a concept. Examining the six projects for the presence of the externalization process showed conflicting evidence. Some of the projects had a clear process of externalization, while in others the same process was nonexistent. Perhaps the most important reason for why some of the projects in the present study did not have an externalization process is that they did not have the kind of ambiguity described by Nonaka and colleagues.

### **The Processor Project**

The Processor project was to develop an incremental product (recall that the target was to develop a new processor product that was cheaper than its precursor, and should work in various 3G applications). The members in the Processor project all had previous experience of processor products. As a consequence of having an experienced project team, there was little need for members to establish a dialogue concerning the development of a concept or a model, a dialogue which may have been established had the task given to the project been more vague and/or the members less experienced.

Contrary to what might be expected, considering the experience among the members working in the project, the project members did initially have some communication. One project member describes the initial phases:

*In the Processor project there has been a lot of dialogue, in order to reach an agreement on the performance and size of the final product. When that was decided we knew fairly well what we wanted to do. This made it possible to divide the product into smaller building blocks.*

However, these initial discussions did not focus on trying to get an understanding of the product being developed, all members already had that knowledge. Instead these discussions were about the possibility of dividing the product into different building blocks, which made it possible for each project member to work on a smaller part of the product. The consequence of dividing the work was that the process of externalization was not facilitated. The focus for each member became their work, on their "own" part of the product and not on discussing the comprehensive product with other members.

Halfway through the Processor project a customer was signed to the project. Analyzing the effects on the project members of the entry of a customer reveals that they continued to work quite individually. The reason was that the customer came with detailed specifications, which were easily translated to the work of the individual project members. The high level of detail did not

encourage the members of the project to have discussions about the complete product.

Thus, in the Processor project there were few discussions, and the ones held at the beginning of the project did not focus on issues such as creating metaphors, or concepts, which are held as the key issues in the externalization process discussed by Nonaka and colleagues (e.g. Nonaka, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000). For that reason it was not possible to identify the externalization process in the Processor project, which in turn can be a result of the project developing an incremental product, and not a platform product.

Summary of observations: The externalization process was not possible to identify in the Processor project.

### **The System Project**

Within the System project there was more evidence for the existence of the externalization process. As described above, under the socialization process, the knowledge of what the system product should look like and be able to perform, was to a large extent related to the knowledge of the assistant project manager. In order to raise the overall level of knowledge, and to spread the knowledge held by the assistant project manager, an implementation proposal was developed by the members of the System project.

To some extent the socialization process and the externalization process are intertwined. The work with the implementation proposal, on the one hand, aimed at transferring the assistant project manager's tacit knowledge to the other members in the project, whilst on the other hand, the output of the implementation proposal, in terms of specifications of functionality and clear construction drawings, indicates an externalization process (cf. von Krogh *et al.*, 2000, p. 7).

The development of the implementation proposal gave all members a guide and a concept that they could relate to in discussions with other project members. Creating a mutual understanding of the implementation proposal as a new concept, facilitated the development of a language that served both as a way to guide new thoughts, but also to communicate new experiences. These are all examples, and evidence, of the process of externalization.

However, Nonaka and Takeuchi (1995, pp. 64-67) put great emphasis in their description of the process of externalization on the importance of using figurative language, metaphors or analogies, for concept creation. In the System project there was little use of metaphors and analogies, instead the shared understanding among the project members of what a system product should look like and perform, was at a more detailed level in the form of an implementation proposal. Despite these concerns, there is more evidence speaking in favor of the externalization process, than there is counter evidence.

For that reason it is claimed that the externalization process could be identified in the System project.

Summary of observations: It was possible to identify the externalization process in the System project.

### **The Component Project**

The Component project had, as was discussed in the analysis of the socialization process, few meetings and as a consequence few opportunities to have a dialogue concerning what the Component project were actually developing. This resulted in the following:

- First, there was a lack of clear specifications regarding the functionality of the product that the Component project was supposed to develop.
- Second, the development work was to a great extent based upon the previously developed plans in project Alpha and project Beta respectively - and the two previous projects to a large extent continued to co-exist inside the Component project.

Due to the lack of a dialogue among the members of the Component project there is no evidence of an externalization process. At the end of the project the two project managers felt that they had to deliver a product and finish on time. To be able to reach the specified deadlines, the two project managers perceived it as necessary for all project members to work in the same direction, to understand and think of the product as a whole, rather than just the single part that they were working on. To achieve this, the two project managers created a sense of a common goal for the Component project.

However, there were no specific discussions emphasizing metaphors, analogies, concepts or models which are the indicators of the presence of an externalization process. Instead the focus was more to create a sense of urgency in the project, making it necessary for all members to move in a particular direction. Thus, in comparison to what is discussed by Nonaka and Takeuchi (1995, pp. 64-67), the externalization process was not present in the Component project.

Summary of observations: The externalization process could not be identified within the Component project.

### **The Integration Project**

It was possible to identify two examples of the externalization process in the Integration project. First, at the outset of the Integration project during the initial discussions, and second, in the discussion when the Integration project entered into a partnership with the Message project.

The first example is from when the Integration project was initiated. During this phase of the Integration project there were four project members who tried to

understand what the instruction, “do something with standards”, from the top management actually meant. By engaging in a dialogue around the rather vague task the project group was able to specify the project at a more detailed level. They agreed that the Integration product they would build should have something to do with B2B. Having defined the overall frame for the project, the discussions continued in the Integration project and the group came to the conclusion that B2B for the Integration project had two dimensions: first, technology, and second, layout and structure. The technology dimension was concerned with how the problems of data handling should be solved, i.e. communication integration. The layout and structure dimension was concerned with how invoices from different enterprise application systems could be integrated.

These discussions, however, did not lead the project forward and it was necessary to call in a group of experts who could actually work with developing a prototype. These experts managed to define an overall goal and structure as well as develop a prototype in a short period of time. But the project still did not make as much progress as the top management expected and wanted, despite the fact that an overall goal existed, the structure was set, and a prototype had been developed. As a consequence, it was decided to initiate a partnership between the Integration project and the Message project, which corresponds to the second critical incident.

The second example of the externalization process occurred as the partnership between the Integration project and the Message project was initiated. Initially the two projects had difficulties understanding each other. They did not share the same values or ideas, due to their having different origins in the organization. In order to overcome this barrier the two projects developed a common language. A “baby language” that everyone could understand, regardless of project origin. The development of a shared language that allowed everybody to understand each other facilitated the future work between the two projects. The baby language not only made it possible for the two projects to understand the needs of the other project, but also reduced the prestige as it was OK to ask “stupid” questions.

At Support Inc. there were few projects from different divisions that worked together, but by using a figurative baby language it was possible for the two projects to bridge the different business logics that existed in the Research and the Development division respectively. The development of a baby language corresponds to the externalization process where it is emphasised that the externalization process is triggered by dialogue or collective reflection around a concept.

Summary of observations: It was possible to identify two examples of the externalization process. First, during the initial project definition. Second, in the fusion between the Integration and the Message project.

### **The Message project**

The Message project was initiated by the top management who had a rather vague idea about developing a product that could improve the input and output coming from enterprise application Communication. It was decided that the Inter Operability Management Group (IOM-group) would develop the product, and so the Message project was initiated.

To be able to understand what type of product the Message project was supposed to develop, the three project leaders for the project met frequently to discuss the concept. The discussions held in the Message project closely resembled the externalization process, where a vague concept was given from a level above the project. The project then had to use a good deal of imagination to try and come down to a more concrete and specific level, from which it was actually possible to develop a product.

From these discussions it was decided that the Message project would focus on developing a product that: (1) collects and sends the right data from the overall enterprise system, and (2) makes sure that such data can be collected. Once the project managers had agreed upon these two rather vague criteria, they discovered that it was actually not one project, but two projects that would have to develop these two products. This triggered the fusion with the Integration project described above. The Integration project would develop the first product: a product that collects and sends the right data from enterprise application Communication. In the Message project the focus would be on the second part, i.e. developing a product that made sure such data could be collected.

The closeness in the development of the Integration project and the Message project thus forced the two projects to work with each other. And as described above, the different origins of the two projects in the organization made it necessary for the projects to develop a “baby language” in order to understand each other, which enabled the externalization process.

Summary of observations: Within the Message project the externalization process first occurred between the three project managers as they tried to specify what the product would do. Second, between the members of the Message project and the Integration project.

### **The Java Project**

The process of externalization within the Java project is difficult to identify. Recall that a group of experts implemented Java as a code base in the existing products within the HR-group because the HR-group lacked not only people

that could handle the Java project, but also knowledge about Java. However, the product that the group of experts developed was not correct, as it contained many small errors that the members of the HR-group had to correct.

During the work of correcting the mistakes made in the original Java project, the members of the HR-group had a constant dialogue about the product already developed and the changes that were needed. The members of the HR-group made the necessary changes and developed new specifications of functionality and descriptions of the product.

The development of output in terms of descriptions and specifications of functionality is pointed out by von Krogh *et al.* (2000, p. 7) as an example of the externalization process. However, Nonaka and Takeuchi (1995, p. 64-67) emphasize the process of externalization as being triggered by a dialogue among the members in a project in which metaphors, concepts or models are developed to generate an understanding of what is going to be developed. Taking the view of Nonaka and Takeuchi, the process of externalization could not be identified. Thus, there seems to be conflicting evidence as to whether or not the externalization process was present in the Java project. It depends on how "rigid" an interpretation is being made, which clearly differs from whether one leans towards Von Krogh *et al.* (2000) or Nonaka and Takeuchi (1995).

Summary of observations: There is conflicting evidence as to whether or not the externalization process occurred in the Java project.

### Combination: From Explicit to Explicit

In chapter two the combination process was described as the process of combining different kinds of explicit knowledge, such as documents, e-mail, meetings or the use of Intranets. Through adding, sorting and recategorizing explicit knowledge, new knowledge is developed. The output from the process of combination is something tangible or concrete, i.e. an archetype (Nonaka, 1994; Nonaka & Takeuchi, 1995). In product development the archetype is often a prototype (Nonaka & Takeuchi, 1995, p. 87). Analysis revealed that it was in the process of combination where the results between the six projects diverged least. There are different reasons for this finding.

- One explanation is that the process of combination is the process which is most easy to engage in for members of the project. For instance, it is easy to have a discussion on an existing blueprint where different members of the project can come with input.
- Another reason is that in both Communication Supplier and Support Inc. the top management who governed the projects emphasized that the project presented their respective developments in the form of written material and through PowerPoint presentations.

## **The Processor Project**

Within the Processor project the work with developing a prototype was initially a smooth process. The main reasons for why the Processor project had a smooth development process were first, due to the lack of a customer, and second, the loose governance of the project from the top management, who perceived it as important that the project worked independently at the outset. During the initial phase of the Processor project there were possibilities to discuss the new product based on previous experiences from each member in the project. There were both formal project meetings in the project, as well as informal meetings.

- The informal meetings were perceived as important and were facilitated by the close proximity between project members. In addition the laboratory at Communication Supplier served as a meeting point for the members in the project in which it was easy to discuss the prototype.
- The formal meetings were held to make sure that everyone was kept on track and developing building blocks that would match with other building blocks to make up a final product. The project also had project meetings, during which the project manager not only informed the members of the status of the project, but also determined whether different people could help each other and take on each others roles and tasks, in order to make sure that the project did not fall behind schedule.

Based upon the formal and informal discussions and the project meetings, the characteristics and performance of the new processor was decided. It was also decided that the new product should be shown to a sample of potential customers to see their preliminary reactions on the design, but also to check out the market and hopefully get a customer interested in the product.

However, before the new processor was developed fully enough to be shown to a sample of customers a single customer was signed to the project. The customer paid little attention to the ideas in the project and came instead with very detailed specifications on what features the product should have and what it should look like. From the perspective of examining the process of combination, the entry of a customer did not facilitate this process. The high level of specifications made the Processor project look more like an executor instead of being a discussion partner. The lack of a discussion with the customer is also evident as there were very many points where knowledge could be exchanged, but was not. Nonaka and Takeuchi (1995, p. 67) stress that the process of combination is facilitated by exchange of documents, meetings, or telephone conversations.

As has been explained previously, the customer decided to cancel the contract. The work within the Processor project once again focused on the development of a prototype that could be shown to a sample of potential customers. In comparison to the early phases of the Processor project, the process of

combination did not occur to any great extent this time, which was particularly evident in the lack of discussions (both formal and informal) among the members of the Processor project. One reason was that some of the project members left to work with other projects, and did not have time to engage in discussions concerning the development of the Processor project. In addition the moral was quite low in the project as a result of not getting a product out onto the market. For that reason, the members of the project just wanted to get the changes done to the processor product in order to have a product that could be shown to the customer. Therefore, there was not a great deal of discussion within the project, indicating a low level of the combination process.

Summary of observations: Within the Processor project there was initial evidence of the presence of the process of combination. However, as a customer entered the project the process of combination seems to have been hampered.

### **The System Project**

The System project had many discussions and meetings, both formal and informal, on numerous occasions, indicating the presence of the combination process. In particular the combination process was easy to identify during the initial phases of the System project.

One reason for the many discussions and meetings was the fact that the project did not sit in the same physical premises as the rest of Communication Supplier. Instead the System project was located at the end of a corridor next to a laboratory in another building belonging to another division at Communication Ltd. This was positive for the project group.

- First, because the project members did not have to answer questions from previous projects they had been part of.
- Second, it was more difficult to be transferred to other projects at Communication Supplier. A project member of the System project was a project member fulltime.
- Third, due to the closeness among the members it was easy to just walk into the next room and ask a question. It was also easy to hear what was going on as the members ran into each other all the time. The positive experience of closeness and a high level of communication is not something unique, but has been showed in other studies (Allen, 1977).

As the work with the individual implementation proposal proceeded into being a comprehensive implementation proposal (the bible), describing what the final product would look like and what features it should contain, the second stage in the development of a prototype could be initiated. In the work on the prototype the goal of the System project was to develop a product that could be shown to potential customers. It was perceived as important to sign a customer as soon as possible in order to get specific and detailed input on the prototype. This

implies that the System project had little interest in only getting preliminary reactions to the design or just checking out the market, which is recommended in the literature (von Krogh *et al.*, 2000, p. 90). For that reason there were few objectives in the System project of creating the process of combination at this stage of the development process. It was more important to get the product out on the market.

Another reason for why the process of combination was hampered during the final phases of the development process was that the System project had to move into the same facility used by the rest of Communication Supplier. This caused a reduced focus among the members in the project as soon after the move they became involved in other projects, which competed for their attention.

Summary of observations: It is easy to find evidence for the existence of the process of combination in the initial phases of the System project, however, over time, less emphasis and evidence can be found of the combination process.

### **The Component Project**

In the Component project the most obvious evidence of the combination process can be found during the work with the code base. The Component project used the code base as a way of adding, sorting and recategorizing the explicit knowledge within the project. The constant work and re-work with the code resulted in the project moving from one prototype to the next, i.e. moving from the delivery of the first beta version through to a beta version 4, and eventually from this fourth and final beta version the Component project could develop a new product.

In comparison to the other projects in the study there were not many meetings in the Component project, which would suggest that the combination process was not in evidence. However, it seems as if the constant work and re-work with the code base to some extent reduced the need for having formal meetings.

Another facilitator of the combination project was the input given from the pilot customer that the Component project managed to sign. The customer came with suggestions and input to the future development work within the Component project, which to some extent seemed to reduce the need for targeting a large sample of customers in order to get their reactions on the product, something which is often claimed to facilitate the process of combination (von Krogh *et al.*, 2000).

Summary of observations: The combination process was present in the component project. However, it was not in terms of meetings, but in terms of written material. The close contact with the pilot customer, to some extent, worked as a substitute for getting input from a sample of customers.

### **The Integration Project**

Once the Integration project had taken the first step of turning the vague vision given by the top management into the more concrete B2B concept (i.e. the externalization process), the next step was to develop a prototype. The importance of developing a prototype was stressed by the product manager who saw that not all members of the project understood what the B2B concept implied. To raise the overall understanding in the project it was perceived as necessary to develop a prototype, which is something more concrete to on which to base future discussions amongst project members. For that reason the process of combination was important as it was a process in which the output became something tangible or concrete (Nonaka, 1994; Nonaka & Takeuchi, 1995).

The Integration project did, however, not make great progress in developing a prototype and after six months without any significant development in the project, the project manager decided to bring in top competence. As a consequence, a group of experts were called in to work with the project, and in particular to develop a prototype that could guide the future work in the project. Three months later the group of experts had developed a prototype. With the existence of a prototype it became easier for the members of the Integration project to identify what they had to do in order to get the product out on the market.

Thus, with the prototype the process of combination was facilitated. It became easier for the members of the project to discuss the progress of the project, not only through meetings, but also during the development of documents describing the product, i.e. the combination of different kinds of explicit knowledge which in turn develops new knowledge. When the prototype had been developed the Integration project managed to sign a pilot customer. The customer gave input on the design and the functionality of the product, which facilitated the combination process.

Summary of observations: The combination process could be identified and was facilitated once the prototype had been developed. At that point in time it became easier for the members of the Integration project to engage in the combination process. The prototype was also shown to a customer and the project received input on the design, which further facilitated the combination process.

### **The Message Project**

After the Message project had gone through the initial phases, defining what they were going to do, the focus turned towards developing a beta product that could be implemented into a pilot customer's enterprise application system. In January 2001, nine months after the start of the Message project, a solution was implemented in a pilot customer's enterprise application system. The implementation of the beta project made it necessary for the project group to

clearly specify the different parts of the product, but also to document the product and its various parts. The work with the documentation of the product is one example of the combination process.

Another incident where the process of combination could be identified was in April 2002. At that point in time there was confusion among the members of the project as to which direction the project should continue in and what should be the focus in the development process. To solve the confusion in the project, the whole project group sat down and discussed and evaluated different solutions from the perspective of the customer. In particular, the project focused on the explicit features in the product that were visible and easy to communicate to the customer. The explicit knowledge of members was used to create an attractive product. This process is, thus, similar to the combination process.

Summary of observations: The combination process occurred twice in the Message project: first, during the implementation of the product at the pilot customer, and second, during discussions among the members of the project team.

### **The Java Project**

In the Java project elements of the process of combination could be identified on two occasions.

- The first occurrence was when the group of experts called in to change the product belonging to the HR-group needed to understand what type of products the HR-group was offering. In order to learn about and understand these products the group of experts reviewed the previous code base of these products, as well as various documents. This generated an understanding of what the experts were supposed to do. In other words; by examining previous explicit knowledge the group of experts understood their task, which is similar to the combination process where different kinds of explicit knowledge is combined, and through that process new knowledge is created (Nonaka & Takeuchi, 1995).
- The second occasion where it was possible to identify the combination process occurred as the group of experts finished their work and the Java project was officially finished. At this point in time the members of the HR-group discovered that there were some flaws in the product that the group of experts had developed. Therefore, the members of the HR-group had to re-do parts of the product. The detection of the errors was facilitated by the inspection of the Java code base and the documentation concerning the Java project, i.e. the process of combination.

Summary of observations: The process of combination first occurred when the group of experts had to understand the products within the HR-group. It occurred once more as the members of the HR-group had to make corrections to the product developed by the group of experts.

## Internalization: From Explicit to Tacit

The fourth mode of knowledge conversion is internalization, which is the process of embodying explicit knowledge into tacit knowledge. Internalization occurs as different members share mental models and technical know-how, it is a process closely related to “learning by doing”. New knowledge is created when individual tacit knowledge is enriched with new ideas and insights. The use of documents or manuals in the internalization process is important (Nonaka, 1994; Nonaka & Takeuchi, 1995).

