Developing Product Development in Times of Brutal Change

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STOCKHOLM SCHOOL
OF ECONOMICS
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In Loving Memory of Gunilla,

To Margareta, Lovisa and Karl Ragnar.

THESIS

This thesis consists of the following parts:

Developing Product Development in Times of Brutal Change. An Extended Summary.

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Paper IV: Kling, A. R. & Linnarsson, H. 2005. Externalizing Product Development for Flexibility: Experiences from the Telecom Industry.
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Paper V: Engwall, M., Kling, R., & Werr, A. 2005. Models in Action: How Management Models are Interpreted in New Product Development.
Published in R & D Management, **35**, 4, 427-439.

ABSTRACT

Developing Product Development – that's what it's about, developing our capability to do what we need to do.

Ericsson Executive

Product development in times of brutal change requires capabilities beyond normal product development capabilities. In order to meet the challenges of brutal change, an ability to change and improve how products are developed, and how product development is organized and managed is required. This thesis looks inside an industrial firm subjected to brutal market changes, forcing it to respond promptly and strongly, to reduce cost yet retain and improve the ability to develop, market, sell, deliver and support its products and services. The firm uses externalization of product development to cut fixed costs and reduce headcount quickly. To cut operating costs, it uses offshoring.

Transformational structural changes destroy both capabilities and rigidities. The increasingly competitive situation calls for even higher efficiency. Product development capabilities have to be recreated to support even higher efficiency while retaining and improving innovativeness. Participative organizational development is performed to rebuild and improve product development capabilities at the workgroup level. Software developers use self-assessment and group reflection to augment their conceptions of efficiency and concurrently improve their efficiency.

This thesis provides a typology of modes of organizing, and of transitions between different modes of organizing. It highlights the role of capabilities in supporting efficiency in the transfer of product development from one mode of organizing to another. In doing so, it aims to contribute to a dynamic perspective of product development organizing, and at the same time provide actionable advice to product development managers in times of brutal change.

This thesis also illustrates the potential in group self-improvement, building on collective knowledge creation and use, with direct coupling to action. It argues that augmentation of conceptions through concept elaboration and reflection may be more efficient and effective than traditional training programs.

Developing Product Development is both about improving the practice of product development and about improving the understanding of- and knowledge about product development.

PREFACE

This report is submitted as a doctoral thesis at the Stockholm School of Economics. The work has been carried out within the framework of the Fenix Research Program at the Institute for Management of Innovation and Technology (IMIT). This research program was founded in 1997 by Chalmers University of Technology, the Stockholm School of Economics, the Institute for Management of Innovation and Technology (IMIT), AstraZeneca, Ericsson, Telia, Volvo, and the Foundation for Knowledge and Competence Development.

Our sincere thanks go to the sponsors of Fenix. The companies associated with Fenix and the Foundation for Knowledge and Competence Development have provided generous funding to support the research over the years. Finally, last but not least, our thanks go to the numerous employees of Ericsson and other firms, who generously provided their time and shared their experiences, for their openness and willingness to collaborate with us and participate in this research.

As is customary, the author has been entirely free to conduct and present his research as he saw fit, as an expression of his own ideas.

Stockholm, January 2006

Niclas Adler
Director of the Fenix
Research Program

Bengt Stymne
Professor,
Stockholm School of Economics

Filip Wijkström
Director of the
Economic Research Institute (EFI)
at the Stockholm School of Economics

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Writing a thesis is not what you expect it to be. Before you begin, that is. Writing a thesis has simultaneously forced me and enabled me to call into question many of my own assumptions and beliefs. Writing a thesis is more than just writing a thesis - it is a personal metamorphosis.

The product of the thesis writing process is more than just a book. It is also the actions performed (and their effects) during the research process. As well as a person who has changed somewhat from the person that embarked on this process more than five years ago.

Writing a thesis is a lonely job, yet it is a job where you depend a great deal on others.

This thesis would not have been written had it not been for the generous support of Ericsson, where I have been an employee throughout my thesis writing process. I owe a lot to Göran Ekman, Örjan Ericsson, Mats Karlsson, Per Westerberg and Anders Wänman, who supported me throughout this process. I also want to thank my numerous colleagues and friends at Ericsson who in various ways supported and participated in my research efforts.

I would like to thank Bengt Stymne, my principal supervisor, for his support and guidance, balancing between practical relevance and scholarly rigidity. And my assistant supervisor Horst Hart, who supported me in both the research and the writing, and encouraged me to go on when everything seemed impossible. Horst did not write one word of this thesis, yet without Horst not one word of this thesis would ever have been written. He listened patiently to my monologues and objections, and somehow successfully guided me towards the goal. Also Niclas Adler, who supported me in setting a firm project plan for this thesis, and sticking to it. And Jonas Söderlund, whose insightful comments contributed to improving this thesis.

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All my colleagues and friends at Fenix played an important role in supporting me in my research process. I did my first research study together with Lotta Svensson, under the supervision of Mats Engwall. And with the support and participation of Andreas Werr, it finally resulted in my first published article. Håkan Linnarsson was a good friend as well as my co-author on the second article. Hans Björkman was another good friend and co-author, although we have not yet published anything together. Sten Setterberg has been my friend and co-researcher on more recent research. Cecilia Gustafsson, Kamilla Kohn, and Lin Lerpold have been valued friends and colleagues, with whom I could talk about both professional and private matters. Johan Berglund may have been the teacher who influenced me the most, in helping me to understand and accept the social construction of reality.

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Finally, however hard I try, I am bound to forget some important friends and colleagues. This paragraph is for you. For having been there for me, and for forgiving me for failing to name you explicitly...

Last but not least, I want to thank my family. Mother, thank you. Father, I know you would have wanted to see this. Gustaf, memories of our conversations have been an inspiration. And all the rest of you who inspired me and supported me through this process: Thank you!

Gunilla, my late wife, you encouraged me to apply to Fenix, as well as convinced me to continue with my research despite you contracting cancer. Jola, you have supported me. Dasha, you have given me hope for the future. Margareta, Lovisa and Karl Ragnar, my children, you have made my life worth living and enabled me to continue my research by being the best kids on earth. Now when I have finished my thesis, I hope we will have more time together.

Stockholm, January 2006

A. Ragnar Kling

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PROLOGUE

This thesis is about my life.

It is about my working life.

It is about product development, since that has been my working life for more than two decades.

It is about some of the things I have gradually come to understand are important about product development.

Product development is about products, new products.

Product development is about development, not only of products, but also of the organization that develops products. That organization consists of people, like you and me.

We develop ourselves while we develop products.

We also develop how we work together when developing products.

We develop product development, which has come to be the title of this thesis.

Writing this thesis allows me to elaborate on what product development is, to me as well as to my colleagues.

Writing this thesis has further developed my understanding of product development. I now understand better the importance of how I conceive of product development.

If I succeed in my writing effort - or rather when you read this thesis, if I did succeed - then you, my dear reader, will at least to some level of detail augment and improve your understanding of product development by reading the thesis.

This thesis will not provide you with all the answers, but rather possibly make you seek more answers. If that happens, then I will have succeeded with what I set out to do when writing this thesis.

1 INTRODUCTION

From a record operating income of 31 BSEK (operating margin 11%) to a record loss of 27 BSEK (operating margin -12%) one year later, to a record margin of 22% (29 BSEK) two years later, that is the brutal, changing environment that Ericsson survives and prospers in.

This thesis inquires into how this was and is possible.

Ericsson's transformation and the related environmental change was extreme. But it will happen again, to other firms, in other businesses.

This thesis tries to help elaborate some of the lessons from this transformation, taking an operational perspective from inside the product development organization. By learning from Ericsson's experience, firms can improve their preparedness for- and management in times of brutal change. Successful management of brutal change is a matter of life and death. Ericsson is now alive and well, in better shape than ever before. By studying brutal change, firms can also learn to improve management in less turbulent times.

In this introductory chapter, I provide a brief summary of the brutal, changing environment that Ericsson experienced. I proceed by framing Ericsson's challenge in terms of capabilities, and briefly introduce my efforts to research my own practice. Finally, I conclude the chapter with a short overview of the thesis, and a guide to the reader.

1.1 BACKGROUND: TIMES OF BRUTAL CHANGE

This thesis takes its point of departure in a large and leading supplier of telecommunications network infrastructure products, namely, Ericsson. It begins in the year 2000. Ericsson is about to report its biggest operating income ever in the history of the firm. Net sales are higher than ever before. Never have so many people been employed in the firm, despite the fact that over the previous decade Ericsson has outsourced almost all of its production operations and, with them, most of the people employed in production. In the year 2000 (in the Annual Report), Ericsson expresses the intent to "grow faster than the market, at a rate of at least 20 percent annually, viewed over a five year period," and to "recruit around 10,000 new employees each year." Ericsson invests 15% of net sales in R&D, and expresses an intent to continue to increase this investment in R&D. The focus is on delivering the new third generation mobile telecommunication system, commonly referred to as '3G'.

Over the previous decade, Ericsson has established itself as the undisputed leader in mobile telecommunications infrastructure, predominantly GSM (Global System for Mobile communications, or earlier Groupe Spécial Mobile). Ericsson holds a 40% share of the GSM infrastructure market. At the end of 2000, Ericsson is named in 22 out of the 33 existing 3G agreements at the time. Ericsson forecasts that in three years time volumes of 3G will equal the current volume of GSM; that which took ten years to achieve for GSM would take three for 3G. There is, however, one area of concern. Mobile phones are making losses, and a restructuring of mobile phone operations is ongoing, with a back-to-profit program. Mobile phone production is outsourced (which I will refer to in this thesis as *externalized*, implying replacement of a previously firm-internal activity by sourcing the results of the activity from an external supplier) and *offshored* (moving an activity from a high-cost country, such as Sweden or the US, to a low-cost country, such as India or China).

The capability to develop new products is clearly one of the key determinants for the future success of the firm. Finding people with the right skills, in sufficient numbers, is one of the biggest challenges facing Ericsson. Innovation that meets and exceeds customer expectations is seen as the path to future success.

During the period of writing this thesis, Ericsson, as well as the entire telecommunications industry, undergoes radical change. In 2001, Ericsson sales fall 41 BSEK, or more than 15%. A record operating income of 31 BSEK (11% operating margin) in 2000 is replaced by a record operating loss of 27 BSEK (-12% operating margin) in 2001. Instead of recruiting some 10,000 new employees as planned, approximately 20,000 people are forced to leave the firm during the year 2001. It is certainly a radical change for just 12 months, and a senior R&D executive describes it as "a brutal change".

Now, as I conclude my thesis, in the year 2005, we have witnessed Ericsson's turnaround. For the year 2004, Ericsson reports an operating income of 29 BSEK, with a record-breaking operating margin of 22%. 50,000 people are now employed by Ericsson, and during the first half of 2005, most key indicators have improved over 2004.

For a firm in a dynamic industry like telecommunications is today, product development is critical. Product development provides the new products that the firm uses to compete in the market. In 2000, delivering better products, earlier than the competition, and meeting and exceeding customer expectations, are seen as the key challenge in Ericsson. The actual cost of a product development project does not receive too much attention. This changes considerably during the five years that follow. Today, Ericsson needs to both contain costs and deliver innovative products.

Looking at Ericsson over the last five years, it is quite clear that being efficient and effective in product development is not enough. Product development is part of the firm, and the firm is subjected to impact from changes in its environment. In this case, the entire telecommunications market slumps in late 2000, a slump that continues for several years. Even now, in the year 2005, the market is far from the record levels of 2000. In order to thrive and survive in such a dynamic environment, it is necessary but not sufficient to be efficient and effective. The firm must also to be flexible, and adapt to changes in the market. Product development must be organized to support this requisite firm flexibility.

1.2 FRAMING THE THESIS: DEVELOPING PRODUCT DEVELOPMENT

Ericsson experiences radical and brutal changes in its environment during the time period 2000 to 2005. Compared to any previously experienced by the firm, these changes are more radical, and more rapid. Ericsson goes from making record-breaking profits to record-breaking losses at record-breaking speed. The number of employees is reduced by more than 50% in three years time, and three years after record-breaking losses Ericsson achieves record-breaking margins.