### **The Processor Project**

Some evidence of the internalization process can be found in the initial work of the Processor project. During the initial phase there were a lot of discussions to develop a common understanding of what the processor product was supposed to do. This made it possible to later on divide the product into smaller parts, so that each individual project member could work with a separate part. It is important to note that the members of the Processor project all had previous experience with previous processor products and for that reason the process of internalization did not focus on “learning by doing”, but as has been emphasized, on making the members of the project share a mental model of what the end product should look like, and what features it should have.

The initial discussions made it possible to divide the processor product into smaller parts, where each member could work on a small part of the product. The project manager realized that this way of working was not without risk. Having each project member working on a small part of the product, could result in a difficulties understanding interfaces between different parts, but also in understanding the end product.

To make sure everyone was kept on track and developing building blocks that would match with other building blocks, to make up the final product, project meetings were initiated in which the overall concept was discussed. During these meetings the project manager not only kept members informed about the status of the project, but also determined whether there was a need for members to help each other and take on other roles and tasks, in order to make sure that the project did not fall behind schedule. These meetings, thus, to some extent resembled the internalization process as the members during these meetings discussed how to develop the end product, i.e. making sure everyone understood and shared the same understanding and mental model.

Little has so far been said about the entry of the customer. As has been emphasized previously in the analysis the customer came with very specific demands, and just as in the other three knowledge conversion modes, the internalization process was not facilitated by the entry of a customer. And when the customer decided to quit working with the Processor project, there were few incidents indicating the internalization process.

Summary of observations: Some elements of the internalization process could be identified initially in the Processor project, over time; however, there were few examples.

### **The System Project**

Before the System project was officially initiated discussions had been going on for few years at Communication Supplier. The result of these early discussions was a description of the principal features and the techniques to use in the system product. This was valuable as these documents served as a starting point for helping the project members to turn explicit knowledge into tacit knowledge and form a shared mental model of what the system product should be able to perform. The initial understanding among the members was useful in the development of the implementation proposal.

In the System project, the work with the implementation proposal is a good example of the process of internalization. By working on the implementation proposition the members in the System project had to work closely together. Each of the individual building blocks that the single project members were developing had to fit with the rest of the building blocks. Therefore there was a great deal of "learning by doing" in the project during this initial phase. Based upon these experiences the members in the project developed a technical know-how about the system product. As the work with the implementation proposal finished, it was not possible to identify evidence of the internalization process.

Summary of observations: The internalization process was identified in the System project in particular during the development of the implementation proposal.

### **The Component Project**

It is difficult to assess the extent to which the internalization process was present in the Component project as evidence points in different directions. In favour of the internalization process is the fact that the members in the project shared a technical know-how, and that the less experienced members in the project learnt by doing. As one product manager said:

*When new members entered the project they had to sit down and check all codes that had been developed. In addition they also walked around and asked other members of the project.*

Evidence that speaks against the internalization process is the general lack of documentation or manuals in the Component project. These are seen as an important tool to facilitate the internalization process (Nonaka & Takeuchi, 1995, pp. 69-70), even though one could argue that the code base can facilitate the internalization process. Many members in the Component project also worked on small parts, without having an overall understanding of what the project was developing. This lack of a comprehensive understanding can make it difficult to put ones own experiences and knowledge into a wider context.

Summary of observations: There is contradictory evidence on the presence of the internalization process within the Component project.

### **The Integration Project**

The process of internalization where project members embody explicit knowledge into tacit knowledge, "learning by doing", could not be identified in the Integration project. Nonaka and Takeuchi (1995, pp. 69-70) describe the need for individuals to socialize, it also helps if there are documents or manuals present.

Within the Integration project there were few documents available describing the product which the project was supposed to develop. It was not until the work with the prototype, made by the group of experts, was finished that the members of the project had a clear idea of what the project was doing on a more detailed level. However, as there was little learning by doing, in which the members of the Integration project watched the group of experts, the internalization process could not be identified at this stage of the development process.

Another incident speaking against the existence of the internalization process is the fact that the members of the Integration had different backgrounds. This lead to a lack of discussions between the developers and the marketing people in the Integration project. The product manager expressed it as:

*An isolation between market and development. The developers wanted a "perfect" product, while the marketing people wanted a product they could deliver. The developers did too much and the marketing side could not deliver according to specifications.*

Thus, the lack of discussions is contrary to how Nonaka and Takeuchi (1995, pp. 69-70) describe the internalization process, as they emphasise the need for individuals to meet and socialize. In the Integration project there were few examples of people meeting and socializing. Nonaka and Takeuchi also discuss the process of internalization being facilitated through documents or manuals. In the Integration project there was, however, not much documentation. For these reasons it was not possible to identify the process of internalization.

Summary of observations: The internalization process could not be identified in the Integration project.

## **The Message Project**

The internalization process in the Message project was most apparent after the project had developed the beta prototype. At that point in time the members in the project realized that they were not sure of what type of solution to continue to develop. In order to obtain a shared view of the selected solution in the whole project group, many meetings were held in the Message project with the focus being to create a shared idea among the members of where the project was heading. In particular an ambiguity about the future was evident in two respects:

- First, the relationship to the Integration project was perceived as unclear and difficult to handle.
- Second, the project group discovered that they did not understand the needs and demands of the customer.

The Message project took the following steps in trying to reduce the ambiguity. First, the interaction with the Integration project was increased and formalized. One example of this work was that the Message project began to send different kinds of solutions to the Integration project for revision and feedback. The possibility to get feedback on the work helped the group to understand what they were doing, and whether they were doing things right. The possibility to have concrete feedback helped the Message project group and its members to learn about what worked and did not work, which in turn facilitated the internalization process.

As the Message project proceeded and became more focused, the second step was to sign a pilot customer to the project, which was done in the autumn of 2001. In the interaction with the customer the members of the Message project had the possibility to get feedback on what worked or did not work in the product, which gave the members new insights and ideas concerning the final product. The input also served as an important mechanism for forming an overall understanding among the members of the Message project, and for that reason it is possible to claim that the process of internalization was present during this stage of the development process.

Summary of observations: The internalization process could be identified and was facilitated in the interaction with the Integration project and in the interaction with the pilot customer.
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## **The Java Project**

The process of internalization within the Java project occurred to some extent after the project was officially finished. The reason is that the group of experts who had been working with the Java project had not managed to develop an error-free product, and as a result the product contained many small errors that the members of the HR-group had to correct. As the members of the HR-group worked with correcting these errors they had a constant dialogue around the

product that was already developed and how that needed correcting. The dialogue was important as it made the members within the HR-group share the same mental models of what they were developing.

Since the members of the HR-group had little or no experience of working with Java there was also a considerable amount of “learning by doing” during this stage of the project. All members helped each other in order to develop a correct product without errors. It is also important to note that the process of internalization was further facilitated by the existence of a code base that the project could work against. This code base also made it easier for the members of the HR-group to understand and share mental models and technical know-how.

Summary of observations: The internalization process could be identified after the official conclusion of the Java project as the HR-group was working with correcting the errors still remained.

## Overall Observations of the Four Modes of Knowledge Conversion

Summarized below are the four modes of knowledge conversion. Basically it is this that will serve as input in the next chapter, when the final step of the analysis is taken and organizational slack and knowledge creation are linked to each other. Recall the table given at the outset of the chapter where I introduced the examination of the four modes of knowledge conversion modes.

**Table 7:3** ▼  
**Examination of Knowledge Conversion Modes and the Six Projects**

The six projects	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
The Processor project	Could not be identified.	Could not be identified.	Conflicting evidence.	Conflicting evidence.
The System project	Identified.	Identified.	Identified.	Identified.
The Component project	Could not be identified.	Could not be identified.	Identified.	Conflicting evidence
The Integration project	Conflicting evidence.	Identified.	Conflicting evidence.	Could not be identified.
The Message project	Conflicting evidence.	Identified.	Identified.	Identified.
The Java project	Conflicting evidence.	Conflicting evidence.	Identified.	Identified.
<b>Summary of findings</b>	There is conflicting evidence in the cases concerning the socialization process.	There is conflicting evidence in the cases concerning the externalization process.	The combination process could be identified in almost all cases.	There is conflicting evidence in the cases concerning the internalization process.

As should be evident from the analysis in this chapter, trying to “fit” the findings in the present study into the work by Nonaka and his colleagues<sup>38</sup> (Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000), was difficult. On more than one occasion it was difficult to assess the findings of this study in terms of the knowledge conversion modes. Below I have summarized the findings, and there is also a discussion about the weaknesses with the knowledge creation model developed by Nonaka and colleagues.

## Socialization – Summary of Findings

Examining the six projects in the study there are contradictory results as to whether or not the process of socialization was possible to identify, ranging from the System project, in which it was easy to identify the socialization process, to the Processor and the Component project, where such a process could not be identified. The main reason for why the socialization process could be identified can be traced to:

- Whether or not the projects were developing a platform or a derivative product and to some extent whether or not there existed some sort of master-apprentice relationship in the projects.

The socialization process was most apparent in the System project which was a platform project. For that reason it was necessary for the members to share their tacit knowledge in order to understand what the project was doing and what the end product would look like. The process of socialization was facilitated as the knowledge of the assistant project manager – who was the only one knowledgeable about what the end result would be – was shared with the members of the project during development of the implementation proposal. In the work with the implementation proposal the members of the group had to work (through a trial-and-error process) with other members of the project making sure the interfaces between different parts worked properly. Not only that, the members also, through the work with the implementation proposal, got a more complete understanding of the end product, in particular as each implementation proposal was combined into the final, comprehensive, implementation proposal.

The process of socialization was, however, not as easy to identify in the other three platform projects, as it was in the System project. The main reason was that in these three projects there did not exist such an obvious experienced member as the assistant project manager in the System project, from whom the other members in the System project could learn from. For that reason it was more difficult to identify the socialization process. Yet in these projects there

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<sup>38</sup> In the following part of the chapter when a reference is made to “Nonaka and colleagues” it is these four works (Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000) that are referred to.

was evidence of the socialization process as the members of the projects tried to share their tacit knowledge by jointly trying to solve the task at hand. They did this, for instance, by agreeing upon common definitions (von Krogh *et al.*, 2000), since they had no or only limited experience of the product they were supposed to develop and there was a need to make everybody move in the same direction.

In the Processor project and the Java project, the two derivative projects, it was not possible to identify the process of socialization with any certainty. The main reason is that in both projects the members had previous experience with the product being developed. In the Processor project the members had worked with precursor processor products, and in the Java project the group of experts called in had all had previous experience of implementing Java. As the group of experts left the Java project they did so without sharing their knowledge with the members of the HR-group. For that reason the members of the HR-group had to correct the remaining errors in the product through a trial-and-error process.

According to the theory of knowledge creation (Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000) there is an implicit assumption that the process of socialization is always present in the creation of knowledge, and it is easy to get the impression that the socialization process is easy to identify. However, the findings of the present study contradict the findings by Nonaka and colleagues, as it appears as if the process of socialization may, but need not always be present. The main reason for claiming that the process of socialization may, but need not always be present is that:

- In projects developing derivative products it is likely that the process of socialization has occurred at some previous point in time. For that reason the socialization process becomes redundant in derivative projects. This is something the literature, so far, has not yet acknowledged. This is not to say that the process of socialization is unimportant, on the contrary, it is a necessary process for knowledge creation. But to solely focus on a single project and its given start and end is not enough, it is also necessary to consider the history prior to the initiation of the project.

The Processor project is a good example as the members of the project were knowledgeable about what they were supposed to develop. Knowledge which had been acquired in the development of precursor products. Comparing the Processor project to the projects discussed in the literature as examples of the socialization process (Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000), the difference is that the examples in the literature focus on platform projects, in which it is easy to identify the socialization process.

The main argument put forward in this thesis, is that the socialization process is redundant in the development of a derivative project as the process has occurred at a previous point in time. For that reason it may seem like a contradiction to

say that the Processor project, being a derivative project, and the Component project, being a platform project are both examples of when the socialization process could not be identified. According to the discussion above it should be possible to identify the socialization process in the Component project. Thus, there seems to be other factors that influence whether or not a project has a socialization process, which cannot be attributed to whether it is a derivative or a platform project.

## Externalization – Summary of Findings

The analysis of the cases reveals that there are conflicting results concerning the externalization process. In the System project, the Integration project and the Message project it was possible to identify the externalization process, however in the Processor project and the Component project it was not. The most important reason for why there was a difference between the cases, i.e. conflicting results, is:

- The role of ambiguity. The ambiguity in the projects came from the vagueness in the description of the projects given by the top management who initiated the projects.

In the three projects where it was possible to identify the externalization process all had one characteristic in common; initially there was ambiguity concerning the task to perform given by the top management. The way the three projects handled this ambiguity, however, differs to some extent.

- The System project had a thoroughly-done preparation study which had been conducted and concluded prior to the initiation of the project. The ambiguity in the project came from a lack of knowledge among the members of the project. In order to raise the overall knowledge in the project it was necessary to disseminate the knowledge of the assistant project manager, as that was the only person who had a clear idea and understanding of what the end result would look like. For that reason it was decided to develop individual implementation proposals, which later on were combined into a comprehensive implementation proposal. This served two purposes:
  - First, the implementation proposals became a guide and a concept which could be discussed with other members of the project.
  - Second, the implementation proposal also guided new thoughts and made it possible to communicate new experiences, as everyone in the project had a mutual understanding of the implementation proposal.
- The Integration project and the Message project are similar as the ambiguity in the two projects was the result of a vague concept given to them from the top management. In the Integration project, for instance,

the task given to the project was, “do something with standards”, to solve this ambiguity the members of the project had to sit down, discuss and understand what the concept actually meant. Later on when there was a partnership between the Integration and the Message project the two projects had to understand each other and the different needs in each project. The solution was to develop a figurative baby language, which bridged different business languages and made collective reflection possible. These two examples highlight the following important point:

- As concepts are developed the use of figurative language and imagination is the key to bring out the tacit knowledge of the project members (Nonaka & Takeuchi, 1995, p. 66)

In the other three projects the externalization process was not possible to identify. In the Java project and the Processor project the main reason was that the two projects were derivative projects, and as a consequence they were not surrounded with the same ambiguity as the three projects described above. The Component project was, on the other hand, a platform project, but still the externalization process could not be identified. The main reason was that the work in the Component project was divided into two parallel tracks – one being the old Alpha project, the other being the Beta project. As the present study has only been concerned with the Component project, and not the two prior projects, it is possible that the externalization process did occur previously in the Alpha and the Beta project respectively.

Nonaka and colleagues (1994, p. 19; 1995, p. 62) claim that the process of externalization is often neglected in studies on knowledge, whereas the other three modes of knowledge conversion are all discussed in the light of different perspectives of organizational theory. Thus, the development of the concept of externalization is viewed as a key contribution by Nonaka and his colleagues, and they try to extend the analysis by giving actual examples of the process of externalization. Comparing the findings of the present study to the discussions by Nonaka to some extent confirms their results, but not in all cases. For that reason it is important to acknowledge that more can be done with their work.

Despite being a cornerstone in the theory of knowledge creation, the externalization process can be developed further in comparison to the original work by Nonaka (1994; Nonaka & Takeuchi, 1995). In particular the fact that the externalization process is dedicated to the development of breakthrough thoughts, i.e. platform projects, is sparsely commented upon. In recent work (von Krogh *et al.*, 2000) there has been some advancement of the theory concerning the externalization process as a process which applies solely to creative work, and not to routine work.

The fact that the process of externalization seems to be applicable on platform projects, but not on derivative projects, to some extent explains the findings of

the present study, as the three projects where the externalization process could be identified were all platform projects, while in the two derivative projects, no such process could be identified.

However, to divide the projects based solely on whether or not they were a derivative or a platform project does not give an explanation as to why it was not possible to identify the externalization process in the Component project. One additional reason seems to come from the ambiguity of the task at hand in the project. In the Component project the two prior projects (Alpha and Beta) continued to work as two independent units under the same umbrella. The result of the two projects not working as a unified project implies that the risk of having an ambiguous task in the Component project was reduced as all members knew what they needed to do. Thus, besides focusing on the type of project (platform vs. derivative) it also seems necessary to take into consideration the history of the projects in analyzing the externalization process.

### **Combination – Summary of Findings**

The output from the combination process often entails the building of a prototype, with the underlying premise that the process is a kind of self-regulating phase in which the members of a project assemble things which are to hand, through media such as documents, meetings, or telephone conversations, to name a few, without losing track of the original concept developed in the externalization process. The analysis of the combination process across the cases shows the most unanimous picture as it was possible to identify elements of the combination process in all projects. In particular there were two reasons for the unanimous picture:

- First, the combination process is the process which is easiest for members of project to engage in.
- Second, at both Communication Supplier and Support Inc. there was an emphasis from the top management who governed the projects, that the progress of the projects should be presented as written material and PowerPoint presentations.

Thus, the reasons as to why there was unanimity among the projects were that the members of the projects were focusing on a tangible input, and converting it to a tangible output. In the projects targeting a customer (the one exception being the Java project) there were also attempts to get input from customers on the product. Either by showing a physical prototype, as was the case at Communication Supplier, or by implementing a solution into an existing enterprise application system, as done at Support Inc. The feedback from the customers was often perceived as valuable as it directed the future work of the project. In the Processor project the feedback from the customer, however, was not beneficial from the view of the combination process. The feedback had too

much detail and the members of the Processor project became executors, and not partners.

As has already been discussed, the prototypes developed by Support Inc. were different beta versions that the company developed. In the literature by Nonaka and colleagues all examples are taken from industries developing physical prototypes and not from the software industry with somewhat different business logic.

Comparing the projects in each company reveals that in Support Inc. the use of the code base as a facilitator of the combination process occurred frequently. For instance, in the Java project the group of experts first learned about the products offered from the HR-group by studying the code base, but also of course through various documents accompanying the products. When the group of experts had finished their work the members of the HR-group discovered that there were some flaws in the product. To be able to repair these damages the HR-group studied the new code base and the documentation from the Java project.

The use of the code base was perhaps even more evident in the Component project which became an umbrella project as the Alpha and the Beta project continued to work as two independent projects with a similar code base. Thus, in the Component project the process of combination was facilitated as the members of the project recategorized, added and sorted the code base. The constant reworks of the code base made the Component project move forward, and enable it to offer different beta versions.

In the theory of knowledge creation there are now discussions concerning whether it is possible that a particular knowledge conversion mode re-occurs over time. In the literature on the development of software products it is, however, pointed out that a software company often releases several beta versions before the final product is ready for the market (see for instance Cusumano & Selby, 1995; Iansiti, 1995; Iansiti & MacCormack, 1997). Developing different beta versions includes rework, i.e. recategorizing, adding and sorting, the code base, which in turn corresponds to the combination process. Thus, for the projects at Support Inc. it would, at least theoretically, be possible to observe the combination process, in terms of building prototypes, more than once.

Examining the projects at Support Inc. shows that it was indeed fairly easy to identify the process of combination in the four projects. It was only the Integration project that did not have an easily identifiable process. According to Nonaka *et al.* (1994) one part of the combination process is the acquisition and integration of external existing data by using published literature. Extending their thinking to include ideas developed by outsiders, manifested in prototypes or descriptions, it is evident that the process of combination also occurred in the

Integration project. The project had to take in a group of experts from other parts of the Research Division at Support Inc. to develop the prototype, i.e. a first beta version.

From the analysis of the six projects it may seem as if the combination process is always present in product development projects. There may be two reasons for why the process of combination was possible to identify.