Most research on the organizing of firms, and on organizing of product development is done when firms prosper and researchers are given access and can inquire into the success of the firm. I perform the research behind this thesis in times of radical and troublesome environmental change, observing the firm's processes and how it responds to these changes and the troublesome business climate. The environmental changes prompt the firm to revisit the issue of the boundary of the firm. What should be done inside the firm? And what should be done outside the firm, and procured in the market? The situation calls for a review of the level of vertical integration. It also calls for a review of how to organize the firm in general, and product development in particular. Radical structural changes tend to destroy capabilities. Thus, the changes indirectly call for efforts to rebuild and augment capabilities.

Sooner or later, many other firms can be expected to face similar radical changes in their environment, and will be challenged to respond quickly and effectively. The communications- and computing industries as a whole are subject to changes in both market and technology that can induce this type of challenge. Other industries can also be expected to weather similar- and possibly even less-anticipated brutal changes. By learning from the radical changes in telecommunications, they can prepare and build the capability to respond.

By studying extreme cases, such as brutal change, we can learn not only about the extreme cases as such, but also create lessons applicable in normal operating situations. The study of extreme cases can help to unravel generally applicable insights that may not be obvious from the study of normal situations.

In this thesis, I aspire to describe, conceptualize and analyze some of Ericsson's response mechanisms to brutal change, and to propose how firms can build and leverage product development capabilities, for efficiency and flexibility.

1.2.1 Product Development

Product development is the process of developing new and improved products. Product development is also the organizational entity that performs the process of product development. This thesis does not draw a strict demarcation line between development of products and services, although the focus is on development of tangible products. There are other researchers who discuss research and development (R&D). I will use their results when applicable, arguing that product development is R&D with a focus on the D. (See e.g. Roussel, Saad, & Erickson, 1991:13-21, for a classification of different types of R&D. Note however that in my view most product development, including fundamental product development of radically new products built using new technologies, product development is still more D than R, thus I part from Roussel's typology.)

Product development in a traditional sense is an integral part of the firm. However, with the externalization of product development and other firm activities, the process of developing products can equally well be defined as the production of product development services.

Much of product development research, and especially research on evaluating the performance of product development, focuses on specific aspects of product development. From reviewing the literature (Brown & Eisenhardt, 1995), I identify the need to combine process efficiency and product effectiveness. In other words, product development performance is contingent on both how and which products are developed. Adding a requirement for sustainability, I argue that essential product development capabilities are those that contribute to efficiency, effectiveness and flexibility.

In this thesis, I want to inquire primarily into what enables firms to develop products efficiently and flexibly. The reason for this focus is both scholarly and practical. The effectiveness of product development is extensively covered in the scholarly literature on strategy, on innovation, and on product development. Efficiency and flexibility of product development is not covered to the same extent. I also want to inquire into the interplay between these capabilities and organizational change.

1.2.2 Capabilities - What firms can do

A capability is a "generally reliable capacity to [make something happen] as a result of intended action" (Dosi, Nelson, & Winter, 2000:2).

In a dynamic world, it is not enough to have good capabilities today. There is a need to be able to improve, augment and sustain good capabilities, to meet new needs and challenges of the future. A dynamic capability is "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece, Pisano, & Shuen, 1997:516).

In a less dynamic world, product development contributes to competitive advantage. Product development capabilities are seen as some the most important capabilities (e.g. Clark & Fujimoto, 1991; Clark & Wheelwright, 1993; Nelson, 1991; Winter, 2003).

In a more dynamic world, development of product development, i.e. dynamic product development capabilities, is critical to creating and maintaining competitive advantage (Collis, 1994; Iansiti & Clark, 1994; Teece et al., 1997).

In this thesis, I see efficiency, effectiveness and flexibility in product development as quality properties of product development capabilities.

1.2.3 Efficiency - Doing things right

Efficiency (in Swedish: 'inre effektivitet') is a measure of productivity. *Efficiency is doing things right* (Drucker, 1974). Efficiency is about producing the maximum amount of relevant output using a minimum amount of input resources. Efficiency focuses on the internal transformation process (Rosenberg, 1994), e.g. product development transforming a specification into a product, or production transforming raw materials into a physical product.

Efficiency, as described here and as used in this thesis, is closely related to Rhenman's (1973) 'internal efficiency', with a focus on conversion process efficiency, and to Stymne's (1970:11) 'internal effectiveness', with a focus on resource exploitation.

Developing product development implies seeking more efficient ways of working, producing more for less, and augmenting product development capabilities to encompass these ways of working.

1.2.4 Effectiveness - Doing the right things

Effectiveness (in Swedish: 'yttre effektivitet') is a measure of the extent to which the results produced meet the requirements and needs. *Effectiveness is doing the right things* (Drucker, 1974). Effectiveness is about producing the maximum value of output using a minimum amount of input resources. Effectiveness focuses on the interaction with the external environment, including such aspects as marketing and supply (Rosenberg, 1994).

My view of effectiveness resembles Rhenman's (1973) product-oriented 'external efficiency'. Effectiveness as used in this thesis, combined with flexibility, forms Stymne's (1970) more organizationally oriented 'external effectiveness'. Stymne's use of effectiveness highlights the fact that sustainable effectiveness requires an ability to adapt to changes and to function and survive in the environment.

Developing product development implies scrutinizing what needs to be done, seeking to eliminate unnecessary or unprofitable activities and focusing on delivering more value for less. New capabilities may be required in order to perform activities different from those previously performed.

1.2.5 Flexibility - Adapting to change

Flexibility is the ability to adapt to and possibly influence changes in the environment. This is in line with Eppink's (1975:2): "to respond successfully to external changes"; and Aaker and Mascarenhas' (1984:74): "to adapt to substantial, uncertain and fast-occurring (relative to the required reaction time) environmental changes." In addition to the adaptation to external change, Krijnen (Krijnen, 1985:67) identifies the anticipation of change and influencing of the environment, in order to avoid having to change, as acts of flexibility. Krijnen, and later Volberda (1997), identify three types of flexibility: *operational flexibility* dealing primarily with the volume of activity (i.e. how much?); *structural flexibility* dealing with the way something is done (i.e. how?); and finally *strategic flexibility* dealing with more fundamental strategic issues (i.e. what?). Krijnen also identifies a steady-state flexibility dealing with the basic properties of the organization and tradeoff between scale and flexibility. Volberda identifies in addition meta-flexibility, the ability of an organization to change its mix of flexibility options over time. Evans (1991) adds to our understanding of flexibility by clarifying that it can be offensive or defensive, planned (active) or reactive. He identifies four classes of archetypal maneuvers: preemptive (active, offensive), protective (active, defensive), exploitive (reactive, offensive), and corrective (reactive, defensive). Stymne (1970:11) identifies the need for adaptation and includes this in his concept of 'external effectiveness'. Citing Emery (1969:28) and Bowman (1973:12), Eppink (1978:40) points out the potential dilemma of a contradiction between flexibility and efficiency. In a traditional view, specialization increases efficiency at the cost of flexibility.

In this thesis, the focus is primarily on operational and structural flexibility. In my everyday industrial work, I see the need to change the volume of product development as well as how a product is developed. This is not to say that strategic flexibility is less important, but is possibly an indication that it is less tangible.

Developing product development requires capabilities to change what is done, as well as how it is done. It requires, as well as leverages, flexibility.

1.2.6 Towards a Purpose of This Thesis

In this thesis, I want to share some experiences from Ericsson's successful responses to brutal change, and interpret and analyze these responses using a number of theoretical concepts. The responses include both structural responses, with direct impact on capabilities and capability development, as well as efforts to augment and improve capabilities that leverage the knowledge and experience of individual employees. Organizational capabilities are a prerequisite to- as well as affected by the changes. During these challenging years, efficiency and flexibility in operations became critical for survival.

Developing product development implies seeking an improved conceptualization and understanding of product development, to support an improved product development practice. This thesis seeks to improve knowledge, understanding and conceptualizations of product development, thereby contributing to both theory and practice.

1.3 PURPOSE OF THIS THESIS

The purpose of this thesis is *to contribute to a better understanding of how product development capabilities contribute to efficiency and flexibility in times of brutal change.*

In this thesis, I primarily address the following issues:

(1) How does organizational response to brutal change impact capabilities and capability development?

(2) How can externalization and offshoring be used to address the challenges of brutal change?

(3) How are capability development and the efficiency of the change process interrelated?

(4) How can efficiency be augmented by leveraging the knowledge and experience of individual employees?

I address these questions by describing and interpreting what happens in Ericsson in these times of brutal change. In this thesis, I provide concepts and typologies and make propositions that contribute towards a more dynamic theory of product development organizing. I provide guidance for action for future development and management of product development.

1.4 RESEARCHING MY OWN PRACTICE

I joined the Fenix Doctoral Program and Research Program at the Stockholm School of Economics in 2000. At that time, I had spent the previous five years managing large product development projects at Ericsson. Prior to that, I had spent thirteen years in the telecom and semiconductor industries in various management positions in product development. I joined Fenix because I wanted to understand how to improve and further develop product development practice. At Fenix, I have the privilege to be a researcher and a practitioner at the same time, concurrently researching management practice and practicing management.

Being both an employee of Ericsson, inside an Ericsson product development organization, and a researcher studying the organization, leads to a number of challenges and important choices. Some of the issues are elaborated in Chapter 3, Methodological Framework. At the same time, this situation allows me to study events, as they are unfolding, challenges that seem important and call for attention. This leads to a certain diversity in my studies, and thus potentially to a limited overall coherence. However, it also enables me to study events and challenges that are important to the firm, and that can contribute knowledge to guide managerial action.

Therefore my results do not make up an exhaustive description of a narrowly defined problem, but rather contribute to knowing - in practice as well as in academia - about various aspects of developing product development. My aim is to contribute knowing and knowledge that can serve to guide improved managerial action as well as contribute to scholarly understanding.

This study of unfolding events provides relevance and limits the potentially negative effects of pre-understanding and bias. By studying important events and processes, I am able to build an understanding while studying, fitting this understanding to the real world, rather than trying to find a reality to fit my pre-understanding.

I would like to recognize up front the extensive existing literature on product development and on multinational corporations. Much of this is on a strategic business level. My intention is not to contribute to this general field of theory, but instead to inquire into selected detailed areas important for the performance and management of product development. In particular, I aim to inquire into aspects of efficiency and flexibility in a product development organization in a brutally dynamic environment, by studying organizational restructuring through externalization and offshoring, and organizational efficiency improvements through internal self-rejuvenation.

Finally, I would like to note that as an insider researcher, being present as events unfolded, I was able to study a process not normally open to researchers: a critical phase of a firms life; a phase where the firm can either disappear or reappear even stronger; a phase that can lead to the death or rebirth of the firm. In this case, the result was a stronger firm, reborn as a result of the brutal change process. By telling this story my aim is to contribute to a better understanding of such processes.

1.5 OUTLINE OF THIS THESIS

In the following chapter, *Chapter 2*, I present a brief review of selected literature on the theory of the firm, combining transaction-cost theory with the resource-based view of the firm, and capability theory. I categorize capabilities in product development into operational or dynamic, and into task-oriented or management-oriented. I discuss the role of capabilities in restructuring product development. A typology of modes of product development organizing is introduced. I also discuss participatory efficiency improvement efforts. Concluding the chapter, I argue the complementary nature of structural change, e.g. externalization and offshoring, and participative incremental improvement efforts.

In my research, I integrate research and action, seeking knowledge while acting in the organization. My aim is to augment the knowing in the organization through taking part in the combined action and research. This has led me to apply a collaborative action research approach, which I describe in *Chapter 3*. Some of my studies are inspired by phenomenography, which focuses on how people conceive of things. I further elaborate on this in Chapter 3. Finally, I discuss the justification and generalizability of my research results.

The context for this thesis, the brutal change that Ericsson was subjected to, is described in *Chapter 4*. Ericsson's organization prior to this period is characterized. The response to the brutal change is described. Structural changes, including externalization and offshoring, as well as efforts to improve efficiency and rebuild capabilities, are initiated. This chapter addresses the first purpose of the thesis.

In *Chapter 5*, I inquire into externalization and offshoring of product development. I describe Ericsson's process of organizing product development and then implementing specific cases of externalization and offshoring. Some candidate externalization strategies are described, and Ericsson's strategy-in-use is positioned and analyzed in these terms. A set of transitions between modes of organizing is identified, and propositions regarding the role of capabilities in making these transitions efficient are formulated, based on theory as well as analyzed observations. This chapter addresses the second and third purposes of the thesis.

In *Chapter 6*, I analyze efforts to augment efficiency, after structural changes, by leveraging the knowledge and experience of the individual staff. Self-assessment of efficiency, concept elaboration and group reflection are used as tools to concurrently improve efficiency and the conception of efficiency. This chapter addresses the fourth purpose of the thesis.

Finally, *Chapter 7* positions my findings relative to previous research, and concludes with implications for managerial practice as well as for research. My focus here is on guidance for action, since the lack of such guidance is what drove me to write this thesis. For this reason, Chapter 7 is purposely quite normative.

Appendix I briefly summarizes the appended papers, which are enclosed in A*ppendix II*.

1.6 ADVICE TO READERS

Ideally, I would wish all readers to read the entire thesis. However, knowing that this is not likely to be the case, I offer, with some hesitation, the following advice to readers with varying interests.

Readers primarily interested in the practical implications should as a minimum read Chapter 7, and hopefully also Chapters 4, 5 and 6. Senior managers and managers with an interest in strategy should read Chapter 5. Managers directly in charge of personnel supervision will find Chapter 6 of most interest.

Scholarly implications are found primarily in Chapters 5 and 6, and in Section 7.3.

Readers interested in the rejuvenation of Ericsson should read this introductory chapter and Chapter 4.

Chapters 2 and 3 are known to be perceived as ‘compact’ and ‘heavy’ by many non-scholars. They provide a background and a basis for some of the reasoning in Chapters 4 through 7, but I think that practitioners can skip them (i.e. Chapters 2 and 3) without any major loss.

2 A DYNAMIC PERSPECTIVE ON PRODUCT DEVELOPMENT

In today's increasingly dynamic context and increasingly complex multinational and networked firms, the ability to combine efficiency and effectiveness with flexibility is increasingly important.

In this chapter, I briefly introduce two theories of the firm. Transaction cost economics highlights the role of asset specificity in defining the boundary of the firm. Transaction cost economics help explain why firms exist. The resource-based view of the firm complements this view, by focusing on firm resources, and how they make firms differ from each other. With its roots in the resource-based view, capability theory focuses on what the firm is capable of and good at, and how to nurture and develop these abilities.

I use these theories in order to better understand the contemporary concepts of externalization and offshoring. In doing so, I elaborate on and propose a typology of different types of capabilities critical to performing and developing product development. Primarily, I focus on and contribute to dynamic perspectives of product development organizing. I propose a typology of modes of organizing product development. These theories and taxonomies are later applied in Chapter 5.

In the final section, I introduce some previous works on participative micro-level organizational development. This section serves as a background to the efficiency improvement efforts described in Chapter 6.

2.1 TRANSACTION COST ECONOMICS

According to the previously dominant theory, a firm was seen as a black box representing a production function. That is, the firm transforms a set of inputs into a set of outputs. Coase (1937) criticizes this view, however, and proposes that firms should instead be seen as institutions that facilitate exchange and interaction between multiple parties in a joint effort to produce certain results. In Coase's view, the purpose of the firm is to accommodate to contractual constraints rather than production constraints. Following Coase, a number of scholars have proceeded to develop complementary theories of the firm.

Williamson (1975; 1985; 1989) proposes a transaction cost-based theory of the firm, based on three transaction properties: (1) asset specificity, (2) degree and type of uncertainty, and (3) frequency of transaction recurrence.

Asset specificity defines the degree to which an asset can be redeployed to alternative uses or users without sacrificing productive value. Investing in an asset that is specific and cannot be redeployed is a sunk cost that cannot be recovered if the intended use fails or is discontinued for some reason. Asset specificity can be of many types: site, physical, human, dedicated, and brand name capital.

Uncertainty is primarily random and unpredictable, risks caused by acts of nature or unpredictable consumer behavior. A secondary type of uncertainty is hazards caused by a lack of communication and/or an inability to get information. These hazards can be unintentional or purposive

Transaction frequency is a measure of the repetitiveness of the transaction.

Transaction cost economics is based on assumptions of bounded rationality and the existence of opportunism.

With the exception of Coase, prior to Williamson, the dominant view of the firm was that efficient firm boundaries are defined by technology and can be taken for granted. Coase and later Williamson argue instead that transaction costs should define firm boundaries, and that asset specificity has important implications. The main alternative modes of organizing are short-term contracts (external: buy rather than make) and vertical integration (internal hierarchy: make rather than buy). Contracting is seen as problematic when either efficient supply requires investment in special purpose equipment (specific assets), or when the winner of the original contract gains such advantages that it secures a de facto monopoly (reducing uncertainty). Transactions that are frequent are often candidates for internalization.

2.2 TRANSACTION COST ECONOMICS AND VERTICAL INTEGRATION

Building on transaction cost economics and the work of both Coase and Williamson, Perry (1989) identifies three determinants of vertical integration: (1) technology, (2) transactions, and (3) market imperfections. In some cases, efficient operations require proximity in time and/or space between process steps, where separation would incur additional costs, e.g. reheating previously molten steel. Costs related to the exchange rather than production of goods are purely transactional, and vertical integration is a way of eliminating such costs. Finally, asset specificity that causes substantial sunk costs that cannot be recovered if transactions are discontinued, is an example of a market imperfection that can justify vertical integration.

Transaction cost economics can be seen as an extension of the neoclassical economic view, "bridging the gap between vertical integration and anonymous spot markets" (Perry, 1989:189). Still, transaction cost economics is criticized for its seemingly dichotomous view of markets or hierarchies, as apparent in, for example, the early works of Williamson (1975). Later, Williamson (1991) explicitly recognizes hybrid intermediate forms, implying long-term contractual relationships beyond short-term market transactions.

The costs and benefits of vertical integration by a given firm depend on the extent of vertical integration by other firms in the industry. A 'vertical equilibrium' can define a pattern of integration in the industry such that no firm will alter its choice of the stages in which it operates (Perry, 1989:229).

Transaction cost economics therefore predicts that externalization and possibly also offshoring is limited by asset specificity, uncertainty and low transaction frequency (Walker & Weber, 1984).

2.3 RESOURCE-BASED VIEW

Another view of the firm is proposed by Penrose, when in "The Theory of the Growth of the Firm" (1959) she describes the firm as "a collection of resources bound together in an administrative framework." Penrose goes on to state that the resources a firm is used to working with "will shape the productive services its management is capable of rendering," and that "the experience of management will affect the productive services that all its other resources are capable of rendering." Other scholars in the 1970s revisit Penrose's theory. Wernerfelt (1984) explicitly proposes a resource-based view of the firm, defining resources as "those (tangible or intangible) assets which are tied semipermanently to the firm". Barney (1986; 1999) complements Wernerfelt by describing the limitations to and mechanisms for trading strategic resources. Still, this new perspective does not gain much attention until the seminal paper by Prahalad and Hamel (1990) promoting the focus on core competence is printed, in which they advocate that firms should focus on their core competencies as their most valuable resources, and make sure to nurture and exploit them for the advantage of the firm.

Resources that are valuable, rare, inimitable and non-substitutable contribute to competitive advantage (Barney, 1991). Durability, transparency, transferability and replicability in resources and capabilities contribute to sustainable competitive advantage (Grant, 1991).

Monteverde and Teece (1982) provide the first substantial empirical support for Williamson's transaction cost economics. Teece's further work seeks to integrate technology aspects into a theory of the firm, and incorporates ideas from the resource-based view into transaction cost economics. In doing so, Teece (1986) clarifies the importance of complementary assets in enabling a firm to capture the profits from an innovation. Further, he clarifies the importance of appropriability regimes, which enable the firm to retain control over the innovation.

Capabilities are combinations of competences and resources (Teece et al., 1997), which can be explored, exploited and protected.

2.4 CAPABILITIES

In his seminal article with Gary Pisano and Amy Shuen (1990; 1997), Teece expands on the importance of capabilities in the operations as well as renewal of the firm. Dynamic capabilities designate the firms ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (Teece et al., 1997:516). Teece et al.'s capability concept makes competencies actionable and constantly evolving, through recombinations of competencies and resources.

Capabilities are also important in the management of new product development (Leonard-Barton, 1992), but must evolve over time, adapting to new challenges and opportunities. If they don't, if capabilities remain static, they can turn into 'core rigidities', that can stifle innovation and change, preventing the 'creative destruction' that innovation requires (Schumpeter, 1942).

Capabilities are embodied in knowledge and skills, embedded in technical systems, managed through managerial systems, and rooted in values and norms (Leonard-Barton, 1992). Capabilities are routines and processes (Teece et al., 1997; Winter, 2003), behavior that is learned, highly patterned, repetitious or semi-repetitious, and founded partly on tacit knowledge (Winter, 2003).

Capabilities are often born first in primitive forms, and improved from there (Winter, 2000). Capabilities evolve over time: they are created, they evolve and they mature: they may be retired, retrenched or gradually retired, renewed, replicated into another geographic market, redeployed to a different product market, or recombined with other capabilities - all different outcomes of the capability life cycle (Helfat & Peteraf, 2003).

Capabilities enable an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result (Helfat et al., 2003). *Operational capabilities* (Helfat et al., 2003; Winter, 2003), also referred to as functional capabilities (Verona, 1999) or productive capabilities (Rumyantseva, 2005), reflect an ability to perform the basic functional activities of the firm (Collis, 1994). *Dynamic capabilities* (Helfat et al., 2003; Teece et al., 1997; Winter, 2003) reflect an ability for dynamic improvements to the activities of the firm (Collis, 1994).

Dynamic capabilities govern the rate of change of ordinary capabilities (Winter, 2003), and reconfigure competences and resources to recreate operational capabilities. Zollo and Winter (2002) stress this routinized learning and internalization, by defining dynamic capability as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness." Dynamic capabilities are structured and persistent, similar to process improvements. Adaptation through creative but disjointed crisis management is not an example of exercising a dynamic capability, but rather ad-hoc problem solving (Winter, 2003). Kogut and Zander (1992) stress the interplay between the application of existing knowledge and generation of new knowledge. Their concept of combinative capabilities acts at the intersection of capability for knowledge exploitation and unexplored potential of the technology. Combinative capabilities can be seen as dynamic capabilities, enabling capabilities to develop into new forms, e.g. to be replicated in another geographic market, or redeployed to a different product market (Helfat et al., 2003).

Finally, I do say 'capabilities', in the plural. I am aware of the debate of singular versus plural form in the theory of capabilities and competencies (see e.g. Dosi et al., 2000). In their path-breaking article, Prahalad and Hamel (1990) chose to use 'competence' in the singular ("*The* Core Competence of the Corporation"), but, as Dosi et al. remark, it is clear, even in Prahalad and Hamel's article, that large corporations have multiple core competencies. Granstrand et al. (1997) show that firms must be more diverse in capabilities than in products, in order to be able to exploit new opportunities, exploit existing products as well as being able to coordinate innovation in products with innovations in processes, thus contributing to 'requisite variety' (Ashby, 1956). In this thesis, I will normally refer to capabilities in the plural, but may in certain instances refer to a specific single capability. I also find that it is often difficult to clearly separate one capability from another: that is, should this be seen as one larger combined capability or two smaller capabilities that are closely interrelated? In many cases, this ends up as a subjective choice for the author. And, as mentioned, *I have for the most part chosen to refer to capabilities in the plural.*

2.5 PRODUCT DEVELOPMENT CAPABILITIES

The capability literature was originally, and to a large extent still is, focused on firm strategy and position, e.g. understanding the issue of sustainable competitive advantage. How can advantage be created? And how can it be sustained? The capability literature can contribute to other fields as well, e.g. the theory of the firm (Nelson, 1991). R&D or product development is often touted as one of the firm's most important dynamic capabilities (e.g. Nelson, 1991; Winter, 2003). But, as Winter (2003) also clarifies, capabilities are "only locally defined", i.e. the scope and meaning of capabilities is contextually dependent. For a firm that has internal R&D, product development can be seen as a dynamic capability, whereas for an independent R&D lab, developing new products can be seen as an operational capability. In this thesis, the context and unit of primary analysis is more the product development organization than the firm. I therefore argue that product development is the focal activity and goal, and thus *I regard basic product development capabilities as operational capabilities.*

Although much of the capability literature has to do with strategy, the capability theory is applied to product development in a number of articles. According to Grant (1996a:120), the primary role of the firm is to integrate “the specialist knowledge resident in individuals into goods and services,” i.e. product development. Leonard-Barton (1992) focuses on new product development and innovation in her introduction of the concept of ‘core rigidities’ early on. Clark and Wheelwright (1993) then identify upstream and downstream capabilities required for effective integration and coordination of different development groups in their description of the product development process. Iansiti and Clark (1994) focus on product development when investigating the role of market and technology integration as well as internal integration in determining dynamic performance. Well-functioning integration can be seen as a dynamic capability, which explores new knowledge in a routinized way and enables subsequent exploitation of that knowledge. Verona (1999) furthers this work, by linking the impact of technological and market functional capabilities as well as internal and external integrative capabilities on process efficiency and product effectiveness in more detail, stressing the reciprocal relationship between action and capabilities. Capabilities are created through the accumulation of experience from action, yet also serve as a catalyst for effective action.