- First, as Nonaka and Takeuchi (1995, p. 8-11) point out, it is possible that identifying the combination process was as a result of the context in which the present study has been conducted. Nonaka and Takeuchi argue that in the traditions of Western management, knowledge has always been viewed as something formal and systematic, which may be reflected in the projects that the present study examined. To answer the question of whether the process of combination is always present it is necessary to discuss the cultural context in which the projects were conducted. Making such a study is, however, a different theme and a different study and not the focus in the present study. As a result the question remains unanswered.
- Another explanation may be that the combination process in some way was positively influenced by the categories of slack, but prior to being able to answer that question the fourth, and final, mode of knowledge conversion – internalization – will be discussed.

### Internalization – Summary of Findings

The examination of the internalization process reveals that, once more, there are conflicting results concerning the findings in the study. There was one main reason for why it was possible to identify the internalization process.

- The cases where it was possible to identify the process of internalization had developed clear documents and manuals as the work in the project proceeded. Having the documents and manuals present facilitated the process of internalization as it became easier for the members of the project to share visions and values with fellow members.

The internalization process could be identified in three projects; the System project, the Message project, and the Java project. It is interesting to note that the reasons for why it was possible to identify the internalization process differed.

- In the System project, where the internalization process was identifiable, the process was facilitated by the work with the implementation proposal which gave members a chance to “learn while doing”. They had to make sure that the individual part they were working on fitted with other parts. Another result of the work with the implementation proposal was that the members of the project developed a mutual technical know-how

about the system product, which also facilitated the internalization process.

- The Message project strived to reduce the ambiguity in the project, making everyone in the project head in the same direction. The solution was to increase the interaction with the Integration project. By getting detailed feedback it became easier for the members of the Message project to share technical know-how as the feedback forced the work to focus on the benefits from a customer's point of view. Towards the end of the Message project an external customer was signed, a customer who not only came with new insights and ideas about the end product, but also served as an evaluation of the product being developed. Both important in the internalization process (von Krogh *et al.*, 2000).
- In the Java project the internalization process could be identified as the members of the HR-group had to correct the flaws in the product that the group of experts had developed. The re-work was characterized by "learning by doing", and all of the members of the HR-group tried hard to help each other develop a flawless product. The internalization process was to a great extent facilitated as the members of the HR-group shared a mental model and technical know-how thanks to the code base in the product.

Examining the projects reveals that there were different reasons for why the process could not be identified.

- One is that projects could be derivative projects, in which the focus was on execution of a given task, not on knowledge creation *per se*. For instance in the Processor project the members knew what they had to do, and how they would do it. Another consequence of being a derivative project is that the members already shared a mental model, making the internalization process unnecessary.
- Another reason for the lack of the process of internalization is the lack of documents that could help facilitate the internalization process. Such was the case in the Integration project. There was little documentation, which could have worked as a starting point in facilitating the internalization process.

The theory of knowledge creation (Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000) describes the process of internalization as being comparable to the justification of a concept. This implies, using more concrete terms, that a concept which has been created needs some sort of evaluation, both internally in the projects, but also externally to stakeholders such as the top management, other projects in the organization, customers, etc.

In both the Message project and the Java project the input and acceptance from top management and users were of great importance. For the Message project it meant that the project was able to get its product out on the market. The input from both people outside, but also inside the HR-group, demanded that the flaws of the product had to be corrected. Without this input it is not certain that the Java project would have understood the importance of correcting the flaws. Recall that it was in the work with making a flawless product that the internalization process was facilitated, and without the rework it is possible that the process of internalization would not have occurred.

The fact that the process of internalization is not always present in different projects is not commented on at all by Nonaka and colleagues. As a consequence, nothing is said about what reasons might cause the lack of an internalization process. In the next chapter it is time to turn to the issue of how the different categories of organizational slack influence the process of internalization.

## **Categories of Slack and their Relation to Knowledge Creation at the Product Development Project Level**

As discussed previously, there are few other studies that have actually examined the model of knowledge creation. Therefore the analysis of the six cases contributes to our knowledge about knowledge conversion modes in an environment characterised by high velocity. Perhaps more importantly, the analysis identifies conflicting evidence for the knowledge conversion modes among the projects. This is important as it gives a more nuanced view to the model of knowledge creation.

The difficulty of identifying the four modes of knowledge conversion is never discussed as a problem in the work by Nonaka and his colleagues. But as shown in the present study, it is sometimes difficult to identify the four modes of knowledge conversion, and there are different reasons for this, ranging from whether projects are platform or derivative projects, to the involvement of people outside the projects (top management, customers, etcetera).

As has been touched upon, the analysis of the four modes of knowledge conversion focused on the identification of the knowledge conversion modes. Little is said in the analysis about what actually happens to each of the four knowledge conversion modes if there is a reduction in the categories of slack identified in the previous chapter. Trying to find an answer to that questions is the theme of the next chapter, in which the third research question of this thesis 'what is the relationship between the identified categories of slack to the four modes of knowledge conversion?' will be addressed.



# CHAPTER EIGHT

## Examining the Relationship between Slack and Knowledge

*The present chapter addresses in detail the third purpose of the thesis: 'examining the categories of slack and their relation to knowledge'. To clearly spell out the relationship between the four categories of slack and the four modes of knowledge conversion, testable propositions are included in the chapter.*

The analysis in the two previous chapters was closely compared to the empirical material. In the present chapter one more step is taken in the analysis as the four categories of slack identified at the project level are examined in relation to the four modes of knowledge conversion, i.e. answering the third research question of the thesis, 'what is the relationship between the identified categories of slack and their relationship to the four knowledge conversion modes?'.

From the analysis in chapter six, the comparison between Communication Ltd. and Support Inc., as well as between the projects within respective companies, it was possible to identify four categories of slack at the level of the product development project: 1) customer interaction, 2) top management control, 3) project deliverables, and 4) human competence, all which seem to influence the knowledge creation in the projects.

In chapter seven the focus of the analysis was on examining the four modes of knowledge conversion, first in each of the six projects, then across the cases. From the analysis it is evident that there are individual differences in the cross case comparison, as the four modes of knowledge conversion could not be identified in all cases. In the analysis in chapter seven some explanations for these individual differences were identified, such as depending on whether a project was a derivative or a platform project, in which case there would be different needs in the knowledge creation process.

- It was, for instance, discussed that a derivative project may have engaged in a socialization process prior to the initiation of a project, making such a process redundant in derivative projects, which is not the case in the platform projects.
- Another explanation is the amount of ambiguity surrounding the task given to a project from the top management, which is higher in the platform projects in the present study, than in the derivative projects.

However, these explanations could not account for all the differences found across the cases and for that reason it is necessary to take the analysis one step further by linking the four categories of slack to the four modes of knowledge creation, which will be done in this chapter.

## Categories of Slack and their Relation to Knowledge

In the following, each of the four categories of slack will be analysed in relationship to the four modes of knowledge conversion. The analysis is structured as follows. For each of the categories of slack, the knowledge conversion modes are discussed. Initially an empirical analysis is made for each knowledge conversion mode. Then the analysis is taken one step further as additional explanations are sought from other complementary theories.

In terms of the research framework, the focus is on explaining the findings marked with grey in the figure below. As categories of organizational slack are changed, it is hypothesised that the four modes of knowledge conversion are affected. The relationship between the four categories of slack and knowledge conversion modes are summarised in table 8:1 below. In the following analysis each of the sixteen quadrants will be analysed and explained in more detail, as well as their relationships to related theories.

Table 8:1 ▼  
Relationship between Categories of Slack and Knowledge Conversion Modes

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

## Customer Interaction as a Source of Organizational Slack and its Relation to Knowledge Creation

In chapter six it was proposed that the interaction between a project and its customers is a source of organizational slack in product development projects. It was briefly discussed that the more direct influence a customer had on the project, the less room there was to experiment within the project, which seemed to negatively affect knowledge creation.

However, the analysis in this chapter reveals a more complicated picture when examining the relationship between customer interaction and the four modes of knowledge conversion. The analysis shows that customer interaction does not always hamper knowledge creation since three of the four modes of knowledge conversion are actually facilitated by an increased customer interaction. It is now time to turn to a closer analysis of the four modes of knowledge conversion. Throughout the analysis the following question was used as a guide:

*What are the consequences of increased customer interaction for the four modes of knowledge conversion (socialization, externalization, combination and internalization respectively) in a product development project?*

In terms of the research framework the focus is on the area marked with grey in table 8:2 below.

**Table 8:2** ▼  
**Relationship between Categories of Slack and Knowledge Conversion Modes**

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

Since four of the projects were developing platform products it implies that these projects were new for the market. For that reason the customers the projects interacted with, or wanted to interact with, can be characterized as “lead users” (von Hippel, 1986), or “innovators” (Rogers, 1995). Lead users are customers whose needs will be general in a marketplace; but lead users face these

needs months before the bulk of that marketplace encounter them. The reason is that lead users focus on Extensive Problem Solving (EPS) as they try to develop criteria for the identification and evaluation of a new product (Howard & Moore, 1988). As a result of developing evaluation criteria, lead users are often used by a company as a way of getting feedback on the product concept and the design of the product.

The Java project and the Process project did not target lead users as they were derivative projects. The Process project initially had a goal of developing a product which could be shown to a wide range of potential customers. In terms of Rogers (1995, chapter 7) framework of categorizing adopters, depending on when customers adopt an innovation, the group of customers targeted in the Process project were the early and late majority, which is the group of customers most commonly targeted for derivative projects.

Besides the differences in terms of what type of customers to target (innovators versus early and late majority), there were few differences in the comparison of the platform projects and the derivative projects. And as a result both types of projects will be included in the analysis below. Comparing the projects in the study with each other, the customer interaction in the projects varied in basically two ways.

- First, the interaction with the customer ranged from a high level of detail in which the customer came with detailed input and suggestions, to a low level of detail, where the customer came with practically no details. Between these two extremes are the rest of the projects in the present study.
- Second, even though all projects worked with a pilot customer, how the projects viewed the pilot customer differed. The two extreme views were that: (1) the pilot customer should be aware that they were in fact a test lab from which the project could get input, or (2) the pilot customer should believe that they were offered some sort of general product, which had already been tested.

It should be noted that different types of customer interactions exist depending upon the familiarity the customers has of the product, ranging from customers characterized by Extensive Problem Solving (EPS), over Limited Problem Solving (LPS), to customers characterized by Routinized Response Behavior (RRB). Over a products life cycle the number of customers in each problem solving stage will shift (Howard & Moore, 1988). A similar model to the one described by Howard and Moore is adopter categorization on the basis of innovativeness, as developed by Rogers (1995, chapter 7). This describes five ideal types of customers based upon when they adapt an innovation. The five types are: innovators, early adopters, early majority, late majority, and laggards.

As has been described, the focus in the present study is on customers focusing on Extensive Problem Solving, being innovators, but the analysis also includes the experiences from the Processor project which targeted customers characterized by Limited Problem Solving, which were early and late majority customers. The reason for including the Processor project is with the ambition of examining common patterns across the cases as the customer interaction is increased (i.e. reducing slack), despite whether the project is derivative or platform.

Since there are different types of customer interactions in the study, as well as differences in how the customer is viewed, it is important to note that it is the common patterns across the cases and the consequences of changes in the interaction with the customer for the knowledge creation process that have been analyzed below. It is important to note that the System project and the Java project did not have an(y) external customer(s) and are therefore excluded from the analysis below.

### **Implications of Increased Customer Interaction for Knowledge Creation**

Previous research has indicated that customer involvement is positive (von Hippel, 1986; Zirger & Maidique, 1990), particularly to speed up the development process. And as a consequence it has been argued that a development team should have close contact with the lead customers (von Hippel, 1986). This ensures that the company understand what the needs of the user are and that these are translated into solutions for the customer (Zirger & Maidique, 1990). A complementary view is given by Brown and Eisenhardt (1995) who argue that external communication with outsiders, e.g. customers, opens up the project team to new information. There are essentially two aspects that speak in favour of involving the customer as a way of improving the productivity and pace of the development process.

- First, if the information is task oriented, the members gain information and viewpoints from outside the team.
- Second, if the information is frequent, the members become more efficient in gaining and using the information they are given.

However, it is not exactly clear at what point in time a customer should be involved in the process, since there are few discussions in the literature concerning the issue of timing (Brown & Eisenhardt, 1997).

The findings in this study indicate that the effect of a close interaction with customers goes beyond productivity and pace and extends into knowledge creation. As a result of a customer being signed to a project, organizational slack is reduced, with subsequent effects on knowledge creation. But to solely look at knowledge creation is not sufficient, because the consequences of increased

customer interaction vary depending upon which mode of knowledge conversion is being analysed.

For instance, increased customer interaction implies that there is less room for the members of the project to engage in the process of socialization. An increased interaction with the customer makes the members of the projects focus on explicit details given by the customer. This hampers the socialization process as the focus on the more explicit details does not allow for on-the-job training or observing others, which is necessary for generating the socialization process. On the other hand, the process of combination is facilitated as increased customer interaction makes it necessary to develop documents which facilitate the combination process.

The finding that organizational slack is reduced through increased customer interaction, which in turn has different kinds of impact on the knowledge conversion modes, may help to explain why it is difficult to know exactly how and when customers should be involved in the development process (Brown & Eisenhardt, 1995; Eisenhardt & Tabrizi, 1995). Because of the difference in impact, the project needs to decide what type of knowledge conversion mode is important. For example, if it is appropriate to develop the explicit parts of the project (*combination*) in the form of prototypes, which can be used to *internalize* knowledge among the members of the project, then it is a good idea to increase the customer interaction, i.e. actively trying to reduce organizational slack. Below, each of the four modes of knowledge conversion and the consequences of an increased customer interaction is discussed in more detail.

### **Increased Customer Interaction and Socialization**

The reason for why the process of socialization was hampered due to increased customer interaction was quite similar across the cases. In the Process project the customer signed to the project came with very detailed specifications on every little part of the product. This caused the members to work on their specific part, not having the possibility to observe others and share experiences, which is a necessary requirement for the occurrence of the socialization process.

It is important to note that the same experience can be found in the Component, Integration and Message project. Thus, the findings in the Process project, being a derivative project, were also found in platform projects. When a customer was signed to the projects, the project members became focused on more explicit details not giving room for the sharing of experiences among the members of the project through on-the-job training or observing others, which is necessary for the occurrence of the process of socialization. These findings suggest the following conclusion:

Conclusion: Increased customer interaction hampers the process of socialization.
--

### **Increased Customer Interaction and Externalization**

The signing of a customer in the Component project made it necessary to clearly specify the functionality of the product. This in turn created a need to have a dialogue in the project about the new concept being developed in order to make all members of the project head in the same direction, facilitating the externalization process.

The Message project and the Integration project had similar experiences with increased customer interaction. In both cases the customer did not fully understand the product being developed. This caused a need in the project to describe the products in terms of metaphors, or as the members of the Integration project expressed it: we needed a baby language to be able to talk to the customer.

It should be noted that the Process project differed from the Component, the Integration, and the Message project as it was not possible to identify the externalization process. The reason was the high level of detail given from the customer on the product. It is important to note that it was possible for the customer to come with the detailed feedback since earlier versions already existed on the market. Thus, the result in the Processor project can be explained by the fact that it was a derivative project. These findings suggest the following conclusion:

Conclusion: Increased customer interaction facilitates the process of externalization (in platform projects).
---

### **Increased Customer Interaction and Combination**

The analysis of the cases reveals that there were similar experiences of increased customer interaction for the process of combination in all projects. In the Component, the Integration and the Message project the customer came with input on the functionality of the product. The input came either directly from the customers to the project or indirectly through the consultants at Support Inc. that were implementing the product. In addition to the development of the product, the three projects simultaneously developed documents concerning the products functionality. The same experience can be identified in the Process project in which the customer focused on the explicit details of the product, giving suggestions for how the project could be developed further. These activities all facilitated the process of combination. These findings suggest the following conclusion:

Conclusion: Increased customer interaction facilitates the process of combination.
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### **Increased Customer Interaction and Internalization**

Across the projects (the Process, Component and the Message project) there were similar experiences associated with increased customer interaction. To be

able to deliver a product it was necessary to make all project members understand the whole product, and not only the small part each member was working on. Thus, it was necessary to make all members share technical know-how about the product in order to understand what worked or did not in relation to other parts of the product. Striving towards the internalization process in the projects was facilitated by the need to develop documents and manuals.

It should be noted that in the Process project, being a derivative project, the members already shared a mental model as they had developed previous processor products offered to customers, suggesting that the internalization process had occurred at a previous point in time. These findings suggest the following conclusion:

Conclusion: Increased customer interaction facilitates the process of internalization.

### Top Management Control as a Source of Organizational Slack and its Relation to Knowledge

In chapter six, top management control was suggested as being a source of organizational slack, since top management influences the knowledge creation in the product development projects studied, through the control they exerted over the projects, or put another way, through the autonomy they granted to the projects. It was suggested that as top management increased its control over a project, there was an increased emphasis on the explicit knowledge in the project. The main reason being that top management could not use the tacit knowledge that the project had developed with regard to the product or concept being developed. This suggestion is analysed in more detail by examining each of the four modes of knowledge conversion. The following question served as a guide in the analysis:

*What are the consequences of an increased top management control for the four modes of knowledge conversion (socialization, externalization, combination, and internalization respectively) in a product development project?*

In terms of the research framework the focus is on the area marked with grey in table 8:3 below.

Table 8:3 ▼

**Relationship between Categories of Slack and Knowledge Conversion Modes**

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

### Implications of Increased Top Management Control for Knowledge Creation

A reduction in top management slack means an increase in the control top management exercise over a project. This is in line with earlier studies on firm-level organizational slack, which argue that as slack is increased more autonomy is given or conversely: little slack means more control (Cyert & March, 1963/1992; Nohria & Gulati, 1996). It is important here to note, however, that top management control is not to be confused with top management support, which has been positively correlated with product development success in several instances (for a review see Brown & Eisenhardt, 1995).

The reduction of top management slack is similar to a reduction of *subtle control*. Subtle control means developing and communicating a clear product concept, which builds upon a vision (Imai *et al.*, 1985). Subtle control also incorporates the delegation of responsibility to project teams. As subtle control is reduced there is less freedom given to the project and the senior management does not delegate responsibility to the project. Another consequence of increased top management control is that the autonomy given to the projects are is hampered, which reduces the motivation for the creation of new knowledge (Nonaka & Takeuchi, 1995).

Thus, an increase in subtle control gives the team autonomy that in turn will make them motivated and creative, resulting in a better development process (Brown & Eisenhardt, 1995). However, there are few discussions in the literature concerning the amount of top management control or when it is appropriate that the top management move from having a directive role over the project to more detailed governance. The findings of the present study suggests that a reduction of top management slack, which is a result of an increased top management control, has different implications for the modes of knowledge conversion.

For instance, the increase in top management control resulted in fewer possibilities for the projects to have a dialogue concerning metaphors or about the concepts being developed, i.e. hampering the externalization process. This was a consequence of the top management taking a more directive role, emphasising the details of the product and paying attention to the prototype being developed, which, however, facilitated the process of combination.

The identification of top management control as a source of organizational slack and the associated findings is in line with the findings of Bonner *et al.* (2002), who found that if top management goes beyond a directive role, into a more detailed governance of a project it creates lower team performance. They therefore suggest that top management should be careful of how they intervene in project activities. Extensive involvement with many formal controls reduces the autonomy and consumes time for the product development team, but too little control can also be negative, as the team does not get guidance and feedback from top management (Karagozoglu & Brown, 1993).