The link between the integration of capabilities and the integration of systems has received considerable attention lately (see e.g. Prencipe, Davies, & Hobday, 2003), highlighting the interrelationship between developing organizations and developing products. Sako (2003) describes the co-evolution of organizational and product structure. Chesbrough and Kusonoki (2001) illustrate the danger of getting caught in a modularity- or integrality trap, being unable to reintegrate or disintegrate when technology or markets justify moving towards a different product and organizational structure. Integration capabilities are both cognitive and task-oriented, and are critical for systems integration (Prencipe, 2003), for knowledge and capability creation (Iansiti et al., 1994; Verona & Ravasi, 2003), as well as for exploring and exploiting existing capabilities for new applications (Kogut et al., 1992). Products, knowledge and capabilities co-evolve (Helfat & Raubitschek, 2000), and integration knowledge and capabilities are the keys to this co-evolutionary process.

Based on their study of Oticon A/S, Verona and Varasi (2003) went as far as to state that there are three capabilities that form the basis for new product development: knowledge creation and absorption, knowledge integration, and knowledge reconfiguration. These capabilities use and leverage four groups of resources: actors, physical resources, structure and systems, and company culture.

I propose a typology of capabilities in product development, based on capability level: operational or dynamic; and focus: product development or management.

In this thesis, I discuss *four types of capabilities* relevant for product development (see Figure 1 page 23).

Operational capabilities refers to the ability to perform the basic activities of the organization. The abilities to perform product development, e.g. C++ software development or ASIC hardware development, are *operational product development capabilities* (A). The abilities to control and manage product development are *operational management capabilities* (B).

In order to be flexible and adapt to change, the organization needs to develop and redevelop its capabilities. Some capabilities will be retired, others will be retrenched, but some will be renewed. Some capabilities will be replicated to other geographic markets or redeployed in other product markets, or recombined with other capabilities. *Dynamic capabilities* are the abilities to develop, redevelop and recombine operational capabilities. The abilities to improve how product development is performed are *dynamic product development capabilities* (C), whereas the abilities to improve how product development is controlled and managed are *dynamic management capabilities* (D).

Capabilities are Processes and Routines for …	**Task: Product Development**	**Management**
Operational	…Performing Product Development Ⓐ	…Control and Management of Product Development Ⓑ
Dynamic	…Development of How Product Development is Performed Ⓒ	…Development of How Product Development is Managed Ⓓ

Figure 1. Capability Types

Capabilities are properties of the organization that build on the resources, the knowledge and the experience in the organization, and are manifested in routines and processes to perform the basic activities of the organization. Organizational capabilities draw on the skills of the individuals of the organization, yet exceed the sum of these, since they also draw on the routines and processes that enable organizational members to efficiently and effectively work together to achieve a common goal (Dosi et al., 2000). Organizational capabilities draw on the abilities of individuals, in a similar way as organizational learning draws on the individual learning (Kim, 1993).

Organizational capabilities also contribute to competitive advantage. In a dynamic environment, the development and renewal of capabilities may be more important than the actual current capability base (Collis, 1994). In such environments, dynamic capabilities are the key to sustainable competitive advantage. Understanding how to develop and use capabilities is clearly an important challenge for managers today.

2.6 TRANSACTION COSTS, CAPABILITIES AND VERTICAL DISINTEGRATION

Transaction cost economics focuses on why firms exist, whereas the resource-based view of the firm addresses why firms differ. Transaction cost economics focuses on efficient governance structures: What makes firms more efficient? The resource-based view seeks to explain the creation and sustenance of competitive advantage: What makes some firms more successful than others?

There is considerable debate regarding the role of the resource-based view in relation to transaction cost economics. Proponents of the resource-based view (Conner, 1991; Conner & Prahalad, 1996) or knowledge-based view (Kogut et al., 1992; Kogut & Zander, 1996) argue that the perspective focused on knowledge in a social community better explains how firms operate. Proponents of transaction cost economics (Foss, 1996; Williamson, 1999) argue that the firm must be understood as an essentially contractual entity that performs transactions in a world of potentially opportunistic behavior. Foss does concede, however, that a knowledge-based view can complement the contractual focus of transaction cost economics (Foss, 1996), as illustrated by e.g. Dosi et al. (1992, as referenced by Foss), but also propose that transaction cost economics can remedy weak spots in the resource-based view (Foss & Foss, 2004).

By combining transaction cost economics and capability theory, critical interdependencies between task or product development capabilities (production skills) and management capabilities (governance skills) can be identified (as also pointed out by contemporary authors, e.g. McIvor, 2005; Rumyantseva, 2005). The resource-based view and the capability theory focuses on efficiency and effectiveness in product development, based on access to superior skills and abilities, whereas transaction cost economics focuses on efficiency and effectiveness in governance, stressing transaction costs and the threat of opportunistic behavior of the suppliers of product development services. According to capability theory, firms retain in-house "those capabilities that are expected to lead to recombinations of economic value" (Kogut et al., 1992).

Externalization of product development often does not lead to 'pure market' relationships. Sometimes, as described in this thesis, it is based on the transfer of resources and capabilities from the externalizing firm to the supplier of product development services.

The externalization is then a dynamic process of concurrently divesting resources and creating a strategic supplier relationship. The chosen mode of governance is a hybrid form, falling somewhere between pure short-term market transactions and pure hierarchical internal organization (Williamson, 1991). Vertical financial ownership is replaced by vertical contracting (Mahoney, 1992), and transaction costs are moderated by long-term strategic supplier relationships. The complete transaction is in fact a route to creating and extending a market for product development services (compare e.g. Arora, Fosfuri, & Gambardella, 2001; Howells, 1999).

Combining transaction cost economics and the resource-based view enables us to understand the path-dependent nature of externalization (see e.g. Holbrook, Cohen, Hounshell, & Klepper, 2000; Raff, 2000). The context for any externalization is contingent on previous externalizations by the firm as well as by others in the industry. This underlines Perry's (1989) point that a certain firm's optimal level of vertical integration is contingent on other actors' choice of vertical integration level, and their actions based on this choice.

Externalization is a method for vertical disintegration, enabling the firm to focus its management capabilities on its chosen core activities while transferring operational management responsibility for externalized product development activities to a supplier. Externalization to a supplier allows the firm to leverage the capability of the supplier, which may, for example, be able to exploit scale benefits. At the same time, externalization creates the need for new management capabilities, in both selecting and managing the supplier relationships, as well as managing the transfers of responsibility.

Offshoring shares many of the properties of externalization in that it involves the transfer out of responsibility, although, in the case of internal offshoring, this happens within the global firm context.

Focusing internal operations on selected activities increases the need to ensure that those activities are performed efficiently and flexibly, leveraging the knowledge and experience of the employees. The firm also needs to create and sustain excellence in the chosen activities.

In the next two sections, I will therefore look specifically at the macro-level structural change through externalization and offshoring, and the micro-level organizational development approaches, in both cases aimed at improving efficiency. These two themes will then be revisited in Chapters 5 and 6, respectively, where I describe and analyze my empirical observations.

2.7 EXTERNALIZATION AND OFFSHORING

Structuring is part of management and control of product development. The organization seeks a structure that will improve its ability to develop products. By creating a structure that is a better fit to its internal as well as external environment, a firm seeks to improve efficiency and effectiveness (Stymne, 1970). A structure fit to its environment contributes to operational management capabilities (B - see Figure 1, page 23). Control and management of product development can be more efficient and effective if there is a balance between organizational structure and environmental requirements. Misfits can drive change towards balance (Normann, 1975).

In order to maintain efficiency and effectiveness in control and management despite a dynamic environment, the firm needs to be flexible in order to adjust to environmental changes. Flexibility can be measured in the time and cost of adjusting to change (Thomke & Reinertsen, 1998). Efficiency in change is thus a measure of flexibility. Effectiveness in implementing change is a prerequisite to flexibility. Routines for efficient and effective structural change constitute an important dynamic management capability (D).

The most tangible parts of structure are localization and the internal organizational structure. The former deals with what to do, where to do it, what to buy, and where to buy it. The latter is explicated in organization charts. One of the primary decisions concerning localization of product development is what to do inside the firm boundaries, what to do 'at home', and what to do in countries with lower operating costs: What should be externalized? And what should be offshored?

Modes of Organizing Product Development	**Internal**	**External**
Onshore	Internal	External
Offshore	Internal Offshore	External Offshore

Figure 2. Typology of Different Product Development Organizations

(adapted from Cronin, Catchpowle, & Hall, 2004)

The firm can either retain product development 'in-house', establish an internal development organization offshore in order to reduce cost, externalize product development to a supplier of product development services, or move product development to an external product development supplier in an offshore location (see Figure 2).

In this thesis, I use the term 'externalization' to refer to the change from performing an activity - in this case product development – internally, to procuring - in this case product development services - from an external supplier, independent of location in the world. This is analogous to Gilley's (2000) definition of substitution-based outsourcing, as well as definitions given by Wasner (1999) and Lonsdale and Cox (1998). Rather than a static condition of external sourcing, I see externalization as a dynamic change process. Therefore, I do not include the case of external sourcing chosen over the potential alternative of building a new internal product development capability, which Gilley (2000) refers to as 'abstention outsourcing'. I see externalization as synonymous with outsourcing, but choose to use the former term, except when quoting extant works. Further, my view of externalization stresses the dynamic change process, implying that the organizational arrangement resulting from externalization is simply external procurement of product development services; in a steady-state condition, this is not externalization.

Fill and Visser (2000, quoting Hiemstra and van Tilburg) choose to define outsourcing as “subcontracting custom-made articles and constructions ... to another company” thereby excluding standard parts. In this thesis, I study externalization of product development resulting in the procurement of product development services. This is in line with Fill and Visser’s definition of outsourcing, although I subscribe to a slightly wider definition of the term, including also the replacement of internal product development by procurement of standard products.

Ulrich and Ellison (1999) describe the option of replacing product development not with procurement of product development services, but rather with procurement and integration of standard components.

Berggren and Bengtsson (see e.g. 2004) study and compare outsourcing strategies of Ericsson and Nokia in a series of articles, arguing that Ericsson pursues a vertically divided model where the firm relinquishes production, whereas Nokia pursues a horizontally integrated model where the firm retains a more complete life-cycle responsibility for its products. Berggren and Bengtsson argue, mainly based on Nokias superior financial performance in the early 21st century, that Nokia’s model is superior.

Fill and Visser as well as Berggren and Bengtsson focus on the product and the production process, whereas I focus on the product development service. My focus is also primarily on the dynamic process of externalization, rather than on strategies for what to externalize. I do concede that there are interdependencies between development and production, but argue that the relationship is more complex than what Berggren and Bengtsson indicate and deserves a more thorough investigation and discussion than what Berggren and Bengtsson provide or than what I can provide here, taking into account aspects of rapid technological developments and related industrial structural implications. The design-select decision, as described by Ulrich and Ellison, is an important, yet complementary rather than competing perspective on externalization.