A reduction in top management slack is positively related to *combination* and *internalization* because top management needs to have a concrete concept or a prototype (*combination*), or in other words: there is a focus on explicit knowledge. The prototype can also support the *internalization* process. On the other hand, the reduction of top management slack is negatively related to the *socialization* and the *externalization* modes. This is because top management did not give the project a vision (*externalization*) that the project could develop, and did not allow for much interaction in the teams to share experiences and technical skills (*socialization*) in order to create the vision.

Below the four modes of knowledge conversion and the consequences of an increased top management control is discussed in more detail. It should be noted that the relationship between top management control as a category of organizational slack and the four modes of knowledge conversion is most salient in the platform projects. This should come as no surprise as they are developing products new to the market, whereas in the derivative projects the focus is more on efficiency. Nevertheless, there are some similar characteristics regardless of the project being platform or derivative.

### **Increased Top Management Control and Socialization**

The increase in top management control of the projects was associated with an increased emphasis from the top management that the projects should reach a closure. Because an increase in top management control seemed to be a result of a wish from the top management that the projects should reach some sort of finish, it should come as no surprise that the process of socialization was hampered. There simply was no room for such a process. A finding irrespective of whether the projects were derivative or platform projects.

The process of socialization is often described by Nonaka and colleagues (Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000) as taking place initially in a project. Since the increase in top management control occurred, in the studied projects, towards the end, one alternative explanation to the hampering of the socialization process could be that there was little need for such a process at that stage of the projects. These findings suggest the following conclusion:

Conclusion: Increased top management control hampers the process of socialization.

#### **Increased Top Management Control and Externalization**

In the studied projects there was little room for having discussions about the concept, or developing a metaphor, around the new product as there was an increased top management control. With increased top management control the focus moved towards the more explicit details of the projects, instead of the vagueness of a concept which is often the result of the use of a metaphor.

There was also a feeling in the projects that the increased top management control was associated with a focus on delivering a product, not on having dialogues about the projects product, which is necessary for the occurrence of the externalization process. It should be noted, as was described above, that the increase in top management control occurred at the end of the projects, making it, perhaps, unnecessary to have an externalization process – it should have been conducted at an earlier stage of the project. These findings suggest the following conclusion:

Conclusion: Increased top management control hampers the process of externalization.

#### **Increased Top Management Control and Combination**

As stated above, the increase in top management control is closely related to the conclusion of the projects, but also on the explicit details of the product being developed. Because the top management mostly cared about getting a product out on the market they focused on the prototypes being developed in the projects or any other explicit development of the product. The focus on the explicit details facilitated the combination process.

For instance, in the Process project, the System project, and the Component project there was an increased focus on generating a prototype. In each of the projects the members tried to combine their experiences through various meetings and the development of documents. Another example of how the combination process was facilitated can be found from the analysis of the Integration project and the Message project. In these two projects top management did not care that much about the development of a prototype, but instead the projects had a lot of meetings with the top management that focused

on explicit details of the project. These findings suggest the following conclusion:

Conclusion: Increased top management control facilitates the process of combination.

### **Increased Top Management Control and Internalization**

There was some contradictory evidence found of the effects and consequences of increased top management control. In some of the cases the increase in top management control made it necessary for the members of the projects to head in the same direction as the top management demanded the projects to reach a closure (which was the reason for the close monitoring). This triggered the members of the project to understand the whole product, i.e. sharing technical know-how, which facilitated the internalization process.

However, exactly the opposite happened in some of the projects as a response to increased top management control. In these projects the increased top management control hampered the possibilities to learn-by-doing among the members of the projects as the focus was on getting the product out on the market as soon as possible and few opportunities were given to the team to develop technical know-how or share mental models. There was only time for each member to work on their “own” part of the project, there was not time to get a comprehensive view of the product or the project. These findings suggest the following conclusion:

Conclusion: There is dual evidence concerning consequences of increased top management control and the process of internalization.

## **Project Deliverables as a Source of Organizational Slack and its Relation to Knowledge**

As presented in chapter six, the term “project deliverables” comprises of two parts which are closely related to each other, namely project deadlines and the functionality of the product. In chapter six the implications of project deliverables on knowledge creation seemed to be related to the ability of a project to change, or more exactly, increase the project deliverables. This can be achieved by either moving the deadlines forward, or deliver less functionality than promised. In the following, the analysis is taken further to examine the consequences of increased possibilities to depart from project deliverables on the four modes of knowledge conversion. The following question guided the analysis:

*What are the consequences of an increased possibility to depart from project deliverables for the four modes of knowledge conversion (socialization, externalization, combination, and internalization respectively) in a product development project?*

As the analysis will show there was contradictory evidence found in all four dimensions in the comparison across the cases. Still it is important to note that the differences could not be attributed to either the type of product being developed (platform versus derivative) or to the company each project belonged to. In the Message project there was no evidence found for the consequences of increased possibilities to depart from the project deliverables, and as a consequence the Message project has not been included in the analysis below.

In terms of the research framework the focus is on the area marked with grey in table 8:4 below.

**Table 8:4** Relationship between Categories of Slack and Knowledge Conversion Modes

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

### Implications of Increased Project Deliverables for Knowledge Creation

The concept product deliverables contains two related parts. The first concerns when to deliver the product and the second concerns what to deliver. Low levels of slack in project deliverables means that there is little possibility to depart from the project deadlines and/or change the promised deliverables.

Comparing the findings of this study with existing literature, the effects of the first part of project deliverables on knowledge creation is, of course, in line with existing research on the effect of time on learning. If employees are hurried or rushed it becomes more difficult to learn (Garvin, 1993). Time, some would argue, is necessary in order to reflect and learn from experience, particularly as technologies become increasingly complex (Lawson, 2001). However, this is not to ignore the crucial importance of meeting deadlines and not being late to the market (Vesey, 1991).

Concerning the second part of project deliverables, the possibility to deviate from the promised product functionality, the analysis indicates that the environment in which the companies operate is of importance. In dynamic and uncertain environments<sup>39</sup> significant changes might occur in customer needs (MacCormack *et al.*, 2001), and as a consequence it is necessary to take in new information during a development project. Many models of product development have their origin in environments where the technologies and target markets are relatively well understood. The outcome of this research is the well-known stage-gate process (MacCormack *et al.*, 2001).

However, the traditional models of product development do not seem to work in more uncertain and dynamic environments (Iansiti & MacCormack, 1997), instead it is necessary to incorporate change as late as possible in the process (MacCormack *et al.*, 2001), since there is a knowledge creation process going on in the projects. In terms of slack in project deliverables this implies that slack is necessary to incorporate late changes. If there is no slack in project deliverables then the possibilities to make changes to the product is reduced.

In the literature there are, however, few discussions on the consequences of a possibility to depart from project deliverables on knowledge creation in projects. From the discussion above it is suggested that a possibility to depart from project deliverables is associated with increased knowledge creation, as the members of the project have time to learn both from their own work, but also in relation to the changing needs of a customer. Yet the analysis of the four modes of knowledge conversion shows a more complicated picture where the consequences from a possibility to depart from project deliverables are far from certain.

Take for instance the process of socialization. To have the possibility to depart from project deliverables, i.e. increasing the deadlines and/or changing the promised deliverables, may at first glance suggest that the members of a project would have the time to engage in the process of socialization. Supporting evidence for this view is found in the analysis of the cases. But, contradictory evidence is also found in some projects where the members of the project became focused on their “own” part of a product trying to develop a “perfect part”, but not being able to have a comprehensive view, that could have been achieved by working with other parts of the product, i.e. on-the-job training.

Another example is the process of combination. If there are increased possibilities to depart from project deliverables it may facilitate the combination process in the sense that there is time available to document the project. On the

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<sup>39</sup> I follow MacCormack *et al.* (2001, p. 133, emphasis in original) who define uncertain environments as environments “in which future evolutions in markets and or technologies are hard to predict. By dynamic, we mean environments in which these evolutions occur rapidly.”

other hand, the increased possibility to depart from project deliverables might be that the project reduces the emphasis on completing a prototype – a consequence evident in the Component project where an increased possibility to depart from project deliverables resulted in a lack of focus on creating a final beta-version (i.e. prototype) of the product, instead the members of the project kept on adding new features.

### **Project Deliverables and Socialization**

In the Process project and the Component project the result of a possibility to depart from project deliverables hampered the process of socialization. This was a result of project members continuously striving towards producing a “perfect” part of the overall product. This in turn made the members internally focused, not sharing experiences inside the project, or allowing for on-the-job training, a precondition for the socialization process.

Yet, on the other hand, the experience in the Integration and the Java project are different as the process of socialization actually was facilitated by increased possibilities to depart from project deliverables. Because these two projects had the opportunity to change the project deliverables, extra time and emphasis was put on making everybody understand the project, either by observing (the Java project), or practically working (the Integration project) with the product, facilitating the process of socialization. These findings suggest the following conclusion:

Conclusion: There is dual evidence concerning consequences of decreased possibilities to depart from project deliverables and the process of socialization.

### **Project Deliverables and Externalization**

Examining the effects of in an increased possibility to depart from project deliverables on externalization proved to be difficult, as there was little evidence found in the cases in this dimension. As a result the consequences are not clear.

The only exception could be found in the Integration project. Here the possibility to depart from the project deliverables, in terms of moving the deadline forward, as well as not delivering agreed upon functionality, made it possible in the project to discuss and form an idea about what the project was supposed to do. One particular circumstance that made it necessary for the Integration project to come up with a concept (here: B2B) that everybody in the project could understand and agree upon was the fact that the originator of the Integration project left Support Inc. This made it necessary for the members of the project to formulate the overall goal and the direction of the project, i.e. facilitating the externalization process. These findings suggest the following conclusion:

Conclusion: There is dual evidence concerning consequences of decreased possibilities to depart from project deliverables and the process of externalization.

### **Project Deliverables and Combination**

In the Process project, the Component project, and the Integration project the result of the increased possibility to depart from project deliverables was that each member of the project began focusing on their own part of the project, trying to make a “perfect” product, instead of trying to build a prototype that everybody could contribute to. In addition, there were few meetings which did not work to facilitate the process of combination; on the contrary the combination process was hampered.

On the other hand, in the System project and the Java project the increased possibility to depart from project deliverables seemed to have facilitated the process of combination. These two projects took the opportunity to have more meetings, trying to understand what each person was doing, in order to create the best-possible prototype. These findings suggest the following conclusion:

Conclusion: There is dual evidence concerning consequences of decreased possibilities to depart from project deliverables and the process of combination.

### **Project Deliverables and Internalization**

Just as was the case for the combination process, the increased possibilities to depart from project deliverables resulted either in facilitation or hampering of the internalization process. For the Process project, the Component project, and the Integration project the process of internalization was hampered. The reason can be traced to a lack of ambition to create a comprehensive view among the members of the project. This in turn reduced the opportunities for the members of the project to share mental models, or “learn-by-doing”, necessary for the internalization process.

However, the opposite reasoning can be found in the System project and the Java project where the members actively learned from their own and other people’s mistakes. This was due to the time being available as a consequence of the possibility to depart from project deliverables. These findings suggest the following conclusion:

Conclusion: There is dual evidence concerning consequences of decreased possibilities to depart from project deliverables and the process of internalization.

## Human Competence as a Source of Organizational Slack and its Relation to Knowledge

In chapter six it was argued that human competence is a source of organizational slack. The discussion about human competence is a result of the need to think about the competence of individuals in the project and not only the absolute number of people in the project. As the analysis in chapter six suggested, it seems as if knowledge creation is hampered when there is a reduction in the human competence among the members in a project. To take the analysis one step further the consequence of reducing the human competence in a project is examined in relation to each of the four modes of knowledge conversion. The question guiding the analysis was the following:

*What are the consequences of a reduction in the level of human competence of the project members for the four modes of knowledge conversion (socialization, externalization, combination, and internalization respectively) in a product development project?*

In terms of the research framework the focus is on the area marked with grey in table 8:5 below.

**Table 8:5 ▼**  
**Relationship between Categories of Slack and Knowledge Conversion Modes**

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

### Implications of Reduced Human Competence for Knowledge Creation

There is much human competence slack if there are (too) many highly competent members in the project team. If there are (too) few members who also have little competence then there is little human competence slack. With this definition, the practice of replacing old and experienced project members with new and inexperienced project members reduces human competence slack.

The consequence of reducing human competence slack is that the ability to create knowledge is hampered as efforts are directed towards introducing newcomers, instead of experimenting with new solutions. This finding is supported by Gupta and Wilemon (1990), who found that if there are too many inexperienced project members, or the wrong mix of members in a project group, the product development process is delayed.

In addition the findings are related to the influence of team tenure on process performance (Brown & Eisenhardt, 1995; Kessler & Chakrabarti, 1999). Project teams with short longevity lack an effective mechanism for sharing information and have not developed effective patterns for working together. This limits the amount and variety of information the project members are able to communicate. But on the other hand, if the teams have a long history together they tend to become inwardly focused, neglecting external communication (Levinthal & March, 1993). This is also known as the Not-Invented-Here (NIH) syndrome, which is defined by Katz and Allen (1982, p. 7) as "the tendency of a project group of stable composition to believe it possesses a monopoly of knowledge in its field, which leads it to reject new ideas from outsiders to the likely detriment of its performance".

Stated differently, the NIH syndrome describes that the highest process performance is reached when the team tenure is at a moderate level. The project has an increased performance initially, which after a while stays steady, and after some time declines noticeably. In their study of a large R&D laboratory Katz and Allen found that with up to 1.5 years tenure the performance increases, to then stay steady for a time, but that after five years the performance clearly declined. This is the result of new project members coming in with fresh ideas and approaches, challenging and improving the scope of existing technologies and methods (Eisenhardt & Tabrizi, 1995; Katz, 1982).

However, the discussions in the literature are basically concerned with discussing the consequences of having the wrong mix of people or the tenure of the team. This implies that the effects and consequences of a reduction in the human competence and how such a change influences the creation of knowledge in general, and the four modes of knowledge conversion in particular, are not discussed. The analysis of the cases shows that a reduction in the human competence does not necessary hamper knowledge creation; on the contrary, knowledge creation within a project can actually be facilitated.

For instance, the process of externalization is facilitated as the projects lost experienced members, i.e. reducing human competence slack. The loss of experienced members triggered a dialogue among the remaining members of the project and newcomers to the project, as they needed to understand the direction of the project, which was facilitated through discussions concerning either a metaphor or the general concept being developed by the project.

The finding that the process of externalization is facilitated as there is a reduction in human resource slack, i.e. many new members in the project replacing experienced members, is in line with previous studies. Katz (1982) and Katz and Allen (1982) argue that new members can contribute with fresh ideas and approaches, which is positive for the project. A similar idea is “redundancy” in the project, which is, among other things, related to “strategic rotation” of personnel inside the organization (Nonaka, 1991, 1994), where newcomers contribute with new insights.

Human competence slack, was to some extent, positively related to the combination mode. In the projects there was a lot of explicit knowledge in terms of codes and prototypes, which made it easy for new members to get systematic knowledge of the product the project was building. As new members entered the project they were given many small tasks in different areas in order to get a better understanding of what the project was doing as well as getting experience with the project and the product.

Thus, there is a lot of learning-by-doing indicating the internalization mode is positively related to human resource slack. Each of the four modes of knowledge conversion will be discussed in more detail below. The consequences of reducing human competence on each of the four modes of knowledge conversion are the same irrespective of whether it is a platform project or a derivative project in focus. For that reason the two types of development projects are included in the analysis below.

It should be noted that the findings in the present study have not attempted to measure the human competence among the members of a project, trying to find a certain level of competence as being an “optimal” level for a development project. Instead the focus has been to examine the consequences of what happens to the four modes of knowledge conversion, and eventually on knowledge creation, as there is a reduction of human competence in the projects.

The basic finding is that it is for the most part positive for a project to have some sort of change among the project members as experienced members leave and less experienced members come into the project. The reason is that new members energize and destabilize the project, preventing the members of the project from developing interactions and behaviors characteristic of the NIH syndrome (cf. Katz & Allen, 1982).

### **Reduced Human Competence and Socialization**

As a consequence of a reduction in the level of human competence there was a need in the project for members to share their experiences, i.e. facilitating the socialization process. For instance, in the Component project the loss of the most experienced member triggered a joint execution among the project members as they shared their experiences. In addition, newcomers replacing

more experienced ones in the Component project had to observe the remaining experienced members, and conduct on-the-job training. It should, however, be noted that the evidence of the consequences of a reduction in the level of human competence of the project members and the implications for the socialization process was not particularly strong in the cross case comparison of the cases. Therefore the finding that reduced human competence facilitates the process of socialization should be interpreted with caution. Keeping that in mind the findings suggest the following conclusion:

Conclusion: Reduced human competence facilitates the process of socialization.

### **Reduced Human Competence and Externalization**

The process of externalization and the consequence of a reduction in human competence are closely related to the findings in the socialization process. Once a project lost competence it seemed as if there was a need to have a dialogue in the project on the metaphor, or concept being developed, so facilitating the process of externalization. For instance, in the Component project the loss of human competence resulted in a perceived need to make everybody in the project have a comprehensive view of where the project was heading.

However, just as with the findings concerning the socialization process, the evidence that a reduction in human competence lead to a facilitation of the externalization process should be interpreted with caution. The evidence cannot be found across all projects in the study. These findings suggest the following conclusion:

Conclusion: Reduced human competence facilitates the process of combination.

### **Reduced Human Competence and Combination**

The consequences of a reduction in the level of human competence took different expressions in the cases making it difficult to say if the combination process was hampered or facilitated by such a reduction. In the Process project and the System project the reduction in the human competence made each member more focused on their individual part of the whole product. Members reduced the number of meetings and were not willing to make a lot of documentation, making it difficult to share explicit knowledge, i.e. hampering the combination process.

The Integration project and the Java project, on the other hand, had a different experience. As the human competence was reduced in these two projects the project members tried hard to make it easy for each other, making as much knowledge as possible explicit through meetings and documentation. These findings suggest the following conclusion:

Conclusion: There is dual evidence concerning consequences of reduced human competence and the process of combination.

### **Reduced Human Competence and Internalization**

As the more experienced members of the projects left, causing a reduction in the level of human competence, the analysis reveals that the internalization process was facilitated. In the Component project and the Java project the less experienced members who replaced the more experienced members learned about the product while working with the product. In the Integration project the internalization process was also facilitated, but for other reasons. Within the Integration project the members found it necessary to share their experiences and know-how as the experienced members left. This was facilitated by the fact that each person documented their work so that other people could read and understand what they were doing. These findings suggest the following conclusion:

Conclusion: Reduced human competence facilitates the process of internalization.
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## **Summarizing the Findings – Towards a Synthesis**

The analysis of the six cases shows a complicated picture of the relationship between the four categories of organizational slack and the four modes of knowledge conversion. At first glance it may appear as if each one of the sixteen quadrants has little in common. However, what is missing, or rather not commented on in the chapter, is the fact that organizational slack is a dynamic phenomenon which changes over time. Therefore, to have a full and comprehensive understanding of the relationship between slack and knowledge it is necessary to take the analysis one step further and synthesize the findings. This implies, to some extent, that I become a little bit more normative than I have been so far in the thesis. The theme of the next chapter is therefore the development of a synthesized model suggesting how the relationship between slack and knowledge may be handled over time in order to manage knowledge creation over time.