Externalization first starts with peripheral, non-core activities, e.g. security and catering (Fill et al., 2000), and later move into IT (Lacity, Willcocks, & Feeny, 1995; Lacity & Hirschheim, 1993) and production (e.g. Berggren et al., 2004). Only lately have core activities like product development become prime targets for externalization consideration (Chiesa, Manzini, & Pizzurno, 2004; Howells, 1999; Rumyantseva, 2005).

Further, for the lack of a better term, in this thesis I use the term 'onshore' to indicate activities performed in a geographical location that is not specifically associated with low-cost. Onshore can imply in the firm's home country, but it can equally well imply in another country that does not have a significantly lower cost structure than that of the home country. This implies, for example, in the case of Ericsson, that onshore product development can be performed in Sweden, but can equally well be performed in Germany or Canada. This, in turn, implies that the dichotomy of onshore-offshore is not identical to centralized-decentralized. 'Offshore' can imply product development in, for example, India, Russia or China. This simplified categorization ignores the fact that there are also a significant number of geographical areas where costs are significantly lower than in the onshore countries mentioned here, yet at the same time significantly higher than in the offshore countries mentioned here. This intermediate cost level would be found in, for example, many countries in Eastern Europe. Offshore development may be internal or external to the firm, i.e. in a subsidiary or in an external firm. This categorization also ignores the existence of intermediate hybrid solutions, such as suppliers where the firm holds a minority interest, or offshore suppliers that have local representation and limited local operations (Cronin et al., 2004).

In terms of organizing modes, externalization implies the transition from an internal to an external mode of organizing, i.e. moving development activities from hierarchical, intra-firm organizing to market-based, extra-firm organizing. Similarly, offshoring implies the transition from an onshore to an offshore mode of organizing, in practice, to a low-cost region of the world (Carmel & Tjia, 2005), e.g. moving development activities from Sweden to India. As Venkatraman (2004) puts it, "outsourced development is done *by someone else*, and offshored development is done *somewhere else*" (my italics).

Externalization has been claimed to increase efficiency (Birkinshaw & Fey, 2000; Quinn, 1999) but sometimes at the cost of decreased effectiveness (Birkinshaw et al., 2000; Fey & Birkinshaw, 2005). Kessler et al.(2000) report decreases in both efficiency and effectiveness. Externalization has also been shown to increase flexibility (Benson & Ieronimo, 1996; Howells, 1999; Suarez-Villa, 1998).

Yet, at the same time, there is significant concern about the failures of externalizing: externalizing thing that should not be externalized, choosing the wrong supplier, writing a poor contract, overlooking personnel issues, losing control, failing to meet expected cost savings, and failing to plan for a contingency (Barthelemy & Adsit, 2003). Bettis et al. (1992) propose that individual decisions to externalize can make sense, while, taken together, can at the same time destroy capabilities formed over a long period of time, and that form the competitive advantage of the firm. McIvor (2000) argues that externalization is used as a tool for organizational restructuring, and for getting rid of problem-ridden parts of the organization. Lonsdale and Cox (2000) describe externalization as a way of changing the boundary of the firm, often in order to reduce vertical integration and increase focus on the core business. Externalization should thus be used as a strategic tool (Doig, Ritter, Speckhals, & Woolson, 2001), or not at all. Others are concerned with the knowledge spillover effects (De Bondt, 1996) and the loss of absorptive capacity (Cohen & Levinthal, 1989, 1990). External product development services should be seen as complementary to, rather than as a replacement for, in-house product development (Arora & Gambardella, 1990; Howells, James, & Malik, 2003; Pisano, 1990). Internal product development develops and sustains a level of knowledge (Veugelers, 1997) that provides an absorptive capacity (Cohen et al., 1989, 1990) to learn from external providers of product development services.

Offshoring is a way to reduce costs and thus increase efficiency (Levy, 2005), and to increase flexibility (Farrell, 2005) for a task such as product development. Firms offshore not only to reduce costs (Ellis, 2004; Hagel III, 2004), but also to provide market presence and support product sales, as well as to tap into local innovative talent. Offshoring is often assumed to be- and treated as one type of externalization. As Preston (2004) points out, this is not necessarily the case. An alternative way of offshoring is through the establishment of internal low-cost operating units, something that is often referred to as 'captive offshoring'. Outsourcing and offshoring are two different dimensions (Cronin et al., 2004).

There is a need to better understand the contingencies for efficiency, effectiveness and flexibility in external and offshore product development. What are these contingencies? And how do they influence flexibility?

Flexibility requires an ability to adapt to changes in the environment, and is measured in the time (Volberda, 1996) and cost of adapting to changes (Thomke et al., 1998; Thomke, 1997). This implies that the efficiency and effectiveness of the organizational change process is critical. Flexibility is not a static condition, but a dynamic process (Volberda, 1996:362). Externalizing is both spatially and temporally contextually determined (Howells et al., 2003). To be a realistic alternative, not only must the alternative solution be attractive, but also the change trajectory must be attractive, with respect to cost, time, and the risks associated with it. A dynamic management capability for product development must encompass this flexibility. Product development flexibility is positively associated with performance (MacCormack & Iansiti, 1997).

There is a lack of research on efficiency and effectiveness of change trajectories in the organizing of product development. Sako (2003) compares three possible trajectories for moving from an integral and internal product to a modular and external product. She does not focus specifically on product development, however, but rather treats product development and production indiscriminately. Further, her alternative of externalizing and later modularizing seems inappropriate for the types of products discussed in this thesis. A more relevant choice of trajectories is formed by externalization and offshoring. In this thesis, I inquire into the contingencies for efficiency in dynamic externalization and offshoring organizational change processes.

2.8 IMPROVING EFFICIENCY IN THE SMALL

Complementing the macro-level structural change processes is also a need to implement participative micro-level emergent organizational development. Beer and Nohria (2000a) advocate that the firm-level transformatory structural change and lower-level intra-firm organizational-development participative change processes are integrated. They argue that concurrency of the two approaches is most effective, though the concurrent approach is most difficult. According to Beer and Nohria, if the concurrent approach is not possible, then sequencing, starting with transformation followed by organizational development, makes the most sense.

Participative change benefits from the closeness of those affected. Lewin (1952) was early to point out what is now a well-established fact in social psychology, stating that participation in decision-making exerts a pressure on the participants to conform to group decisions about change. Participation therefore facilitates the implementation of the change, helping to overcome resistance to change (Lawler, 1986). Participation also contributes to the legitimacy of the decision to change (Industrial Democracy in Europe (IDE Group), 1981). As Weick (1995) argues, group reflection can result in a collective sense-making that leverages the knowledge and experience of those participating.

These lower-level processes build and rebuild product development capabilities locally. The change processes in themselves form the basis for dynamic product development capabilities, whereby product development groups can themselves renew and augment their own development capability.

These dynamic processes seek out knowledge resident in the group and its members, and seek to recombine this, possibly combining it with knowledge sought outside the group, and then apply and evaluate the knowledge. Knowledge creation and knowledge use are united into one concurrent process. The use of the knowledge forms the basis for instant evaluation and augmentation.

Bushe and Shani (1991) advocate the use of ‘parallel learning structures’, where a semiformal organization is created, which operates side-by-side with the regular formal hierarchy and structure, with the purpose of increasing organizational learning.

Participative approaches to designing and improving work practices attract significant interest, although more so for blue-collar work than for professional work. Inspired by Trist's (1981) sociotechnical systems theory, Pava (1983a) elaborates on the potential for applying participative improvement methods to non-routine tasks performed by professionals. Pava proposes topic deliberations, and the use of discretionary coalitions to guide and implement change.

Firms seek efficiency and effectiveness within each organizational entity, in how the entity goes about developing products. Improvement actions include process reengineering and motivational improvements, as well as installment of incremental and participatory improvements. But how does a software developer conceive of efficiency? And how does it matter how the developer conceives of efficiency?

Fisscher and de Weerd-Nederhof (2001) argue that, in order to learn, improve and prepare for future challenges, it is necessary for product development organizations to develop an ability to reflect on past experiences. This process can be seen as a form of dynamic capability for product development. Such reflection can also help augment and improve the conception of work and efficiency and effectiveness at work, something that in itself would promote increased efficiency and effectiveness (Sandberg, 2000). How can reflection and augmenting conceptions be used in practice in order to improve efficiency?

In contrast to Bushe and Shani (1991) whose approach relies on parallel learning structures outside the current structures, in this thesis, I describe how interventions within the existing organization can be used to improve both the understanding of efficiency as well as actual efficiency.

2.9 CONCLUSION

A dynamic perspective on product development benefits from combining transaction-cost and capability theories. Asset specificity, as well as access and control of resources and capabilities, play an important role in the creation of efficiency, effectiveness and flexibility.

Externalization and offshoring of product development yields potential benefits but also risks for the firm. Externalization can reduce headcount and fixed costs and offshoring can reduce operational costs, contributing to efficiency and flexibility that supports adaptation in times of brutal change. Externalization and offshoring requires as well as contributes to developing new capabilities. Further research is needed on the efficiency of change trajectories in product development organizing, and in particular the moderating role of capabilities.

Participative micro-level change is needed and has a great potential to complement transformatory structural change efforts. Participative approaches that build on reflection in groups offer opportunities for learning and improving.

3 METHODOLOGICAL FRAMEWORK

In this chapter, I introduce and describe the methodological framework for my research.

The objective of my research is to improve the practice of developing product development. Knowledge creation, conceptualization and theory development are means towards this end. Gradually, my research came to focus on structuring and changing the way a firm develops its products. Through interviews and participant observations as well as interventions I inquired into the practice of organizing and improving product development. As an insider action researcher, I used collaborative action research to understand and improve practice.

3.1 DOING AND WRITING ABOUT MY RESEARCH

This thesis is the result of a five-year plus endeavor to primarily understand and improve organizing of product development, in the context of the firm that I was employed in. During the time of my research, my time was divided between research and practice. I have combined research on managerial action with managerial action in practice. I have had the benefit of being present in the practice studied, being able to draw on my knowledge of the business - the technology as well as the organization - grounded in more than twenty years of managerial experience in the industry. I have been able to observe ongoing action, as well as had easy access to informants. At the same time, I have had easy access to researchers and scholars, many of whom have helped and supported me.

In writing about my research, I wish to convey both what I did and the results I achieved. I want to write about process as well as outcome. In writing about the process, I want to give the reader sufficient insight into my own emergent understanding and gradually evolving logic-in-use. Writing about the results and the outcome, the use of a reconstructed logic provides more clarity to the reader.

Research is about exploring, venturing into the unknown. Science is partly about serendipitous discovery that cannot be reduced to rule, but that, as observed by Mill (quoted in Kaplan, 1964:15), can be cultivated. Kaplan argues that reconstructed logic is an idealization of scientific practice (ibid.,10). Therefore it is not enough to merely provide the reader with a description in terms of the reconstructed logic. To be able to fully comprehend and evaluate the research performed, one must provide sufficient insight into how the process evolved over time, into "the logic of discovery" (ibid.,15).

Yet, at the same time, to develop and sustain the interest of the reader, there may be a need to focus more on the results than on the often long, tedious and crooked path from start to finish. Huff (1999:17-19) describes this path of expansion and contraction of focus as "the accordion path of scholarship".

I try to strike a balance between the emergent logic and the reconstructed logic, between how and what, between the research story and the research results. I aim to give sufficient insight into my process, but still concentrate on what eventually became my research focus, and into the logic that I reconstructed to understand and justify my results.

Being both an observer and a participant in the change process in Ericsson enabled me to come to the insights reported in this thesis. The understanding of the externalization and offshoring process, for example, would not have been possible from a pure outside-in perspective, nor from a pure top-down perspective, nor - for that matter - from a pure bottom-up perspective. By combining and contrasting these perspectives, I was able to make sense of and understand the process. As a combined observer of and facilitator for efficiency improvement efforts in a software development group, I was able to concurrently augment the conception of efficiency held by the developers and my own conception of efficiency. The process was important to enable my results. For many readers, however, the results are more important than the process. Hence the need for a balance between the logic of discovery and reconstructed logic.

3.2 INTERVIEWS AND OBSERVATIONS

My research is based primarily on interviews and observations. During my studies, I have personally conducted 122 interviews. Complemented by interviews that colleagues have done for me, I base my studies on 153 interviews, of an average duration of 46 minutes. All interviews were recorded, and most have either been transcribed literally, or summaries have been written soon after the interview with the support of the recordings. The transcriptions and summaries were analyzed using NVIVO text analysis software.

The interview data have been complemented with participant observations of unfolding actions. In many cases, I have been a participant in the actions, and therefore purposely both observe and intervene in the action. In several of my studies, my intent has been dualistic: to understand as well as to change and improve. The interventions have been of varying types.

In the study of externalization of product development, I draft a proposed strategy for externalization of product development (Papers III and IV), in interaction with a set of senior managers in the firm. Through this interactive strategy development, I am able to get information on past and planned externalizations, as well as past experiences and objectives for the future. Through my active role in the strategy development, I am able to impact future planned action. Also in this same study, I concurrently study and act as an advisor to one project group that is evaluating and planning a possible externalization, and to another project group implementing an externalization of product development.

In the study of the conception of efficiency in product development (Paper I), and the identification of obstacles to improvement (Paper II), I act as a catalyst for initiatives for improvement from the individual software developers. As a result, I gain insights into their conceptions of efficiency, the perceived obstacles, as well as potential methods for augmenting efficiency.

3.3 ACTION RESEARCH AND COLLABORATIVE RESEARCH: IMPROVING KNOWLEDGE, THEORY AND PRACTICE

I want to combine knowledge creation and improvement of action in my research. I see improved action as the goal, and knowledge creation, conceptualization, and theory augmentation as a means to enable improvement of action in different situations in different places at different times. In action research (Collier, 1945; Lewin, 1946), I find a research methodology that explicitly argues for combining "action, research and training". Action research has been developed further by many different scholars (see e.g. Reason & Bradbury, 2001a; Shani, David, & Willson, 2004 for a review), creating various flavors, including action science (Argyris, Putnam, & McLain Smith, 1985), developmental action inquiry (Torbert, 1999), clinical inquiry (Schein, 2001), participatory action research (Whyte, Greenwood, & Lazes, 1989), and intervention research (David, 2001). And though the focus may vary, what they all have in common is that they want to contribute both to practice and theory, and to knowledge creation and knowledge in action.

Some authors primarily stress the ability to "help the client" (Schein, 1987, 1988), whereas others stress the ability to uncover deeper levels of knowledge, that would be inaccessible with traditional research methods (Argyris et al., 1985 stress actionable knowledge rather than action), and to contribute to theory. Lewin himself (1946:42) takes a balanced view and argues that "we should consider action, research and training as a triangle that should be kept together for the sake of any of its corners." To those who argue that the supreme goal is practical action (as I did when I first started on the endeavor), or others who argue that the supreme goal is scholarly knowledge (as some of my research colleagues did and possibly still do), I would like to say that the benefits of action research in collaboration between research and practice are sustainable only if actors from both worlds - academia and practice - benefit. The goal must therefore be dualistic: action and knowledge.

Based on the perception that management research is becoming less relevant to managerial practice, Starkey and Madan (2001) argue that management researchers can overcome this relevance gap by working closer together with practitioners. Being a practitioner myself, I find methods whereby research can be made useful in practice, and where the improvement of practice can actually be an integrated part of the research process, most promising. Such methods offer an opportunity to exploit my own industrial experience as well as my presence in practice. Collaborative research methods (Shani et al., 2004) offer great promise in this direction.

The Fenix Executive Doctoral Program (Hart, Kylén, Norrgren, & Stymne, 2004) where I have been a doctoral student, offers a setting that promotes exactly this type of boundary-spanning research. Throughout my years in the program, I have come to develop a conviction that in order to be helpful, to ensure relevance and to be disseminated, more management research should be collaborative, participative and action-oriented. I strive to combine the ideals of collaboration between practice and academia, with the idea of combining action and knowledge creation. I seek to combine action research with collaborative research. Together, they offer a potential tool for creating knowledge and exploiting knowledge concurrently in action. I see the amalgamation of action- and collaborative research as a tool for organizational development. In order to sustain the changes of an organizational development process, those affected should participate in and internalize the change process. Reason and Bradbury (2001b) argue that "action research is participative research, and all participative research must be action research." I do not agree with this perspective. I do advocate participation, as Reason and Bradbury do, but have seen through my research that it cannot be taken for granted. I therefore prefer to make the call for participation explicit. I strive to apply action research, combining knowledge creation and knowledge exploitation, in a participative and collaborative way. I refer to this as *collaborative action research*.

3.4 MY ROLE AS AN INSIDER ACTION RESEARCHER

As an employee of the firm that I am researching, I have the advantage of knowing the technology, the organization and the language of the firm, and of having networks within the firm, simplifying access to people and resources. At the same time, though not always obvious, this does pose a set of challenges. Anthropologists speak about the risk of 'going native' (Alvesson, 2003; Pettigrew, 1985), whereby the researcher begins to identify with the organization studied, loses the ability to distance himself from the object studied, and loses the analytical capability of the outside researcher. Being a 'native' from the start, it is a challenge to distance myself, so that I can see the organization in the way an outsider would, yet still retain the benefits I have as an insider. In addition, I must also maintain a good relationship with key actors in the organization since I intend to remain a part of this organization when I have completed my doctoral research. Coughlan and Brannick (2001) illustrate the benefits of, as well as the challenges related to, the dual roles of organizational member and researcher.

In my case, I have worked together with research colleagues in the execution of my studies and co-authored scholarly works with several of my research colleagues. And while I have received much help and support from them, as well as from my academic supervisors, perhaps more important is that they have also questioned and criticized me. They have both posed difficult questions and proposed alternative interpretations and ways of analyzing my observations. They have been both helpful and a pain-in-the-neck. And, difficult as it may be to admit, I probably owe them more for being a pain-in-the-neck than for their positive support of my work. Their constructive criticism has enabled me to distance myself more from the practice that I have studied, and thereby see aspects that, as an insider, I may otherwise not have seen. Hopefully, this also increases the validity of my observations and conclusions. My former research colleagues Jonas Roth, Robert Sandberg and Charlotta Svensson (2004) have elaborated on the dual roles of the insider action researcher: "Insider action researchers conduct research in the setting where they act as practitioners, applying frames of reference from the setting where they act as researchers."

Combined with my knowledge of and network in the firm, my constant presence and participation in the organization during the period of my research has enabled me to study the organizational change process in a more continuous manner than most external researchers. I have been able to follow change processes over time, and not been limited to sporadic observations. I have been able to follow multiple perspectives, and not been limited to those represented by my primary informers.

3.5 PHENOMENOGRAPHY: CONCEIVING OF WORK PRACTICE

In the study of the use of management models in product development, I find that different respondents talk about projects, project management and management models in very different ways. Why is this, and how does it matter?

Sandberg (2000) has in a similar study, of engine optimizers at Volvo, found that different individuals experience their work in fundamentally different ways. Sandberg builds his discussion on a phenomenographic interpretive approach. Phenomenography (Marton, 1981, 1986) was developed in an educational research group headed by Ference Marton at Göteborg University in Sweden, to describe the qualitatively different ways that aspects of reality are perceived. Sandberg (2000) describes competence "as constituted by the meaning the work takes on for the worker in his or her experience of it." This view is based on a phenomenological perspective, that the world and the individual are linked, through the individual's experience of the world (Berger & Luckman, 1966). The inter-subjective common-sense world is created through objectivations of subjective processes.

In my study of the use of management models in product development, my co-authors and I identify different conceptions of projects, project management and management models (see Paper V for further details of the analysis). By applying an analysis guided by a phenomenographic approach (see Paper V), my co-authors and I are able to show five different conceptions of these three aspects of product development. We argue that these conceptions have implications for performance, optimal team composition, and improvements. Sandberg (2000) shows that some conceptions are related to higher performance, and argues that efforts to augment how staff conceive of their work may be more productive than traditional staff training programs.

Later in my study of efficiency in a software development group, I make, in a similar way, an analysis guided by a phenomenographic approach (see Paper I) and identify four different conceptions of efficiency.

3.6 VALUE AND JUSTIFICATION OF RESULTS

I perform most of the research reported in this thesis in one product development organization at Ericsson. For some of the research (reported in Paper V, and partly in Papers III and IV), I apply fairly traditional case study research methods, but for most of the research (reported in Papers I and II, and partly in III and IV) I use collaborative action research.

In addition to the potential value of the direct results of the research, in terms of this thesis, published articles, seminars and other means of communicating the findings, the organizations I study also benefit directly from the research. The respondents in the interviews explicitly state that "*having to answer these questions, forces me to think about the issue*" and "*interviews like this are much better [than employee surveys],*" indicating that the fact that somebody cares about their opinion makes them more motivated. Respondents enrich their understanding of their situation through individual reflection. Engineers in reflection groups learn from each other. They also develop a joint understanding of problems and joint action plans. The inquiry prompts them to take action to improve. My intervention and inquiry initiates actions that they could have taken themselves, but the intervention serves as a catalyst for the action. Managers who spend hours discussing strategies for externalization and offshoring later use my ideas and diagrams. One senior executive later tells me that I "*have stretched [his and their] thinking*" through my participation and interventions, thus indicating the value that a relative outsider perspective can add. I cannot quantify the impact that my research has on their decisions and actions, but I can observe the dissemination and use of my terminology and theories, as well as resulting artifacts such as slide presentations.

As a result of my research, I am asked to take part in various activities, e.g. related to externalization and offshoring, as well as organizational development initiatives, where I am able to directly put into practice my own lessons from the research. In some cases, I am asked to make more formal proposals, such as strategy development proposals. Once again, I cannot quantify the value of these contributions, but can only use these as illustrations of how knowledge production and knowledge exploitation are integrated into practical managerial action.

Research without impacting the object under study is often difficult. According to Lewin, "you cannot understand a system until you try to change it." In some cases, the impact is actually intentional. In my case, impacting the object under study is intended, yet it is also a side effect of the aim to understand and to create knowledge. I am not able to quantify the value of these side effects. The research has an impact and makes a difference, which can clearly be observed, as is elaborated above.

Justification of the results of research is dependent on the purpose of the research, on the methods applied, and on the underlying ontological (existential) and epistemological (cognitive) perspective. I conduct this research with the aim of contributing to guiding management practice, as well as a theoretical understanding, of developing product development. The main criteria for justification of this research is thus whether the results provide such guidance.

This reasoning differs rather significantly from traditional scientific perspectives, but is well in line with Lyotard (1984), who defines the main criterion for a good theory as its practical value: how it guides action. Lewin (1945:129) stated that "there is nothing so practical as a good theory." The validity of action-oriented research "rests not in abstract explanation or interpretive understanding, though these might indeed be relevant, but in the action capacities and effectiveness of the change that the research creates" (Morgan, 1983:399).

Alvesson and Sköldberg (1994) stress the empirical basis for research. At the same time, research should provide new knowledge, an epistemological discontinuity with common knowledge (Bourdieu et al. (1968) as cited in Alvesson et al., 1994:358). The empirical data should allow, but not directly lead to the interpretation. Alvesson and Sköldberg stress the need for a trade-off between empirical support and degree of newness.

The traditional positivistic criteria for good research have been brought into question by many researchers (see e.g. Bradbury & Reason, 2001, for an overview in the field of action research, and e.g. Sandberg, 2005, for an overview in the field of interpretive research). Bradbury and Reason (2001) argue that good action research must fulfill requirements for good relationships, practical outcomes, extended ways of knowing, purpose and enduring consequence. Susman and Evered (1978) propose alternative evaluation criteria for action research. Evaluation of action research should focus on understanding rather than explanation; on making things happen rather than prediction; on conjectures rather than deduction and induction; on engagement rather than detachment; and on action rather than contemplation.

Argyris and Schön (1989) identify the dilemma of rigor versus relevance, and propose that good action research must "meet standards of appropriate rigor without sacrificing relevance."

According to the Husserlian notion of perceived fulfillment (Sandberg, 2005), communicative validity can be seen as a criterion for achieving truth. Communicative validity can be achieved through the use of dialogue in the data collection as well as the analysis process, and through reflecting on the conclusions with other researchers as well as practitioners (Kvale, 1996).