# CHAPTER NINE

## Balancing Knowledge Creation

*The present chapter summarizes the findings from the analyses conducted in chapter six, seven and eight into a synthesized model of the knowledge creation process. The model is a suggestion for how a process of knowledge creation can be achieved, over time, in product development projects, by achieving a balanced level of slack.*

### Towards a Balanced Level of Slack

The fundamental problem motivating the research conducted in the present thesis is whether organizational downsizing and innovation are two organizational trends that are compatible, or incompatible. Today many organizations face a risk that creativity and idea generation are not given enough room in the organization, as time is only available for the most necessary activities (Amabile & Conti, 1999). This hampers the ability of an organization to be innovative. The reason for the reduced capacity of being innovative is attributed to a reduction in organizational slack, which is often viewed as a form of efficiency. However, as has been discussed, organizational slack is also essential for innovation (Geiger & Cashen, 2002; Nohria & Gulati, 1996).

In the literature it has been suggested (Geiger & Cashen, 2002; Nohria & Gulati, 1996) that companies are constantly faced with trying to achieve a balance between discipline and experimentation. In most studies, however, slack has been viewed as a non-dynamic phenomenon where it is possible to achieve an *optimal* level of slack by examining the financial resources of a company (e.g. Cheng & Kesner, 1997; Damanpour, 1991; Greenley & Oktemgil, 1998).

In comparison, the present study takes another view by arguing that slack is a dynamic phenomenon and that companies should strive towards achieving a *balanced* level of slack, a balance that changes over time. In addition, the literature review and the analysis in chapter six revealed that there are other

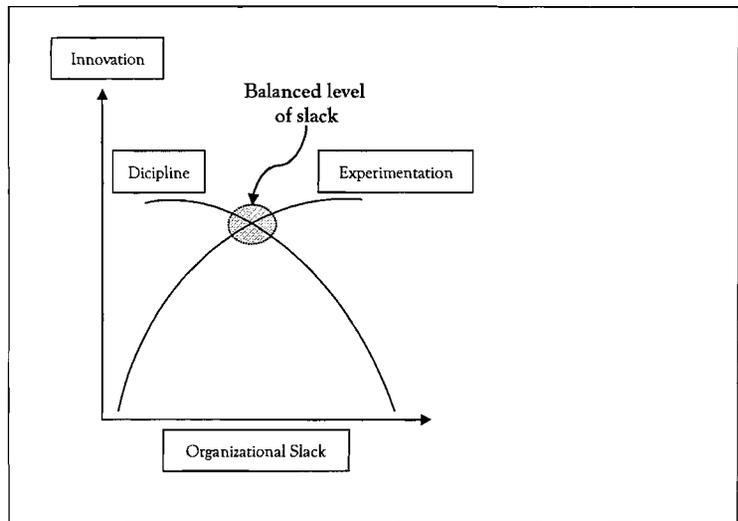
categories of slack, than solely financial resources. The consequence of focusing on categories of slack is that the dynamics of organizational slack are emphasised.

It has been emphasised throughout the thesis that knowledge is used as an explanatory mechanism to increase our understanding of the relationship between organizational slack and innovation. In the review of the literature, knowledge was conceptualized as the ability to create knowledge within product development projects. By linking the categories of slack to modes of knowledge conversion over time it is possible to develop a synthesized model.

The synthesized model suggests how knowledge creation can be managed by achieving a balanced level of slack over time. This is similar to the discussion by Judge *et al.* (1997) who suggest that it is not the level of slack that is important, but the continuity. In terms of figure 9:1 below, it is all about reaching the grey area, i.e. the balanced level of slack, over time. Before going into details about the synthesized model of the knowledge creation process, the main findings from the previous analysis are briefly reviewed.

**Figure 9:1 ▶  
Organizational Slack  
and Innovation**

The relationship between organizational slack and innovation is hypothesized to be inversely u-shaped



### Categories of Slack at the Level of the Project

The analysis conducted in chapter six showed that it was necessary to refine the categories identified at the level of the firm, to categories of slack at the level of the project. Starting the analysis with seven different categories of slack identified from previous literature on organizational slack conducted at the level of the firm, it was possible to identify four categories of slack at the level of the project. These four categories of slack identified at the project level were: customer interaction, top management control, project deliverables, and human competence.

Each of these four categories of slack was discussed in relation to previous theory and in the analysis it was also suggested that each of the four categories influenced the creation of knowledge in different ways. The exact relationship between the four categories of slack and the creation of knowledge was, however, not discussed in the chapter. At the end of the chapter the relationship between the four categories of slack was discussed, suggesting that project deliverables as a category of slack was to some extent a result of, and closely linked to, decisions made about customer interaction and top management control, two other categories of slack. Human competence being the final category of slack at the project level on the other hand, seems to be only moderately influenced by the top management control.

### **Knowledge Conversion Modes at the Level of the Project**

Before the analysis of how the categories of slack influenced the knowledge creation in product development projects could be conducted, the knowledge conversion modes at the level of the project were examined in the seventh chapter. From the analysis in the chapter it was evident that not all modes of knowledge conversion could be identified in all cases, in addition there was also some contradictory evidence as to whether or not some of the knowledge conversion modes were actually present or not.

The analysis conducted in the chapter, to an extent, seemed to contradict some of the findings discussed by Nonaka and colleagues (1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995), since the modes of knowledge conversion could not be identified in all the cases. As a consequence of this contradictory evidence it was decided that the analysis should be taken one step further by examining whether changes in a category of slack could explain why some modes of knowledge conversion did not seem to be present in all cases. This served as input to chapter eight.

### **Categories of Slack and Knowledge Conversion Modes**

Examining the relationship between the four categories of slack and four modes of knowledge conversion was the focus of chapter eight. The analysis was structured around a four by four matrix symbolizing the four categories of slack on one axis and the four modes of knowledge conversion on the other. Since slack is a dynamic phenomenon (cf. Nohria & Gulati, 1996) that changes over time, the analysis began by examining how a reduction in organizational slack influences each of the four modes of knowledge conversion.

A reduction in organizational slack implies different things in each of the four categories of slack. Reducing slack in terms of customer interaction implies that the customer interaction is increased, since it was suggested in chapter six that

the more direct influence a customer had on a project, the less room there was to experiment within a project. The consequence of increased customer interaction is that the process of socialization is hampered, while the remaining three modes of knowledge conversion (externalization, combination, and internalization) are in fact facilitated by an increased customer interaction.

Examining top management control and human competence as categories of slack, reveals a similar pattern to the one found for customer interaction as a category of slack. In some of the modes of knowledge conversion a reduction of slack is associated with a facilitation of one or more modes of knowledge conversion, while in other cases the knowledge conversion process is hampered (see table 9:1 below). Analyzing project deliverables as a category of slack showed ambiguous results. This could be explained by the fact that, to a great extent, project deliverables is a residual of the customer interaction and top management control. For that reason project deliverables will be omitted from the rest of the analysis in the present chapter and also in the discussion of the synthesized model.

**Table 9:1 ▼**  
**Relationship between Categories of Slack and Knowledge Conversion Modes**

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

It should be noted that the analysis in chapter eight said little about the different needs a project may have over time, which is also evident in the figure above. Perhaps not all modes of knowledge conversion need be present all the time. Or perhaps it is even beneficial to not have, or at least reduce, some of the knowledge conversion modes over time. Answering these questions is the theme of the present chapter and a synthesized model of the knowledge creation process is developed. The model suggests how managers can achieve a state where it is possible to manage knowledge creation in product development projects, over time.

## Towards a Synthesized Model of Slack and Knowledge Creation

The development of a synthesized model of the knowledge creation process over time, i.e. how knowledge creation can be managed in product development projects *over time*, implies that attention needs to be focused on the *categories of slack* at the level of the project, as well as on how each of the categories of slack influence each of the four modes of *knowledge conversion*, that are the *foundations for knowledge creation*. The model suggests a sequence of steps which are necessary to pass through in order to create knowledge. It is, however, important to acknowledge that the process of knowledge creation is not always a sequential process; in different projects there might be a need to have iterations, going back and forth, and not necessarily following a sequenced process as in the model.

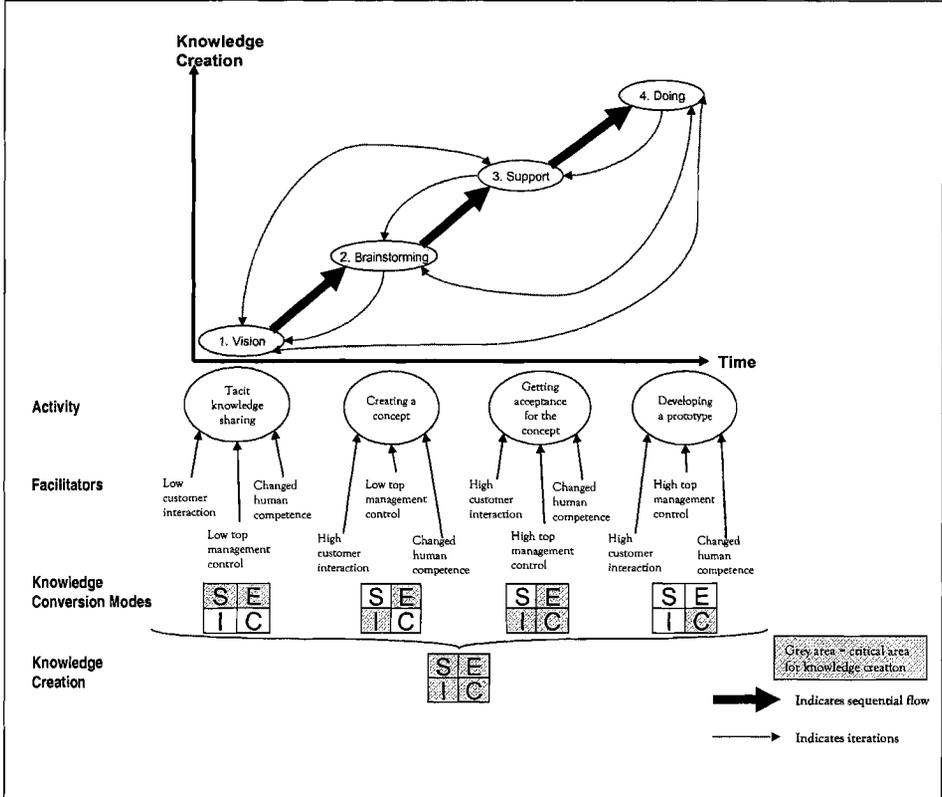
### Balancing Knowledge Creation: A Synthesized Model

In the following, a synthesized model of the knowledge creation process is presented. The model is built upon the two concepts in focus in the present study: organizational slack and knowledge creation. More specifically the model focuses on how a balanced level of organizational slack can be achieved in different phases in a product development project, which in turn facilitates knowledge creation, i.e. balancing knowledge creation. As was pointed out in chapter eight, there was contradictory evidence concerning project deliverables as a category of slack, therefore it has been excluded from the synthesized model. Below the synthesized model is presented. There are a few things worth noticing at this stage, which will be elaborated upon further in the discussion to come.

- There are *four guiding principles* in the model, these are: 1) vision, 2) brainstorming, 3) support, and 4) doing.
- Each of the four guiding principles are associated with *activities* in the project, which are: 1) tacit knowledge sharing, 2) creating a concept, 3) getting acceptance for the concept, and 4) developing a prototype.
- For each activity there are *facilitators*. These facilitators correspond to the categories of slack previously discussed, i.e. customer interaction, top management control, and human competence. These facilitators can either hamper or facilitate the knowledge conversion modes.
- Moving from the first guiding principle (vision) to the last (doing), over brainstorming and support, the project simultaneously covers each of the four knowledge conversion modes, which is necessary for engaging in *knowledge creation*.

- It should be noticed that the move from vision to doing is not always a step-by-step process; sometimes it is necessary to move back and forth between previous guiding principles.

Figure 9:2 ▼  
Balancing Knowledge Creation



To some extent the synthesized model resembles the discussions in Nonaka (1994; Nonaka & Takeuchi, 1995) and von Krogh *et al.* (2000). There are, however, some differences between their work and models and the synthesized model used in this thesis.

- First, the synthesized model in the present study explicitly links the creation of knowledge to reduction in categories of slack.
- Second, the synthesized model highlights that the process of knowledge creation is not always a step-by-step process. At certain points in time it may also be necessary to go back one or two steps, for various reasons, in order to be able to reach a closure.
- Third, by identifying the type of project in focus, i.e. derivative or platform, it is easier to predict and later on guide a project through the

four guiding principles. For instance a derivative project can be expected to have a process with less deviations from the original plan, than a platform project.

As mentioned above, there are similarities between the synthesized model and the work by Nonaka (1994; Nonaka & Takeuchi, 1995) and von Krogh *et al.* (2000). Here are some initial observations that are worth paying attention to. These will be elaborated upon later:

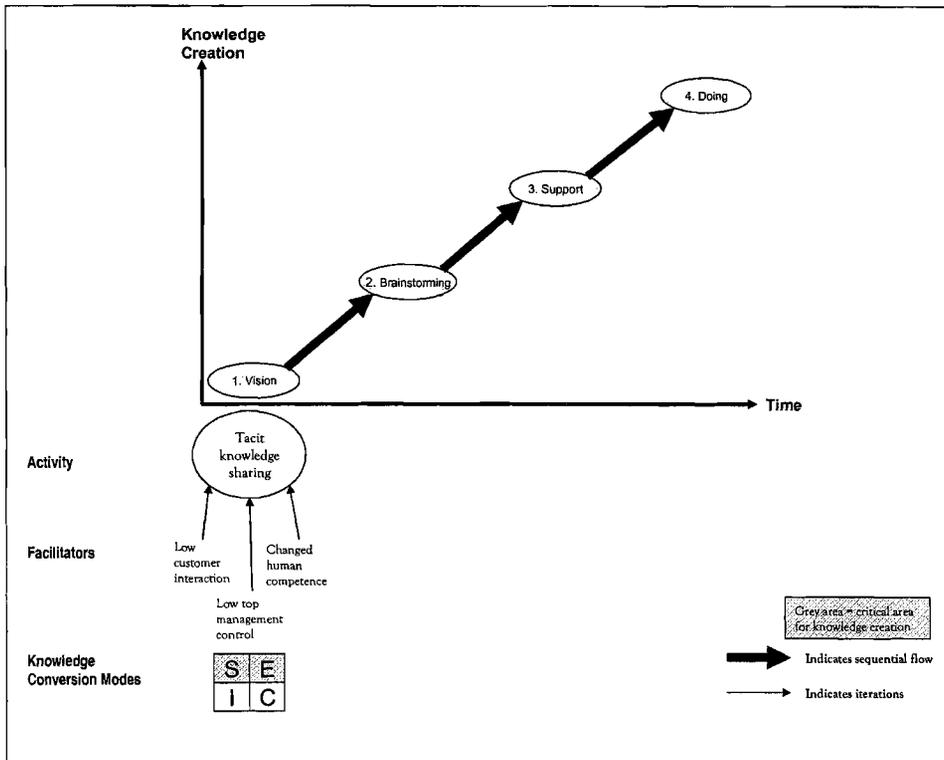
- First, in terms of organizational slack, a higher customer interaction and increased top management control implies that organizational slack is reduced (and conversely: low customer interaction and top management control implies increased organizational slack).
- Second, a change in human competence can imply that organizational slack is either reduced or increased. For instance, if an experienced member is replaced by a less experienced member, then organizational slack is reduced (and conversely). As the discussion below will show, it can be advantageous to try and reduce organizational slack by replacing old members with newcomers since the new members can contribute with new knowledge and perspectives.
- Third, it is worth acknowledging that the four different phases evolve over time, and that the categories of organizational slack need to adapt to these different phases.

### **Guiding Principle 1: Vision – Tacit Knowledge Sharing**

The first guiding principle in the work of engaging in knowledge creation is labeled vision. To put this in more concrete terms, it is the activity of tacit knowledge sharing among the members of the product development project, which is in focus. The basic premise for the first guiding principle in the knowledge creation process is that an organization cannot create knowledge on its own, it is through the tacit knowledge held by individuals that knowledge is created. As discussed previously, tacit knowledge can be difficult to share because it is acquired primarily through experiences and not through words. Therefore it is necessary to create a condition where individuals can interact and share their experiences in order to develop a shared mental model among the members, but also that the members begin to verbalize the mental model in words and phrases. These two activities are closely related to the socialization process and the externalization process.

Figure 9:3 ▼  
Balancing Knowledge Creation

Guiding principle 1: vision – tacit knowledge sharing



In relation to the categories of slack, it is important that there is low customer interaction and top management control, to make it possible for the members of a project to share their experiences. Concerning changes in the human competences among the members, e.g. new members entering the project, it need not be negative, as new members can bring new perspectives and insights.

Facilitating the tacit knowledge sharing among the members of the project is of crucial importance, as the ideas generated during this first phase set the stage for the later phases of the project. The importance and consequences of the initial phase, for the later stages of a product development project, have been discussed previously in the literature (e.g. Wheelwright & Clark, 1992).

In a number of studies Cooper (e.g. 1987; 1995) has argued that a key factor for the success of product development projects is doing a solid up-front homework. The general argument in these articles is that the activities undertaken in a project prior to the development phase are of crucial importance. It is in the early phases of a project that the product is defined, and the development plan for the rest of the project is constructed. Among the consequences of not doing a solid homework are that the needs of the user are poorly understood, and that

project features and performance requirements are unclear. In these studies the effects from the categories of slack on the possibility to share tacit knowledge have, however, not been discussed.

- Starting with customer interaction as a category of slack and its influence on the sharing of tacit knowledge among project members, the implication is that the project should not interact with customers to any great extent at this stage. The reason is that the members of the project need to be given the opportunity to share their tacit knowledge through observation, on-the-job training or imitation. A close customer interaction would hamper such a process since the customer often comes with detailed input on the product being developed. Therefore, the recommendation is that a project should try to be as autonomous in relation to a customer as possible during the phase where tacit knowledge is shared.
- In the first phase of knowledge creation the top management control should be as low as possible. The reasons are the same as for the customer interaction: the project needs to work as a self-organizing team; not having to explain what it is doing all the time to the top management. If the project is not given the opportunity to work autonomously there is a risk that the process of sharing tacit knowledge is hampered. Consequently, the recommendation is that a project should be given the possibility to work autonomously during the first phase of knowledge creation.
- A project being autonomous is not to say that new members are unwelcome. On the contrary, newcomers can contribute with new perspectives and insights. Thus, human competence as a category of slack can be reduced at this stage, since it facilitates, or rather makes it necessary, for members to share tacit knowledge during this stage. The recommendation given is that it is not a disadvantage to have some changes among the members in the project. This is, however, not to say that the project cannot consist of the same members throughout the first phase of the knowledge creation process. What is emphasized is that it need not be negative to have new members coming into the project in this phase.

Having low customer interaction and low top management control, yet introducing new members (i.e. reducing human competence) to facilitate the sharing of tacit knowledge, is similar to the discussions in Nonaka and Takeuchi (1995, p. 85) who discuss that a team should be granted autonomy from the management, i.e. low top management control. Similar arguments are also brought forward by Cooper (1999) who argues that it is negative for the success of a project if the top management begins to micromanage the project. In

particular Cooper emphasizes that if the project has to make (too many) presentations to the top management, or write (too many) status reports, then there is little time left for the members in the project to engage in the sharing of tacit knowledge, and later on, in the development of concepts.

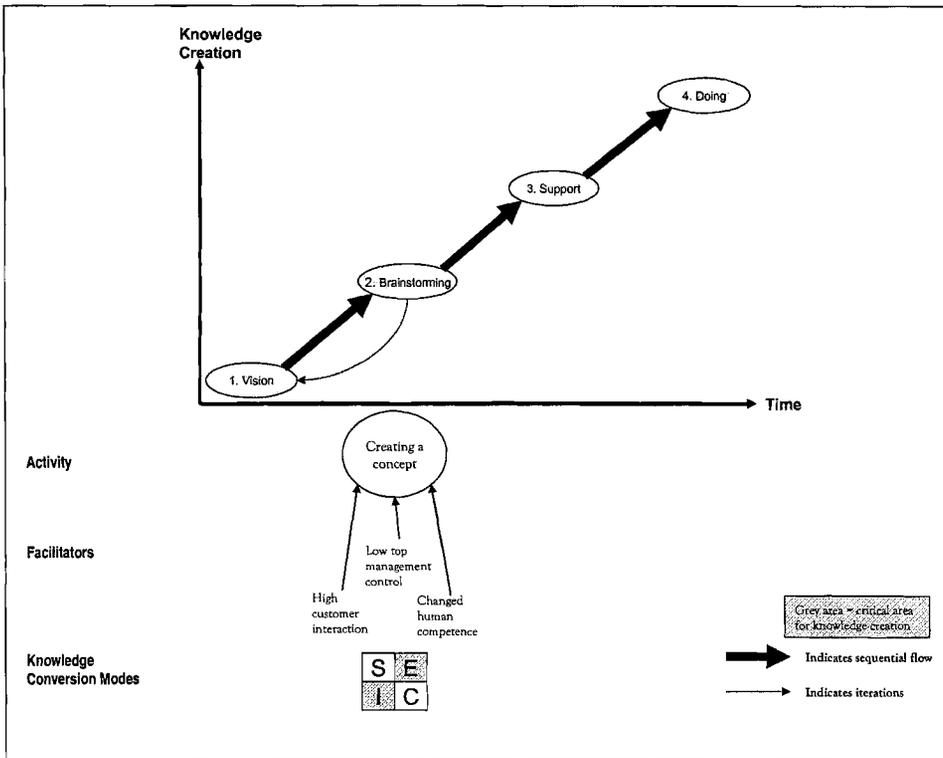
A recent study by Kessler *et al.* (2000) discusses the problems of involving external sourcing, i.e. input from customers, too early in the process since it appears that early customer involvement slows down the product development process. The reason for the slower process is due to the difficulties of *integrating* the external knowledge. In addition, external knowledge faces more organizational barriers than internally developed knowledge. Thus, the evidence from Kessler *et al.* (2000) supports the findings in the present study that customer involvement should be low during the initial phases.

### **Guiding Principle 2: Brainstorming – Creating a Concept**

The second phase of the knowledge creation process focuses on the creation of concepts. In terms of the synthesized model, the focus is on the second guiding principle; brainstorming, which is the point in time where most interaction occurs between tacit and explicit knowledge. Using the shared model developed in the previous phase, the members of the team engage in a continuous dialogue, aiming at verbalizing the mental model in words and phrases, e.g. through metaphors, which are eventually crystallized into explicit concepts. In addition, by using these concepts it is possible for the individual member to share mental models and technical know-how, and as a result individual tacit knowledge is enriched with new ideas and insights. Thus, the creation of a concept is similar to the process of externalization and internalization.

Figure 9:4 ▾  
Balancing Knowledge Creation

Guiding principle 2: brainstorming – creating a concept



In the process of creating a concept, where brainstorming is the guiding principle, the categories of slack diverge. Customer interaction should be increased, however top management control should still be kept low and the human competence in the project can still be changed, just as in the previous phase. During the creation of concepts it is important that the product development project is given the possibility to work quite independently, but still have the possibility to work closely with customers if necessary. The reason is because the members are trying to make the shared tacit knowledge explicit during this phase in the form of a concrete concept, which sometimes has to be tested on the market. The concrete consequences for each of the three categories of slack are discussed below.

- First, in terms of customer interaction, the project can increase the customer interaction in comparison to the previous phase. The reason being that input from the market may be needed as a concept is being developed. It is, however, important to note that increased customer interaction may result in a project too focused on small details of little importance, due to the demands from customers and thus forgetting

about the overall concept. As a consequence, an increased customer interaction should be initiated with caution.

- Second, the project also benefits from having a relatively high degree of freedom and autonomy in relation to top management, i.e. low top management control. The reasons are similar to those for having little customer interaction: the project needs to focus on the overall concept, not on having to discuss and explain small details. Therefore the project should have low top management control.
- Third, in terms of human competence, it need not be negative to have new members join the project, either replacing old members or simply increasing the size of the project. The reason is that having new members joining the project at this stage forces the old members of the project to bring out their tacit knowledge in explicit models. For that reason the recommendation is that a project can benefit from having changes in human competence, i.e. having new members join the project.

In comparison to other theories about the creation of concepts, the arguments about low top management control are supported to some extent by Nonaka and Takeuchi (1995, p. 86) who argue that a development team should be granted autonomy while developing a concept. But they also argue that the team should interact with the organization and the external environment. To some extent that is an argument that stands in opposition to their previous argument about giving the project autonomy.

This contradiction is in fact not a contradiction if time is added as an explanatory variable. Understanding that a project has different needs over time it is obvious that, for instance, a project team should be granted autonomy in relation to customer interaction, particularly during the first, but also to some extent, in the second phase of the knowledge creation process. However, in the third and fourth phases there should be an increased interaction. The reason is that projects in different phases have different needs as they create knowledge over time.

So far little has been said about the consequences of changes in human competence among the members of a project during these first two phases. The use of cross-functional teams for the success of a project has been known for a long time, and has been identified as the strongest driver of timeliness: staying on schedule and undertaking projects in a time-efficient manner (Cooper & Kleinschmidt, 1995), i.e. resembling the category of slack called project deliverables.

The arguments brought forward in the present study concerning changes in human competence as being positive for the sharing of tacit knowledge and the creation of concepts, should not be interpreted as a suggestion to change the whole project group. Instead it should be understood that it is a possibility for

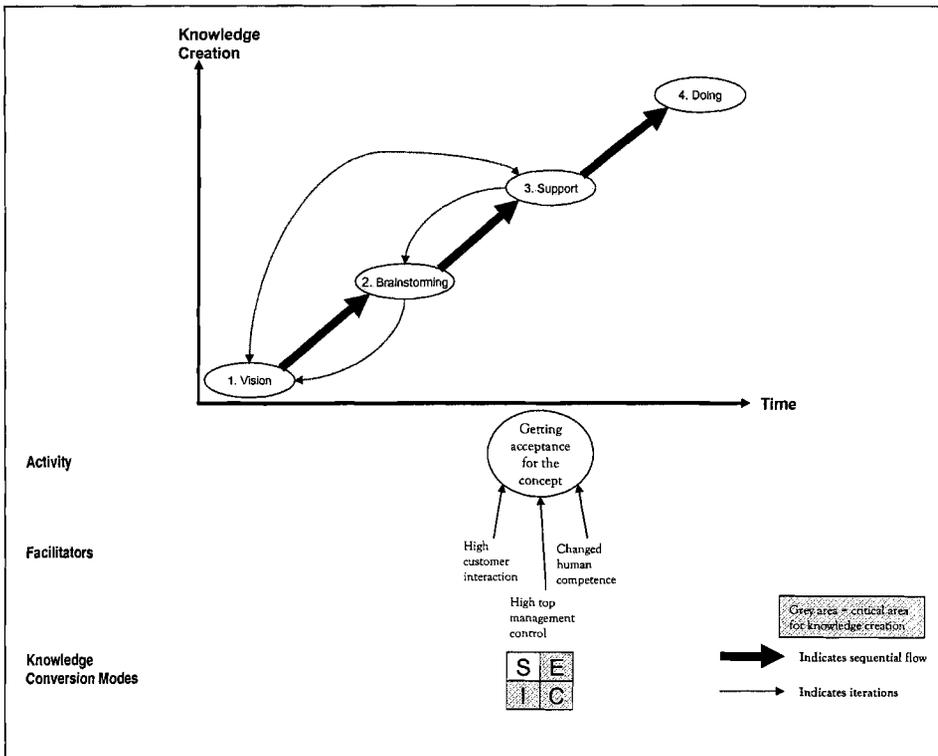
the project to get access to some specific knowledge and new perspectives while still being dedicated and focused on their task (c.f. Cooper & Kleinschmidt, 1995, p. 326).

### Guiding Principle 3: Support – Getting Acceptance for the Concept

During the third phase in the knowledge creation process the focus is on getting acceptance, both inside the company, but also outside the company, for the concept developed in the previous two phases. During this phase there is a mix of tacit and explicit knowledge. Tacit knowledge is in focus as people outside the project try to understand the concept which has been developed, i.e. enriching their tacit knowledge with the new ideas developed in the project. But the explicit knowledge is also in focus during this phase as blueprints and prototypes from the early stages are shown and discussed. Thus, the process of combination and internalization are in focus as the project tries to get acceptance for a project. However, the externalization process may also come into focus as a project can use metaphors in order to verbalize their mental models in words and phrases.

Figure 9:5 ▾  
Balancing Knowledge Creation

Guiding principle 3: support – getting acceptance for the concept



When the first two phases are over it is time for the project to get acceptance for the concept, or concepts, that have been developed. A project seeking acceptance for the work conducted should try to get it both internally, as well as externally.

- First, in terms of the categories of slack it implies that a closer customer interaction is sought. The reason is, perhaps obvious, that in order to later on sell the product being developed, it is of crucial importance to test the developed concept to see if there is a future market for the product. Therefore the customer interaction should be increased during the third phase of the knowledge creation process.
- Second, the control that the top management exercise should also be increased. The top management should now govern the project to a greater extent than they did in the previous two phases. There are two reasons for this. First, to position the project in relation to other projects and products in the organization. Second, to make sure that the project is making progress. As a result the top management should increase its control over the project during the third phase of the knowledge creation process.
- A third way of getting acceptance for the concept is by changing some of the members in the project, replacing experienced members with newcomers. The change of members in the project serves two purposes. First, the members that are moved from the project into other parts of the organization can tell others about the project. Second, the new members can add additional views about the concept and bring in knowledge from the outside. Thus, during the third phase of knowledge creation it is advantageous to change the members of a project.

In the literature the most common criterion for examining whether or not a concept can be accepted is related to the cost, profit, margin, and the extent to which the concept could contribute to the growth of the company (Nonaka & Takeuchi, 1995, p. 86). This is closely related to the increase in top management control. Cooper (1999, pp. 126-127) discusses that top management need to engage in the project in such a way that they clearly understand the implications of their decision, but still do not over manage all the details of the project. In essence, the top management should focus on controlling the project by mentoring, not controlling all small details of the project. However, in comparison to the two previous phases, the top management should take a more active role in pushing the project forward.

An important part of getting acceptance for a concept can be traced to whether the project is familiar to the company or not. Roberts and Berry (1985) discuss that project familiarity can be measured on two dimensions: technology and market. From a technical dimension it is easier to get acceptance for a concept if

there is a synergy between the product development project and the core business, so that a company can level on the in-house resources and attack from a position of strength (Cooper & Kleinschmidt, 1995).

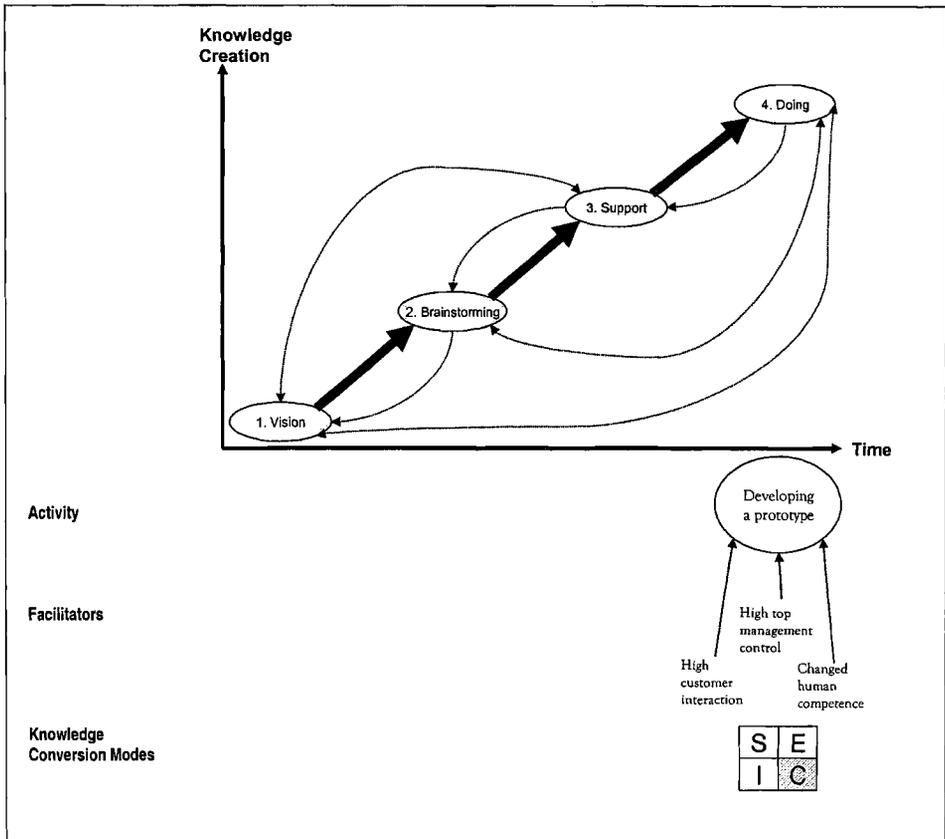
Concerning the market dimension, previous studies have pointed out that customers are an excellent source of product ideas (von Hippel, 1986). But, as Cooper and Kleinschmidt (1995) have noted, there are other categories of ideas (internally generated, competitors, and suppliers) and the source of an idea only has a moderate effect on new product performance. This is not to say that it is unimportant to get acceptance for a product on the market. On the contrary, to be able to sell a product being developed it is important to introduce the product to customers classified as innovators and early adopters (Moore, 1999, p. 12), which can be done after the concept has been created.

#### **Guiding Principle 4: Doing – Developing a Prototype**

In the fourth and final phase of the knowledge creation process, after the project has gained acceptance for the concept they have developed, it is time to develop a prototype. When the concept is accepted internally and externally it is time to convert the concept into something tangible or concrete, i.e. some sort of an archetype. In a product development process the archetype corresponds to a prototype, while in a service setting it corresponds to a model operating mechanism. For both the underlying logic is the same. That is, new explicit knowledge is combined with existing explicit knowledge, which facilitates the development of the prototype, i.e. resembling the process of combination.

Figure 9:6 ▾  
Balancing Knowledge Creation

Guiding principle 4: doing – developing a prototype



When the product development project is moving into the fourth phase, the focus is on developing a prototype. During this phase the focus is on creating something tangible that can be shown externally, but also to be used internally, in other parts of the organization besides the R&D division.

- In the fourth and final phase the project should try to get input from actual or potential customers. The reason is that such input is important in order to determine whether the product needs to be re-designed to better fit the needs of the customer. Thus, the recommendation is that the project should increase the customer interaction, since it facilitates the process of knowledge creation.
- During the fourth phase the top management should increase its control over the project. The increased control implies that the top management makes sure that the project is proceeding and keeps on working on the development of a prototype, and not taking a step back to refine the concept, unless it is perceived as necessary. However, a decision to end

the work with the prototype should be a mutual agreement between the top management and the project on what is best for the project. The recommendation given is that the top management should increase its control during the fourth phase of the knowledge creation process.

- In the final phase the human competence can also be changed. Since new members can also contribute with additional knowledge that is missing in the project. For instance the project can bring in new members that are knowledgeable about marketing or production. Therefore the recommendation is that a project can benefit from bringing in new members in the final phase of the knowledge creation process.

The findings in the present study, that the independence of a project in terms of increased customer interaction and top management control can be reduced at this stage, is supported by Nonaka and Takeuchi (1995, p. 88) who discuss that the autonomy of a team is not that important at this stage. In addition, they also discuss the importance of redundancy at this stage, which is similar to the findings of the present study about the benefits of introducing new members, i.e. reducing human competence. Kessler *et al.* (2000) argue that input from external categories, such as customers, should be kept low in the initial phases of a product development project, but that it is beneficial to increase the reliance on external knowledge during the later phases of a project, which is in line with the findings and recommendations in the present study.

## **Implications of the Synthesized Model**

Returning to the original problem – organizational downsizing and innovation, or, the tension between short-term problem solving and long-term strategic thinking – the synthesized model of the knowledge creation process is a suggestion for how knowledge creation can be managed over time, while a company is simultaneously reducing slack and being innovative (operationalized as the ability to create knowledge).

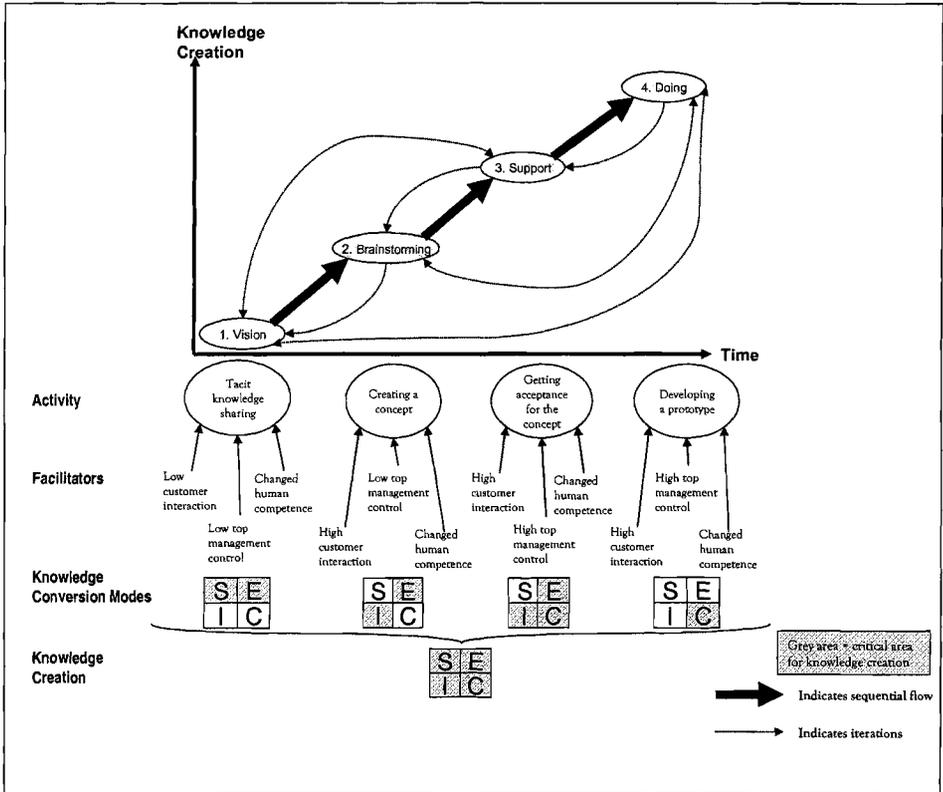
The challenge for companies is to acknowledge that projects in product development pass through a number of phases, each with different characteristics. The difference between the phases makes it possible to reduce organizational slack in some phases, while it is of crucial importance that slack is increased in other phases. In addition the synthesized model builds upon categories of slack, which are easier to grasp than organizational slack, which is a rather vague concept and as a result difficult for companies to apply. Examining the synthesized model of knowledge creation there are three main implications.

- First, there is a need to understand the role of different categories of slack for knowledge creation.
- Second, not all projects need to, or should, be focused on knowledge creation.