Pragmatic validity involves testing knowledge produced in action (Kvale, 1989; Sandberg, 2005). It can also reduce the weakness in communicative validity: that people do not always say what they actually do. Communicative validity runs the risk of reflecting what Argyris and Schön call 'espoused theories' (Sandberg, 2005). This risk can be reduced and pragmatic validity assured by testing knowledge claims in action, through observation, or through provoking the respondent by making a counter-proposition and observing the respondent's response to this.

Pragmatic validity is the validity construct that is most relevant to this research. Since the production and use of knowledge to a large extent are concurrent processes in the type of action research that I have performed, pragmatic research validity translates to a positive contribution to the action studied. In the case of organizational improvements (see Papers I and II, the Improving Efficiency study), there is evidence of positive contributions. In the case of structural change through externalization and offshoring (see Papers III and IV, the studies on Corporate Transformation and Externalizing Product Development), the contributions are tacit and not easily evaluated.

Communicative validity is also relevant to this research. Throughout my research, I have had numerous opportunities to expose my findings and my theories in various ways (e.g. seminars, strategy contribution, organizational development efforts, consultation to individuals and groups) to other practitioners in the field of developing and improving the practice of product development. Through their comments and reflections, I am able to confirm, refine and augment my theory. After the interviews and interventions, I have discussed my findings with some of my research subjects as well as with research colleagues. Through this dialogue, I hope to have achieved communicative validity.

One executive who read the manuscript for this thesis, made the following comments: "*[It] provided coherence and a context in which I can better understand what happens and what I am doing…this makes me feel more secure and confident, and I feel more motivated when I can see the connected whole…. [The thesis] provides me a set of pieces of advice that can guide my action. But I want more details, I want help to do it….*"

The thesis itself can never provide all the details and practical guidance. I myself am also a product of this research process, and will personally carry some of the results into the organization.

The presence in practice, not only during a time-limited observation period, but also on a daily basis and while doing the analysis and writing about the research, is a unique advantage that I have as an insider researcher. This, almost by definition, leads to relevant research results.

Some of my studies (e.g. externalizing product development) could be repeated, but retrospectively, whereas most of my studies were concurrent with the unfolding of events. Other of my studies (e.g. improving efficiency) could not be repeated in the same way, in the same spatial, temporal and contextual setting. Action research is in general difficult to replicate, since the research purposely impacts the research object, and therefore identical circumstances will never occur. Traditional reliability constructs therefore fail to capture the essence of this research. I hope that I am able to ensure appropriate reliability by striving for interpretive awareness. Primarily through reflecting on my research with research colleagues and my academic supervisor, I believe I have been able to limit my personal bias on the results.

3.7 GENERALIZABILITY

This thesis is mostly based on observations and interviews in one product development organization during a specific period of time. This does limit the possible claims for generalization.

The specific context of brutal change is unique. Still, these types of unique challenges, of brutal change, will arise in many other firms. It is reasonable to expect that a number of other technology-based industries can expect radical and brutal contextual change, caused by technological discontinuities (e.g. new fuel-cell technology in the automotive industry, and T-cell-based therapy in the pharmaceutical industry) or market discontinuities (e.g. increased and more direct end-user influence on the pharmaceutical industry, and new dominant business models in the automotive industry), or combinations thereof. By studying the experiences of others – such as Ericsson in this case - firms may be able to better prepare for managing and responding to similar situations of brutal change in the future.

The brutal change described in this thesis was a difficult time for the firm. Although this could be seen as the opposite of expansive times, this is not necessarily so. Recessions and periods of prosperity have certain properties in common. Both are dynamic and call for flexibility. Both can create times of brutal change. I expect that many of the results in this thesis may be valid also in times of prosperity and strong market growth. Only in static contexts would I expect them to be less relevant.

In addition, by studying dramatic and often unique sequences of events, we can create knowledge and conceptualizations that can improve our understanding of less dramatic situations as well (Starbuck, web publication accessed December 23, 2005). By studying event sequences from major accidents and catastrophes, e.g. the Estonia, the Challenger (e.g. Starbuck & Milliken, 1988) or the tsunami in the Indian Ocean, we can gain knowledge not only about the event as such, but also knowledge that is useful outside the context of the event. The study of extreme cases can help researchers counteract over-generalizations, the narrow focus on averages, and static theories about systems in equilibrium; and expose instead a world filled with individuality, complexity, variety, and change (Starbuck, web publication accessed December 23, 2005).

The aim of the concepts and taxonomies introduced in this thesis is to be applicable to product development in a more generalized sense. They should also be applicable to a wide array of other contexts. I urge managers who read this thesis to actively evaluate the difference between their context and the one in which this research was performed, and to carefully augment and adapt the concepts and taxonomies to their own environment as needed.

The identification of the role of capabilities for efficiency in organizational transitions in Chapter 5, should be applicable to many other cases of externalization and offshoring of product development, when performed in ways similar to those described in this thesis, including the transfer of development staff and procuring product development services. In different settings, e.g. during periods of expansion, or where externalization leads to procurement of standard products rather than to procurement of product development services, I hope and expect that my concepts and findings can be augmented and modified to support these cases as well.

The findings from Chapter 6, on efficiency improvements through organizational development, should be applicable to most other product development contexts, as well as many other non-routine office work contexts (Pava, 1983b). Concurrent concept elaboration and improvement should be applicable to most such contexts. The potential in reflection and sharing of knowledge and experiences likewise.

The claim that collaborative action research can be seen as a higher-order capability, and used as an organizational development tool certainly applies to other contexts. The ways of applying collaborative action research will however vary between different settings.

Finally, I have here indicated the generalizability and applicability of my findings, as perceived by me, researcher as well as practitioner. I argue, in line with Kvale (Kvale, 1996) that generalizability should not be limited to- and an issue only for me as a writer and researcher, but must be judged by the reader contemplating the applicability for his or her situation.

4 THE CONTEXT: BRUTAL CHANGE

In this chapter, I describe the brutal environmental change, as well as Ericsson's corporate response to the change, that defines the context for the studies described in the next two chapters, thus addressing the first part of the purpose of the thesis.

In the two chapters that follow, I address the questions of: how externalization and offshoring are used in times of brutal change; how capabilities are affected and how they affect efficiency in organizational change; and finally, how efficiency can be augmented by leveraging the experience and knowledge of individual employees.

4.1 RESPONDING TO BRUTAL CHANGE

In January 2001, Ericsson reports record profits for the year 2000. Only two months later, in March 2001, Ericsson issues a revised outlook for the full year 2001. The report for the first quarter indicates a slowdown in system sales and a shrinking market for terminals. A corporate efficiency program is initiated. Quarter by quarter following this, sales decrease, and the operating margin falls and then turns to a loss.

In March 2001, corporate management initiates a corporate efficiency program "to transform Ericsson into a more efficient, integrated and responsive organization," leading to a review of the product portfolio, as well as the organization. During 2001, the workforce is reduced by 22,000, and that of consultants by 8,000. A new position as Chief Operating Officer (COO) is instituted to drive the change process.

The COO organizes a group of senior executives around him, representing the major product development units, as well as finance and certain other functions. This group meets regularly to discuss the situation and how to change the organization to increase efficiency and reduce costs.

The primary goal driving the process is headcount reduction. Successively, as the market and financial situations deteriorate further, Ericsson communicates to the market in terms of having reduced the headcount according to previously communicated plans, and in terms of the new further headcount reductions planned. Always meeting planned the headcount reductions becomes, or at least is perceived as, critical in order to retain the confidence of investors and the market.

4.2 BEFORE: THE IT AND TELECOM BOOM

How Ericsson's fortune could change so dramatically and so quickly is beyond the scope of this thesis, and will only be briefly addressed here.

During the late 1990s, both IT and Telecom are booming. Share prices skyrocket and it is claimed that traditional valuation methods are no longer relevant. The value of many firms in the IT and Telecom sectors seems unrelated to assets and current earnings. For many people, it almost seems that the greater the losses, the higher the valuation.

During this time period, the GSM market is booming, generating profits for Ericsson, the leading GSM infrastructure supplier, as well as for Ericsson's competitors. At the same time, third generation mobile telecommunications, 3G, are expected to appear soon, providing a whole new set of services and driving up revenues for operators in many ways: new services, more usage, longer connection times. Operators invest heavily in their networks, both to expand their GSM capabilities and to prepare for 3G. Many incumbent, previously government-controlled, monopoly operators have recently been converted into commercial firms, and are competing for their former monopoly customers against a set of green-field operators with much leaner organizations and stronger market orientation. In addition, in many countries, licenses to operate 3G networks are no longer granted as before, but are now auctioned off to the highest bidder. In only a few years, operators in Europe spend 1200 BSEK in 3G license fees, equaling ten years of network infrastructure investments. In addition to this, they also need to make new network infrastructure investments.

It is against this background that the brutal change in the market shall be seen.

4.3 BEFORE: HETERARCHICAL, TRANSNATIONAL AND DISTRIBUTED

Prior to the brutal change in 2001, Ericsson has a decentralized, distributed and heterarchical (Hedlund, 1986) organization of the firm, as well as of product development within the firm. Ericsson has a local presence in 140 countries worldwide. Product development is performed at more than 80 sites. Already in the

1980s, Ericsson's ability to organize product development in projects that leverage globally distributed resources is praised, and depicted as a model for future organizing of firms, transnational (Bartlett & Ghoshal, 1988) or heterarchical (Hedlund, 1986) organizing. In the 1990s, Ericsson's corporate project management model, PROPS, a type of stage-gate model (Cooper, 1986, 1993, 2001), is praised as a tool to integrate and coordinate the various product development groups worldwide (Mulder, 1997).

In the late 1990s, while the market is booming and Ericsson is moving continuously toward new successes and new sales records, there is at least one senior executive who warns that product development is not efficient enough. The executive identifies and elaborates the downside to the complex product development organization: "*A relatively simple technical project today can engage some 30 development units in 15 countries. This poses a great administrative challenge. The advantage with today's distributed organizing is that we gain a wide contact with research and development worldwide. The downside is that it is no longer cost effective to operate in this way. We need more developers and fewer coordinators.*" (Source: internal newspaper Contact, 1999, Issue 16.)

The decentralized organization is possible due in part to the properties of the modular architecture of the AXE system, Ericsson's cash cow and main product platform. According to this executive, new product architectures do not support decentralized development in the same way. In the past, products were adapted to local needs, often by a local development unit. New products are to a larger degree built on global standards, requiring less adaptation.

To circumvent the disadvantages to the then-current organization, the executive advocates a centralization of control, while retaining a distributed product development organization. But in the heydays before the brutal market downturn, his words fail to initiate action.

4.4 RECENTRALIZATION AND CONCENTRATION

In the group organized around the COO, the strategy for how to concentrate product development and reduce costs evolves. The group includes the director of technology, the directors of all top-level development units, and selected corporate R&D staff. In order to create both control and accountability, all product development units are allocated to one of the top-level development units.

In order to reduce organizational complexity, both in the permanent organization as well as in product development projects, a decision is made to concentrate development. Each unit responsible for a product should perform at least half of the work in-house, and a maximum of three other units should be involved. The product development organization should focus on product development.

In addition to providing accountability and controllability in internal development, this organizational streamlining (see Paper IV for a richer description) also provides a packaging of product development resources that enables and supports closure, divestiture, and transfer of responsibilities, as well as externalization of product development.

In the group around the COO, in late 2001 and during 2002, a number of proposals for closure as well as for externalization of product development are put forward. Coordination with the other organizations affected is conducted at the group meetings. In many cases, a proposal for closure or externalization is put forward in the group, and then shelved until the next meeting. In the meantime, each member of the group investigates the implications of the proposed decision for their organizations. After a decision by the group, the responsibility for implementation lies with the director responsible for the unit affected.