- Third, the synthesized model is not necessarily sequential.

These are discussed below, and in the next chapter these implications form the basis for the conclusions of the thesis, but also key lessons and implications for managers.

Figure 9:7 ◀  
Balancing Knowledge Creation



### Implication 1: The Need to Understand the Role of Categories of Slack for Knowledge Creation

If the relationship between the categories of slack and the knowledge creation process is not well understood, the risk is that the facilitators, i.e. the categories of slack, are changed in such a way that they actually hamper the knowledge creation process. As discussed extensively in this chapter, there are four guiding principles and associated activities pointing out the facilitators in different phases giving rise to a particular knowledge conversion mode. Since each of the different phases has already been discussed, the following is only a short summary.

- Customer interaction is of crucial importance, at the right time, in order to get the product out on the market. However, it is important to have little customer involvement at the outset of a project since otherwise the risk is that the project begins focusing on the demands of the customer, instead of sharing the tacit knowledge among the members and agreeing upon a vision. At later phases it is, on the other hand, of crucial importance that the project gets input from customers.
- Closely related to customer interaction is top management control. To grant autonomy at the right time, in particular in the early phases of a project, is important in facilitating the process of knowledge creation. While in later phases of the project, where there are demands for results and there is a need to communicate the importance of a project both internally and externally, top management need to exercise more control.
- Human competence is the third category of slack. In the thesis it has been argued that changes in human competence in a development project are often positive, as new members come with new perspectives, fresh ideas, and challenge and improve the accumulated knowledge. The reason for why a project group should change over time is well captured by Katz (2004, p. 161) who argues that ‘research and development groups seem to have performance curves analogous to the human life cycle – tentative youth, productive energy, and decline with maturity’. To avoid a situation where a project becomes “old and tired”, resulting in little knowledge creation, it is important that there are changes in the human competence over time. Needless to say, the changes in human competence cannot be too considerable at any one point in time as the project then risks losing the history of the project.

## **Implication 2: Not All Projects Need to Engage in Knowledge Creation**

The synthesized model focuses on knowledge creation and says little about project outcome. As a result, it is possible for a company to have projects that develop successful products for the market, but these projects cannot be characterized as knowledge creation projects. This may seem like a contradiction. It is, however, necessary to recognize the difference between projects, and in particular between derivative and platform projects. Not all projects have to, or even should, engage in knowledge creation.

There are, however, projects in which it is important to create knowledge in order to be innovative in the long-term. This is especially important in projects that are platform projects, as these projects are the foundation for future, derivative, projects. The difference between platform and derivative projects has already been touched upon as a reason for why it was not possible to identify the knowledge conversion modes in some of the projects in the study. The

consequence of not making a distinction between platform and derivative projects may be that a company does not manage to develop projects that engage in knowledge creation. The difficulty of treating platform and derivative as two distinct types of projects, with different needs, is a heritage from the view that all projects fit into well-defined stage-gate models.

In the literature on product development the role of stage-gate models is often highlighted as *the* way of running a development project (c.f. discussion in Engwall, 2003b, chapter 7). The basic idea behind stage-gate models is that each stage begins and ends with a formal decision (gate). As more knowledge is gained over time the level of detail in the decisions (at the gates) is increased. During the evolution of the project it is possible to end or make changes in the project as a project reaches a gate. The strength of the model is that they are a disciplinary way of managing product development. In particular the following five benefits are often attributed to the stage-gate models:

1. The stage-gate models are easy to understand, and create a meaning over time.
2. Since the stage-gate models have a number of gates along the way it is easy to control the progression of a project.
3. The progression of a project and the efficiency of a project may be difficult to assess prior to the conclusion of the project. For that reason the stage-gate models create a sense of trust in the relationship with customers and other actors surrounding the project. Thus, the models give a sort of legitimacy.
4. Stage-gate models have an organizational meaning. By using the models a standard is created for how development work is conducted in the organization. As a result the members in the organization speak the same language, the predictability is increased (making it easier to move from one project to the next), and a number of standard procedures are developed.

In conclusion, the stage-gate models are powerful tools for managers as they organize development work. Recently, however, the limitations of the stage-gate models have come into question (Engwall, 2003b; Engwall & Westling, 2004). In particular, there are shortcomings in stage-gate models when it is difficult to know the end result, when a lot of knowledge creation is involved in the project over time, and when it is a non-standardized task at hand. Thus, the stage-gate models are beneficial if control over the development process is sought, but disadvantageous if innovation and knowledge creation are in focus. The key issue is to understand that project success is not equal to knowledge creation and, as a consequence, it is necessary to identify what the outcome from a project is supposed to be.

- If it is only to get a product out on the market as soon as possible, then the top management can control the project closely from the outset, and the interaction with customer(s) can be high all the way, while there may be no or only small changes in the human competence among the members of the project. Thus, there is no need to change the level of slack depending on what phase in the knowledge creation process is in focus. And as a result, the success of the project has little to do with whether the projects were able to create knowledge.
- If, however, the focus is on creating a product that demands knowledge creation, in the project, but also afterwards, there is a need to recognize that a project may be unsuccessful in terms of getting a product out on the market, but that there may be key lessons to be learned from the project. The knowledge developed in a failure project may be used in future projects, and as a result it is important to take a more holistic view of the context the project is developed in, instead of analyzing the project as a single and temporal event (c.f. Engwall, 2003a).

Put differently; the solution is to recognize that there are different projects in an organization; derivative and platform projects. The difference between the two can metaphorically be expressed as an implementation process versus a knowledge journey; or as the difference between exploration versus exploitation (March, 1991). Basically the problem is rather easy to grasp, there is a need to go beyond the stage-gate models, allowing for knowledge to be created along the way in a project. This in turn puts a demand on the project not to set a fixed goal at the outset of the project, but instead be open to the fact that knowledge can be created along the way. The challenge is to create a readiness for knowledge creation and to review the project during the *whole* project.

Several authors (e.g. Choo, 1998; Darroch & McNaughton, 2002; Soo *et al.*, 2002) discuss the ability to create knowledge as not only being a key to becoming innovative, but also as a way to enhance the competitive advantage of a company over time. Therefore a company needs to have projects focusing on knowledge creation, which puts a demand on companies to successfully manage and balance the increase and decrease of organizational slack over time. By finding a balance, companies increase the possibility of being innovative over time by reducing organizational slack, and still meeting the requirements of short-term results. That is to some extent an answer to the question of how companies can address the short-term demands whilst still being innovative in the long-term. This, however, puts a demand on the project to go beyond thinking strictly in stages and gates.

### Implication 3: The Synthesized Model is Not Necessarily Sequential

In development work, there is often a goal that different stages should come in a nice sequential order. This originates from the ideas in the stage-gate models, but such is not always the case, especially in more radical, or platform projects. In these projects it may, in fact, be necessary to go beyond the thinking of stages, and instead understand that iterations back and forth between different stages are necessary.

In the present study it was evident that in the platform project there was a need for the members to share their tacit knowledge and then to develop a concept that everybody understood. It was important for the members to reduce the uncertainty surrounding the *product* - what are we supposed to develop? - and the *process* - how are we supposed to do it? As the uncertainty is reduced in these two dimensions it is possible to take the next step and begin developing the product. In terms of the synthesized model, it corresponds to the move from 'vision', over 'brainstorming' and 'support' to 'doing'. The move is, however, not always straight forward.

- For instance, in the Integration project the group of experts developed a prototype, i.e. the phase of 'doing'. But since neither the members of the project nor the potential customer could fully grasp the product, it was perceived as necessary to take the project back to the phase of 'brainstorming'. By doing that the project laid a foundation for a shared understanding among the members of the project which made it possible to talk and act as if the future product already existed.

Thus, in a development project there may be a need to have iterations between different phases over time, as the process of knowledge creation is not always a straight forward process. In addition, the different phases in the synthesized model are also closely related, which again suggests that it is important to be able to manage a development process that is not necessarily sequential.

# CHAPTER TEN

## **Contributions, Managerial Implications and Future Research**

*In the final chapter of the present thesis the focus is on discussing the study's contribution to existing knowledge, but also to highlight the managerial implications as well as suggesting directions for future research.*

### **Organizational Downsizing and Innovation – Two (In)compatible Trends?**

The central problem examined in the present study is whether it is possible for a company to downsize, in order to improve the competitive position of the company, while at the same time have a sustained level of innovation, often cited as the key to long-term success for companies. The central problem was conceptualized as the relationship between organizational slack and knowledge creation.

More specifically, the aim of the present study was to examine organizational slack and knowledge creation at the level of the product development project. The intention behind this aim was to start to open up the black box linking organizational slack and innovation. The proposition underlying the thesis is that knowledge creation is an important mechanism for the relationship between organizational slack and innovation. Knowledge creation was conceptualised as the ability to share and transfer knowledge between and among members in product development projects.

Here, in the final chapter, the findings from the present study are compared with existing studies addressing organizational slack and knowledge creation in product development projects, and the contribution to existing knowledge is

stated. It should be noted that even though a comparison has been made across the cases, identifying similarities and differences, the patterns that have emerged are only preliminary patterns. Based on six cases researched in the information technology and telecommunication industry, there are clear limitations to what can be claimed to be general and, as a consequence, more research is clearly needed in order to validate the findings of the present study.

However – and this is important – if the six cases are viewed as typical examples for cases which face the challenge of maintaining a high level of innovation, while there is downsizing in the organization, it is possible to suspect that the conclusions in the present study are relevant for other cases facing the same challenge in similar settings. Consequently, the conclusions from the present study are hopefully valid in other development projects as well, even though the validity must be tested in each case. In addition, discussing the contributions from the present study in relation to existing knowledge, also addresses the issue of generalization, since the findings from the six cases in the thesis can be made more general through a comparison with existing knowledge (c.f. Engwall, 2003b; Åhlström, 1997).

Thus, despite the concerns over the limitations of the study, important preliminary conclusions can still be drawn. Returning to the central problem in the present study, the question of whether companies can simultaneously downsize and still maintain a high level of innovation, the simple answer is; yes. A more correct answer is; yes, but it is difficult and challenging. The clues to success lie in paying particular attention to how categories of organizational slack influence the knowledge creation process over time.

The main conclusion in the present study is that attention needs to be paid to the different categories of organizational slack in product development projects and their effect on the knowledge creation process. The main conclusion is expressed in the synthesized model presented in the previous chapter, the model is a suggestion for how knowledge creation can be managed over time, while a company is simultaneously reducing slack and at the same time are innovative (operationalized as the ability to create knowledge).

Taking into consideration the relationship between categories of slack, and their relationship with knowledge creation, I would on the basis of the results in this study, argue that it is not enough to think in terms of increases or decreases in organizational slack at a general level, to attain a certain outcome in innovation, as previous research has indicated. Instead, attention needs to be paid to the different categories of organizational slack and their effect on the knowledge creation process in product development projects.

In comparing the present study's findings to existing knowledge on organizational slack and knowledge creation, it is possible to arrive at the present study's contribution to existing knowledge. It is in the difference

between existing studies and the present one that the present study's contribution to knowledge can be identified. There are three contributions from the present study. First, categories of organizational slack are identified at the level of the project. Second, the relationship between these categories of slack is shown. Third, the relationship between categories of slack at the level of the project and knowledge conversion modes is shown.

### **First Contribution: Categories of Slack at the Level of the Project**

*The identification of four different categories of slack at the level of the project is the present study's first contribution – corresponding to the first research question in the thesis.*

Through the exploratory case research it was possible to reduce and refine the seven categories of slack previously identified at the level of the firm, into four categories of slack at the level of the project. The identification of these four categories of slack constitutes the present study's first contribution to existing knowledge. The four categories of slack are:

- Customer interaction – The interaction between a project and its customers is a category of organizational slack in product development projects.
- Top management control – The control that top management exerts over a project is a category of organizational slack in product development projects.
- Project deliverables – The possibility for projects to depart from the promised deliverables, in terms of deadlines and/or product functionality, is a category of organizational slack in product development projects.
- Human competence – The level of the collective competence of project members is a category of organizational slack in product development projects.

In comparison to other theories of organizational slack, the present study differs in some respects. First, and perhaps most obvious, the present study does not view slack as being solely related to a company's financial resources (e.g. Cheng & Kesner, 1997; Greenley & Oktemgil, 1998; Singh, 1986), which is the prevailing view of slack. Instead the view in the present study is that there are other categories of slack as well (c.f. Meyer, 1982). Second, while most studies of organizational slack are conducted at the level of the firm, the present study has used the project as the unit of analysis. The main implication of the findings is that it is not appropriate to think of organizational slack in general terms. At the level of the product development project different categories of slack exist, which are different from categories of slack at the level of the firm. A change in

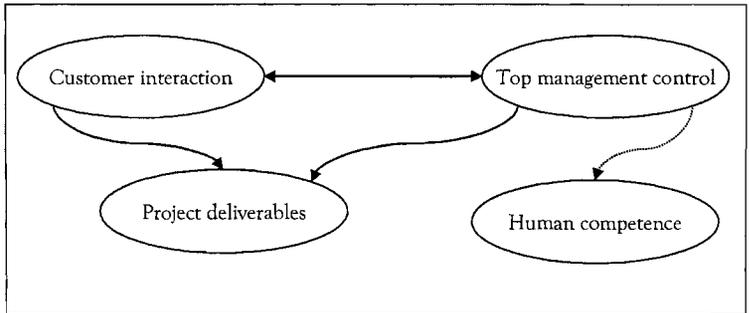
the different categories of slack, in turn, leads to different effects on each of the four knowledge conversion modes, as discussed in chapters eight and nine.

## Second Contribution: Relationship between the Categories of Slack

*The examination of the relationship between the four different categories of slack at the level of the project is the present study's second contribution – corresponding to the second research question in the thesis.*

In chapter six, the four categories of slack identified at the level of the project were related to each other. The present study identified that customer interaction and top management control are closely related and difficult to discriminate between. These two categories of slack influence project deliverables, which is comprised of two parts: when to deliver, and what to deliver. Human competence, being the fourth category of slack, is to some extent a category of its own, which is only to a minor extent influenced by top management control. The identification of the relationship between the categories of slack constitutes the present study's second contribution to existing knowledge.

**Figure 10:1 ▶**  
**Relationship between**  
**Categories of Slack at**  
**the Level of the**  
**Project**



The conclusions drawn on the relationship between categories of slack at the level of the project are particularly difficult to relate to existing studies. The reason is that there is a lack of studies which take a comprehensive view of the project and include all four different categories of slack. Instead, it is more common to focus on one of the categories. For instance, it is possible to identify studies on customer interaction, and among many authors the works by von Hippel (e.g. 1986) on lead users are of particular importance. As there is a lack of studies taking a more comprehensive view, including all categories of slack, it is difficult to make a comparison between the conclusion in the present study and other studies. And as a result, the present study's findings stand uncontradicted.

### Third Contribution: Categories of Slack and Their Relationship to Knowledge

The examination of the four different categories of slack at the level of the project and their relation to the four knowledge conversion modes is the present study's third contribution – corresponding to the third research question in the thesis.

The present study also examined the relationship between the categories of slack and knowledge conversion modes. The discussion and analysis of the relationship between slack and modes of knowledge conversion was built up around a four-by-four matrix. The analysis suggests that a reduction of organizational slack in each of the four categories of slack can hamper or facilitate each of the four knowledge conversion modes. The identification of the relationship between the categories of slack and the knowledge conversion modes constitutes the present study's third contribution to existing knowledge.

**Table 10:1** Relationship between Categories of Slack and Knowledge Conversion Modes

Category of slack	Knowledge conversion modes			
	Socialization process	Externalization process	Combination process	Internalization process
Increased customer interaction (less slack)	Hampered	Facilitated	Facilitated	Facilitated
Increased top management control (less slack)	Hampered	Hampered	Facilitated	Dual
Decreased possibilities to depart from project deliverables (less slack)	Dual	Dual	Dual	Dual
Reduced human competence (less slack)	Facilitated	Facilitated	Dual	Facilitated

- The conclusions related to customer interaction are as follows:
  - Conclusion 1A) Increased customer interaction hampers the process of socialization.
  - Conclusion 1B) Increased customer interaction facilitates the process of externalization.
  - Conclusion 1C) Increased customer interaction facilitates the process of combination.
  - Conclusion 1D) Increased customer interaction facilitates the process of internalization.
- The conclusions related to top management control are as follows:
  - Conclusion 2A) Increased top management control hampers the process of socialization.

- *Conclusion 2B) Increased top management control hampers the process of externalization.*
- *Conclusion 2C) Increased top management control facilitates the process of combination.*
- The conclusions related to project deliverables are as follows:
  - *The evidence concerning project deliverables is dual.*
- The conclusions related to human competence are as follows:
  - *Conclusion 3A) Reduced human competence facilitates the process of socialization.*
  - *Conclusion 3B) Reduced human competence facilitates the process of externalization.*
  - *Conclusion 3C) Reduced human competence facilitates the process of internalization.*

The implication of the third contribution is that consideration must be taken as to the category of slack that is influenced by an action. Each category of slack has a different influence on each of the knowledge conversion modes, which in turn affects the creation of knowledge and in the end the firm's innovative ability. Building upon this finding, a synthesized model for how the knowledge creation process can be managed over time, by having a balanced level of slack, was developed. Three implications stand out from the synthesized model: 1) there is a need to understand the categories of slack for knowledge creation, 2) not all projects need to engage in knowledge creation, and 3) the synthesized model is not necessarily sequential. Each of these three implications was thoroughly discussed in the previous chapter, and will not be elaborated on in the present chapter.

In comparison to related theory (Nonaka, 1994; Nonaka *et al.*, 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000), the conclusions in the present study differ, since the present study explicitly focuses on the relationship between categories of slack and knowledge creation. In addition, these earlier studies also focus on knowledge creation as an activity that has to be cross-leveled in the organization, which is something the present study does not claim to do. There are, however, similarities to these previous studies since they are concerned with the development of an enabling context, which is similar to the idea of managing changes in the categories of slack over time.

## **Managerial Implications**

The present study's findings also have implications for managers. Clearly more research is advisable before fully confident recommendations can be made to managers, nevertheless, the research does have messages for managers. In particular there are two challenges facing managers and companies.

First, managers need to recognize and understand the processes, or underlying mechanism, that guides the relationship between downsizing and innovation, i.e. organizational slack and knowledge creation. On the basis of the present study's results, it is possible to argue that the key to success lies in the ability of an organization, and its management to understand that it may not be enough to simply increase or decrease slack at a general level, in order to have a certain outcome in innovation, as previous research has indicated. Instead, attention needs to be given to those different categories of organizational slack in product development projects and their effect on innovation.

Second, managers need to recognize that there are different needs in a knowledge creating (platform) project than there are in incremental or derivative projects. As an organization downsizes they face the risk of having a product development portfolio consisting of only incremental projects that are easy to implement, measure and execute. Incremental projects may be effective in the short-run, but they can be self-destructive in the long-run (March, 1991). As a consequence, organizational downsizing solely targeting explorative projects may cause a situation where the long-term ability of being innovative is damaged. Thus, the challenge for companies that need to downsize, but want to be innovative over time, is the challenge of maintaining a balance between knowledge creating projects and incremental projects.

- At an overall level, the message is that programs to increase cost efficiency and operational effectiveness may damage the ability to innovate in the long run. However, the reduction of resources has no direct and clear influence on the ability to innovate. Different focuses in rationalisation programs have different impacts on product development projects. Through reducing organizational slack, the ability for project teams to create, share and transfer knowledge is reduced, and the risk is that this will have negative implications on innovation.
- A second message from the research is that there are different categories of organizational slack in product development projects. Depending on the category of slack that is being reduced, we can expect different results in knowledge creation and ultimately innovation. The four categories of organizational slack identified, can be seen as levers that managers can use to affect how knowledge creation takes place in product development projects and thus ultimately innovation. The levers can be used to deliberately change the prerequisites of a product development project. Depending on what outcomes are desired, in terms of knowledge creation, different levers can be used.
- Finally, managers need to understand that there are different types of projects, not all of which should create knowledge. These projects should be treated differently in comparison to knowledge creating projects. For

more incremental projects (with a low level of knowledge creation) stage-gate models works fine. However, for (platform) projects where the creation of knowledge is in focus, it is important to recognize the limitations of a stage-gate model. There may be a need for projects to have frequent iterations between different stages or phases, it may also be necessary for a project to start “doing” prior to deciding upon the goals and end result of the project, since it is difficult to understand where the project will end at the outset of the project (c.f. discussion in Engwall, 2003b).

The managerial implications on managing and balancing knowledge creation described below may seem a little bit speculative and normative in comparison to the rest of the thesis. The implications are, however, based on the present study’s results and as such they should be understood in the light of an attempt at translating the somewhat more theoretical part of the thesis, to something more useful and understandable for managers.

### **Managing and Balancing Knowledge Creation**

In chapter nine a synthesized model for how companies can manage knowledge creation over time, through achieving a balanced level among the categories of slack, was developed. I will not repeat the model in its entirety, but rather point out the most important lessons from the model.

- First, it is important to recognize that the level of organizational slack in each of the categories of slack changes over time. Projects in different phases have different needs in terms of the levels of slack in each of the categories. To actively make changes in the categories over time is challenging, but rewarding if done right, as the knowledge creation process is facilitated.
- Second, it is important that the company develops a climate which guarantees that a knowledge creating project has the possibility to engage in building a vision; where all members can contribute with input and create a shared view of what the end result should be. Thus, the company must grant the project autonomy to “act first, understand later”, instead of forcing the project into a rigid stage-gate model which is supposed to guide the development work.

- Third, closely connected to the vision is the creation of a concept, which can be (just as the vision) difficult to express and communicate in words. For that reason the project should be encouraged to develop metaphors and simple models that aid the members of the project to share their experiences and knowledge.
- Fourth, a knowledge creation project is not necessarily a straight forward process. Sometimes there is a need to go back to previous phases and revise previous solutions before moving forward again, which is a consequence of the fact that knowledge and experience is gained over time in a development project. As a result, the organization must manage to handle these iterations.
- Fifth, it may seem as if a knowledge creation project should be managed without having any type of control. That is, however, a misinterpretation. At certain phases there should be an emphasis on reaching a closure in the project. During such a phase the possibility to deviate from the project plan is minimal. In other phases it can, on the other hand, be beneficial to have flexibility in the project to make possible, for instance, iterations with earlier steps in the development process.
- Sixth, it is important to note that even though knowledge creation projects are important for the organization's long-term survival, and may call for special treatment as they do not always fit with the traditional stage-gate models, they cannot be the sole activity of an organization. One reason is that knowledge creating projects may be costly, and they also carry a good deal of risk with them. Another reason is that the organization needs to engage in incremental projects, which are less risky and give a more certain pay-back. Thus, an organization needs to find a balance between knowledge creating (explorative) projects and exploitation projects.

Thus, there is a need to recognize that there are different types of development projects in an organization, with different characteristics. Without being knowledgeable about these differences it is easy to reduce slack in such a way that it hampers the development work. For that reason it is necessary for managers to think beyond the short-term bottom-line financial results and the associated focus on cost minimization and efficiency.

The message to managers is not to try and reduce organizational slack with, for instance, 10 percent all across the company. But instead examine the consequences of a reduction in organizational slack in each product development project, identifying the type of project in focus. The consequence may be that in some projects, it might be beneficial to reduce one or more categories of slack by more than 10 percent. It could make the work in the project more focused on reaching a closure, particularly salient for projects in

their final phases. On the other hand, at the outset of a project it might be more beneficial to actually increase slack in order to create opportunities to share tacit knowledge inside the project, i.e. achieving the first step necessary for creating knowledge.

The finding that managers need to integrate the view of focusing on short-term efficiency with the more long-term goals in the organization is supported in a recent study by Smart *et al.* (2003) who discuss the difficulties that managers face as they try to integrate the achievement of medium- and long-term goals with short-term efficiency gains. They argue that it is not enough to try to “get out more for less” by stripping the organization in order to achieve cost minimization. In these organizations an emphasis is often placed upon a strong division of labor and prescribed bureaucratic forms, which does not always – as has been explained – go hand in hand with knowledge creating projects.

### Advice to Managers

In order to manage the creation of knowledge, taking the different categories of slack into consideration, there is some specific advice that can be given to managers. This advice can, hopefully, be used as a guide in organizations faced with downsizing, while still striving for achieving a high level of innovation. In the following, particular attention is given to activities aiming at the achievement of a balanced level of slack, but also to the difference between explorative and exploiting projects.

- Managing knowledge creation is a complex and challenging task. In particular there is a need to understand that a development project passes through different phases, each with different needs in terms of the type of slack needed. To be knowledgeable about when to reduce slack, and in what category, is one key to achieving a long-term innovative capacity, while still being able to downsize.
  - To, perhaps, further complicate things, a knowledge creating project is not always a straight forward process. As a result, the organization needs to be able to handle iterations between different phases in a product development project.
  - A decision to launch a project should be associated with resources being given to the project. If it is necessary to do some sort of downsizing, then it is necessary to look at each project individually and at the specific needs of each project. It is not a good idea to try to downsize equally in every project, rather look at the phase the project is in at that moment in time, and the needs in the different slack categories. Thereafter decide what should be reduced and what should be increased.

- Another challenge for organizations and managers faced with downsizing is to find a balance among the projects in the organization, which involves the trade-off between knowledge creating (platform) projects and incremental projects. The choice between the two is difficult. The realization of returns and level of uncertainty is difficult to assess in the case of knowledge creating projects, but easier for incremental projects. Nevertheless it is important to make a conscious choice in the organization, which is in accordance with the overall innovative strategy in the company.
  - This also calls for an examination of all development projects, from which the goal should be to create a balanced portfolio of incremental (exploitative) projects and more radical (explorative) projects.

## **Suggestions for Future Research**

Subsequent and future research on organizational slack and knowledge creation can take a number of directions. Drawing on the presents study's limitations and contributions, the directions for future research are suggested. The comparison of the results and conclusions in the present study to literature on organizational slack and knowledge creation suggested that the conclusions of the study were plausible. There are, however, limitations to this research. More research is clearly needed in order to validate the present study's findings.

It was chosen to conduct the present study in the information technology and telecommunication industry. More research is clearly needed to examine whether the same categories of slack can be found in industries with different characteristics. Another limitation is the small sample. Hence, opportunities for future research lie in these three directions.

- First, replicating the study in different types of industries may help to identify further categories of organizational slack.
- Second, doing survey-type research may help to validate the propositions derived in this research, through testing and clarifying the findings. Such a quantitative study should examine the conclusions considering the relationship between categories of slack and the modes of knowledge conversion. Based upon the present study's findings, the propositions to be tested would be the following:

Table 10:2 ▼

**Propositions Concerning the Relationship between Categories of Slack and Knowledge Conversion Modes**

Customer Interaction	Top Management Control	Human Competence
P 1a) Increased customer interaction hampers the process of socialization	P 2a) Increased top management control hampers the process of socialization	P 3a) Reduced human competence facilitates the process of socialization
P 1b) Increased customer interaction facilitates the process of externalization	P 2b) Increased top management control hampers the process of externalization	P 3b) Reduced human competence facilitates the process of externalization
P 1c) Increased customer interaction facilitates the process of combination	P 2c) Increased top management control facilitates the process of combination	P 3c) Reduced human competence facilitates the process of combination
P 1d) Increased customer interaction facilitates the process of internalization		

- A third and further avenue which future research can take is to make a deeper investigation into the relationship between knowledge creation and the categories of organizational slack at the level of the product development project. Of particular importance would be to follow a company that is about to downsize, examining the reasons and strategies before, during and after the period of downsizing, analyzing the effects on organizational slack and knowledge creation, and ultimately on innovation in product development. Such a study would have the potential to further clarify the relationship between organizational downsizing and innovation. Time will tell if I am the one to do any of these suggested studies...

# APPENDIX

## Appendix I: Knowledge Conversion Modes

In his two most famous works Nonaka (1994; Nonaka & Takeuchi, 1995) is not that explicit about the operationalization of the knowledge conversion modes. Rather, these four modes are discussed as examples. Therefore additional explanations were sought after in the literature. Luckily I was able to get hold of an article written by Nonaka *et al.* (1994) in which a first comprehensive test (i.e. quantitative survey) of the knowledge creation theory was conducted. I decided to use the article as a basis for the operationalizations made about each of the four modes of knowledge conversion in the present thesis.

The reasons for choosing these operationalizations were twofold. First, they were developed by Nonaka who is the founder of the knowledge creation theory and should thus reflect his interpretations of the four modes of knowledge conversion. Second, in the article Nonaka and colleagues also find support for each of the four modes of knowledge conversion. Thus, the operationalizations seem to be working. However, I also wanted to acknowledge other work by Nonaka (e.g. 1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000) that discusses the knowledge conversion modes. As a result I have included their work in the operationalization used, which is described in the table below.

The operationalization of the knowledge conversion modes was used at different points in time in the thesis. First, when I developed the case-study protocols guiding the interviews. Second, during the coding of data in N-Vivo the operationalization of the knowledge conversion modes helped me to discriminate between different statements by the respondents in the interviews, e.g. should something be coded into socialization or into internalization? Third, the operationalization was most helpful during the analysis conducted in chapter seven.

A short summary of each mode of knowledge conversion and the operationalization are presented in the table below, building mostly on Nonaka

*et al.* (1994), but with complementary input given from the works by Nonaka and colleagues (1994; Nonaka & Takeuchi, 1995; von Krogh *et al.*, 2000). As has been discussed, mostly in chapter seven, but also in chapter eight and nine, the operationalizations below have their disadvantages. Nevertheless, at the outset of the present study I thought it was better to begin working with a model that had gained widespread attention among scholars as I developed the research framework. But as discussed in chapter nine, my synthesized model of how to manage knowledge creation deviates from the work by Nonaka.

**Table 11:1 ▼**  
**Operationalization of Knowledge Conversion Modes (Source: Nonaka *et al.*, 1994)**

<b>Socialization</b>	
Tacit knowledge accumulation	The extent to which managers gather information from sales and production sites, share experiences with suppliers and customers, and engage in dialogue with competitors.
Extra-firm social information collection (wandering outside)	The extent to which managers engage in bodily experience through management by wandering about, get ideas from corporate strategy from daily societal life, interaction with external experts and informal meetings with competitors.
Intra-firm social information collection (wandering inside)	The extent to which managers find new strategies and market opportunities by wandering inside the firm.
Transfer of tacit knowledge	The extent to which managers create a work environment that allows peers to understand the craftsmanship and expertise through practice and demonstrations by the master.
<b>Externalization</b>	
Use of metaphors	The extent to which managers use metaphors in dialogue and concept creation.
Dialogue in concept creation	The extent to which managers perform facilitation of creative and essential dialogue.
Dialogue about concepts and models	The extent to which managers involve industrial designers in project teams, and the use of "abductive thinking".
<b>Combination</b>	
Acquisition and integration	The extent to which managers are engaged in planning strategies and operations, assembling internal and external existing data by using published literature, computer simulations and forecasting.
Synthesiz and processing	The extent to which managers build and create manuals, documents and databases on product and services and build up material by gathering management figures or technical information from all over the company.
Dissemination	The extent to which managers engage in planning, implementation of presentations, to transmit newly created concepts.

### Internalization

<b>Personal experience, Real world knowledge acquisition</b>	The extent to which managers engage in “enactive liaisoning” activities, which corresponds to when members from functional departments are put together in cross-functional development teams, in order to get an overlap of competencies in product development. In these teams the members search and share new values and thoughts. The members also share and try to understand management visions and values through communications with fellow members in the organization.
<b>Simulation and experimentation, virtual world knowledge acquisition</b>	The extent to which managers engage in facilitating prototyping, benchmarking and test marketing, and facilitate the challenging spirit within the organization. Form teams as a model and conduct experiments and share results with the entire department.



# APPENDIX II

## Appendix II: Case-Study Protocol

Below is an example of a case-study protocol that was used at the outset of the study. As discussed in the third chapter the case-study protocol is a “living” document that changes over time. By comparing the case-study protocol with the example included in chapter three the reader can themselves see the difference. The reason for including the case-study protocol was that I wanted to show the type of questions that were asked during the initial interviews. It should be noted that in most cases it was not possible to ask all questions, either due to restraints in time, or due to other subjects being elaborated on (recall that the interviews were semi-structured).

Figure 12:1 ▼  
Case-study Protocol

**A – INTRODUCTION**

- Me – name and background
- The study – background, why here (sampling), aim, duration of study
- Confidentiality

**PROJECT – general and specific**

What is a project for you?

1. Tell me about the project
  - When was the project initiated
  - Thoughts and goals at the outset of the project
  - Background of members in the project (research/market/development org.)
  - Are there similar projects in the organization
  - What happens when the project ends
2. Tell me about the new project model
3. How are projects composed, by whom
4. Size and length of projects
5. Link between projects (formally/informally)
6. Coordination in project (meetings, PM/Reports, formally/informally)
7. Project followups (type of variables)
8. Time frames in project – are they possible to change
9. Goals in project – initial goals, end goals, vision

**KNOWLEDGE CREATION S + E**

How do you create knowledge?

1. On-the job training vs. formal education
2. Does mentorship exist
3. Who is included in mentorship, time
4. How are goals created, who participates
5. What are the goals (soft/hard, implicit/explicit)
  - Different types of goals (organizational/project/individual)
6. To what extent are goals reached
7. Critical success factors for goal attainment

**KNOWLEDGE TRANSFER**

How do you transfer knowledge?

1. Is benchmarking used – why, how, against who, what, extent, goal with benchmarking
2. Learning from customers and suppliers – extent, who participates
3. How are knowledge and experiences transferred/shared
  1. Internally – frequency, within/between projects and departments
  4. Who is responsible for transferring knowledge
  5. Incentives for knowledge and experience transfer/sharing
  6. What hinders the sharing and transfer of knowledge

**B – BACKGROUND PERSONALIA**

- Respondent – background and position
- Organization – size, etc.
- Type of work – project or line

**INNOVATION**

What is innovation for you?

1. Where do you/project get input for new ideas (internally/externally)
2. To what extent is input given from customers/suppliers
3. Who is forcing through the development process (market/development/research)
4. Contact between different divisions in the organization
5. Communication between different levels – frequency, format
6. What is the role of innovation – its importance in the company for competitive position

**SLACK**

How are projects governed – do you experience freedom?

- Resources
  - What are the key resources in the project, priorities
  - What resources are governed by the project
  - What other persons are you dependent on in your work
- What activities are you engaging in besides the project
- Time
  - To what extent do you govern over your own time
  - Do you experience time pressure, why, how
  - What type of freedom do you experience in your work/do you want to have/is the most important
  - Time for reflection (individually, in the project)
  - How are you/the project influenced by deadlines
- Goals
  - Difference between, and extent of short-term and long-term goals
  - What is emphasized in the project, short-term vs. long-term or a combination
  - Influence from stock market on company/project/you

**KNOWLEDGE CREATION C + I**

How do you create knowledge?

1. Where/how can old knowledge and experiences be retrieved
  1. Frequency, format, extent
  2. External experts
2. External sources for new knowledge
  1. Universities/research
  2. What tools (databases/intranet/experiences) are used to collect data and solve problems

# APPENDIX III

## Appendix III: List of Interviews

Below is a list of the interviews made in the present study.

Table 13:1 ▼  
List of Interviews

Systems Supplier		
Interview	Position	Date
1	Vice President of Technology	2001-12-11
2	Vice President of Technology and Quality & Development Manager	2002-01-14
3	Project leader	2001-01-17
4	Project leader	2001-01-29
5	Project member	2001-01-29
6	Project member	2002-03-25
7	Project member	2002-03-28
8	Project member	2002-04-03
9	R&D Planning Manager	2002-04-10
10	Project leader	2002-05-15
11	Project leader	2002-05-15
12	Vice President of Technology	2002-06-25
13	R&D Development Manager	2002-09-25
ERP Inc.		
1	Vice President of Technology	2001-12-03
2	Project leader	2002-01-15
3	Project leader	2002-01-18
4	Project leader	2002-01-18
5	Project member	2002-02-01
6	Project member	2002-02-01
7	Project leader	2002-02-04

8	Project leader	2002-02-05
9	Project member	2002-02-05
10	Project leader	2002-03-12
11	Project leader	2002-05-15
12	Project leader	2002-05-21
13	Project leader	2002-05-31
14	Project leader	2002-05-31
15	Project member	2002-06-03
16	Vice President of Technology	2002-06-25
17	Vice President of Technology	2002-06-26

# APPENDIX IV

## Appendix IV: Categories in N-Vivo

Below is a list of the categories, and subcategories used in N-Vivo. General statements were coded in a general category. The more specific answers were coded in a subcategory. In other words, the following structure was used:

- Category (general statements)
  - Subcategory 1 (more specific statements)
    - Subcategory 2 (the most specific statements)

It should come as no surprise that most statements were coded in subcategory 1 due to the semi-structured approach during the interviews, where fairly detailed questions were asked. It may seem that some of the different categories and subcategories do not “fit in”. However, it is important to keep in mind that the research in the present thesis is exploratory and that the categories (just as the case study protocol) are all part of a “living” document. In addition, the case write-ups helped me to further structure the data in order to identify patterns among the cases. If I were to replicate the present study, I would use a different structure in N-Vivo.

Table 14:1 ▼  
Categories in N-Vivo

Category	Subcategory 1	Sub-category 2	Category	Subcategory 1	Sub-category 2
<b>Respondent</b>			<b>Knowledge S+E</b>		
	Company			Mentors	
	Position				For whom
	Time in the company				Extent
	Education			Project goals	
	Customers				Are the goals reached
	Competitors				Different kinds of goals
	Products and markets				Who decides
<b>Project</b>					What are the goals
	Coordination in the project			New project members	
	Link to other projects			Education	
	Similar projects			Physical position	
	Members of the project			After work	
	The new project model			Dialogue	
	Project goals		<b>Knowledge C+I</b>		
	Project name			External sources of knowledge	
	Project start				Amount
	Project end				Universities
	Post-project audits			Old experiences and knowledge	
	Composition of the project			Tools for collecting experiences	
	Size and length of project			Comprehensive understanding	
	Timeframes in the project			Meetings	
	Project product		<b>Knowledge diffusion</b>		
	Problems in the project			Benchmarking	
	Steering committee			Hinders for knowledge diffusion	
<b>Innovation</b>				Input from suppliers and customers	
	Input to new ideas			Diffusion of knowledge	
	Input from customers and suppliers				Incentives
	Communication between different levels				Who is responsible
	Contact with different parts in the organization				Education
	Who "drives" or pushes the development		<b>Slack</b>		
	Important competitive tools			Goals	
					Share price
					Short- and long-term
					Success factors
				Resources	

					Other activities
					Staff dependent
					What can be governed
					Most important
				Time	
					Deadlines
					Freedom
					Reflection
					Governance of own time
					Time pressure



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