4.5 EXTERNALIZATION AND DIVESTITURE

When this period of brutal change begins, Ericsson does not have a documented and known strategy for what to externalize, and how to do it. However, by studying many cases of externalization, and comparing how other firms have gone about externalization, a number of dominant perspectives can be noted. In its externalization during these years, Ericsson uses a combination of criteria for deciding which units to externalize, divest or close. Unit performance, ‘coreness’ of the product and technology, market aspects and cost level, as well as legal aspects and the cost of closure, are all factors that impact the decisions. When it is possible to terminate an activity, Ericsson often argues for closure. When an activity has to be upheld but at diminishing volumes for a period of time, externalization is preferred. When externalizing, in several cases Ericsson divests units to major suppliers of product development services, e.g. Teleca and Tieto-Enator, thus contributing to an enhanced market for product development services. The divestiture is in many cases accompanied by a contract where the acquirer commits to delivering and Ericsson commits to procuring product development services under specified terms: e.g. volume, cost, and quality.

In many cases of externalization and divestiture, a set of distinct actor roles can be identified within Ericsson: the manager previously responsible for the unit, the receiver and future procurer of results from the unit, the dealmaker who manages the actual divestiture, the experts who assess technical as well as other aspects of the prospective acquirer, and the director responsible. The dealmakers consist of a small group of experienced staff with previous experience of mergers and acquisitions. They are the carriers of experience from one deal to the next. For the first two years at least, most managers have no previous experience of divestiture. The dealmakers thus provide a framework and emerging routines for how to go about externalization and divestiture. Initially, there is limited experience of the impact that the way of externalizing an activity has on the future management of the relationship with the supplier of product development services. Over time, as more cases of externalization are executed, routines start to be established regarding how to set up and manage these new relationships.

Looking at individual cases, as they unfold, makes it clear that the key goals to be achieved are tacit, and thus interpreted differently by different actors. This also means that often the team of actors involved in a specific transaction cannot jointly reason to come up with the best trade-off between income from divestiture, price of future product development services, and other contractual terms. Different actors describe the process as well as the strategy differently. Each actor sees the process and the strategy from their own perspective, based on their own role in the process. Management describes an espoused view of the process, that possibly helps to guide the process but that does not closely reflect the actual process.

While a particular case is being prepared and a divestiture is being executed, confidentiality is high. For divestitures that are completed, after a certain period of time, the need for confidentiality is reduced. However, for divestitures that are never carried through, but are stopped prior to execution, the need for confidentiality in most cases still remains for a long period of time to come. These divestitures may in some cases be carried through at a later point in time. Units and staff affected are not to be bothered unless a divestiture is to be executed.

To complement the externalization through divestiture, Ericsson externalizes a number of product development operations to offshore suppliers of product development services, e.g. in India, China and Russia, freeing up internal resources for other tasks. In at least one case, internal offshore development is externalized, and in another case, external development is offshored (see Chapter 5 for more details).

4.6 A CATALYST FOR CHANGE AND REJUVENATION

At the beginning of this time period, Ericsson's organization is transnational (Bartlett et al., 1988) and heterarchical (Hedlund, 1986). It is complex, distributed and decentralized. The increasingly sophisticated project organization structures enable global product development. Ericsson's ability to combine global efficiency and national flexibility is praised (Bartlett et al., 1988). In the late 1990s, effectiveness, innovativeness and lead times are critical issues. In the wake of the brutal change in the market, the focus shifts towards efficiency and survival. This calls for simplifications in the organizational structure, and for global flexibility rather than local flexibility.

The speed and magnitude of the changes requires prompt and effective action to drastically cut costs in product development and other parts of the firm, yet at the same time maintain new product development. The requirement for prompt action as well as the sensitivity of the necessary actions leave little option for participatory change, and leads Ericsson to a top-down driven, transformational change process (Dunphy & Stace, 1988, 1993).

The externalization and divestiture contributes to reducing head-count. Salary costs, which tend in the short-term to be fixed costs, are replaced by costs for product development services, which tend to be more flexible. For an initial period of time, control is gained at the cost of flexibility, by contracting for the option and obligation to procure a certain amount of product development services at predefined terms. Flexibility is improved by externalization (see Paper IV and Chapter 5 for more details).

The initial concentration phase is important for both internal efficiency and controllability, as well as for enabling externalization. During this phase, an alignment between organizational structure and product architecture occurs. In fact, this is the enabler for both structural flexibility (e.g. being able to externalize) and operational flexibility (e.g. being able to decrease or increase in volume).

By combining the fit between organizational and product architecture with externalization of selected modules, in addition to supporting cost reductions and downsizing, the firm can also prepare for paradigm changes, which could require a reintegration into a tighter organizational- as well as product architecture, and thus reduce the risk of falling into the 'modularity trap' (Chesbrough et al., 2001) and becoming stuck with too complex an organizational structure. It could actually be argued that Ericsson's situation in the late 1990s is partly a result of extreme organizational modularization, and that the changes initiated by the move from GSM to 3G and by the move from the established mature and modular AXE platform to new emergent platforms are starting to catch Ericsson in a modularity trap.

In a long-term longitudinal perspective, externalization can be seen as a tool for rejuvenation. Externalization, in particular in combination with divestiture, enables the firm to focus on core products and technologies, and to divest core rigidities (Leonard-Barton, 1992) embodied in mature products as well as in capabilities. Through externalization, the firm can still leverage those capabilities for a period of time, without them constraining the development of new products and associated capabilities. Externalization provides a tool for controlled dismantling of organizational capabilities turned rigidities. Seen in this way, externalization followed by organizational development serves as a tool for using a flexible boundary of the firm first to divest rigidities and then rebuild capabilities, to first decrease vertical integration and to then potentially rebuild that same level of integration in new ways, to meet new and future challenges.

In hindsight, it could be argued that the brutal change period is in fact only a catalyst for inevitable changes. The drastic changes in the market force Ericsson to focus more on efficiency and flexibility. The brutality of the changes forces Ericsson to be more brutal in scrutinizing procedures and routines as well as modes of organizing itself, and thus to eliminate core rigidities and revitalize itself. This was, is and will be critical for future success.

In the next chapter, Chapter 5, I inquire into the role of capabilities in supporting externalization and offshoring, as well as how capabilities are affected by these types of structural changes, in this context of brutal change.

The transformational structural changes disrupted organizational routines, processes and capabilities. Many people had to leave the firm. Of those who remained, many or most were reassigned to new tasks and positions. The brutal change called for improved efficiency. There was a strong need to rebuild and augment product development capabilities.

In Chapter 6, I inquire into the means for rebuilding capabilities, based on leveraging the knowledge and experience of individual employees, in the wake of brutal external change and radical structural change.

5 EXTERNALIZING AND OFFSHORING

Externalizing – moving internal operations to an external supplier, and offshoring – moving operations to a unit located in a low-cost country, e.g. India, China or Russia, can be used to reduce operational and short-term fixed costs, and transform them into lower non-fixed costs. During these times of brutal change, Ericsson externalizes product development and divests operations to suppliers of product development services, thus reducing head-count, reducing their liabilities for firm employees, and increasing flexibility. Ericsson also offshores product development, thus lowering operating costs.

From a corporate macro perspective, externalization and offshoring are tools to change the boundary and the cost structure of the firm. There are many potential strategies for externalization of product development. Some aspects of the strategy-in-use at Ericsson are described in the previous chapter.

In this chapter, I inquire into the externalization and offshoring of product development, in response to the brutal environmental change, with a specific focus on the role of capabilities. How do capabilities contribute to efficiency in externalization and offshoring? And how are capabilities affected by externalization and offshoring? I thus address items two and three of the purpose of this thesis.

This chapter is based on the research described in Papers III and IV.

5.1 TWO LEVELS OF ORGANIZING PROCESSES

Ericsson manages changes at two levels (see Figure 3 and Paper IV) during this turbulent time. At the corporate or firm level, a concentration process occurs, enabling and driving closure, divestiture, externalization and offshoring. At the unit level, individual cases of closure, divestiture, externalization and offshoring are carried through.

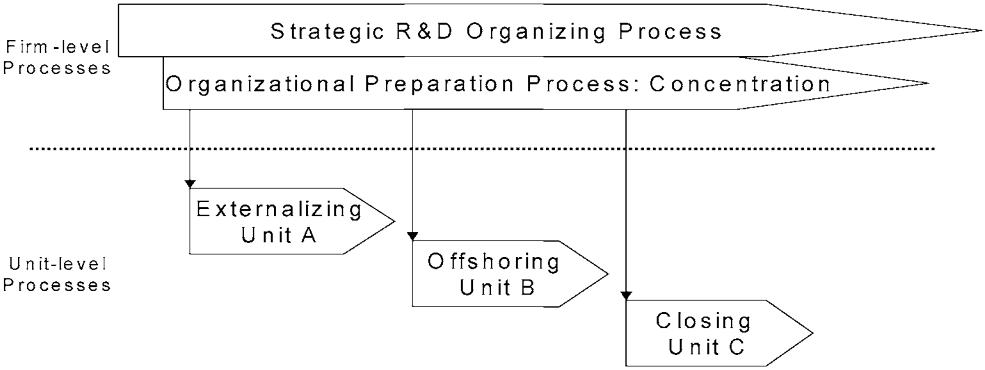
Firm-level Processes
Strategic R&D Organizing Process
Organizational Preparation Process: Concentration
Unit-level Processes
Externalizing Unit A
Offshoring Unit B
Closing Unit C

Figure 3. Processes at Firm Level and Unit Level (Adapted from Paper IV)

5.1.1 Concentration – Firm level

In response to the brutal contextual changes, Ericsson appoints a COO responsible for rejuvenating the organization, who gathers a group of senior executives around himself (see Chapter 4 and Paper IV). A procedure for the changes is implicitly defined, centered around this group that meets weekly or bi-weekly. The group thus manages a firm-level change process, where strategies evolve and are implicitly defined through the discussions and decisions taken.

The firm-level concentration process streamlines the organization, creating a more simplistic organizational structure, with a clear line of command and corresponding accountability. Ericsson dissolves much of the complexity of the distributed heterarchical organizational structure created over the past two decades. The concentration process paves the way for the following closures, divestitures, externalization and offshoring. In retrospect, the concentration process can be seen either as a way of streamlining in order to improve efficiency or accountability, or as an organizational preparation phase for major structural change. These same organization principles support efficiency and accountability internally and at the same time make divestiture and externalization possible.

5.1.2 Closure, Divestiture, Externalization and Offshoring - Unit level

Decisions are taken in this group of executives to move responsibilities and to close, divest, externalize or offshore activities. The executive responsible for the operation in question takes charge of planning, evaluating and executing the particular change effort. Coordination between different organizations is handled within the group. Task teams appointed by the responsible executive handle the planning and execution of each case. The cases are handled on a subunit level, with different people involved in different cases. During the first year or two, few team members have any previous experience of externalization or offshoring. As time passes, experience accumulates, and a distributed externalization capability begins to develop. When new task teams are formed, more and more often team members have previous experience of similar cases. Initially, the carriers of common procedures and previous experience are the dealmakers, staff from the central mergers and acquisitions unit. In practice, they carry a set of tacit assumptions about how to externalize product development.

In this chapter, I inquire further into how Ericsson goes about externalizing and offshoring product development, and how capabilities contribute to- as well as are impacted by these structural changes.

5.1.3 Organizational Development

Major structural change, where many- and in some cases all individuals in a group are reassigned to new tasks and given new peers and management, disrupts organizational routines and procedures. Such structural change can pose a threat to capabilities as well as rigidities. Following major structural change, there is a need and an opportunity for organizational development to selectively rebuild and augment capabilities. In the case of externalization, there is also a need to develop and apply new capabilities when interfacing with an external supplier of product development services. The organizational development phase can be seen as concluding and succeeding the unit-level transactional phase of change: externalization and offshoring that typically precedes it.

Organizational development is often needed both at the firm level and at the unit level. For example, on firm-level, new or modified processes for interaction with suppliers of product development services may be needed. At the unit level, new ways of working with the specific, previously internal, now external supplier of product development services may be needed.

A case of and approach to post-transactional workgroup level organizational change will be presented in the next chapter, Chapter 6. In the rest of this chapter, I focus on externalization and offshoring.

5.2 EXTERNALIZATION STRATEGY

Although Ericsson has no documented, communicated and known formal strategy for externalization at the time when I start this research (see Section 4.5 for a discussion of Ericsson's externalization strategy), a strategy-in-use can be identified.

Based on observed externalizations as well as extant literature (e.g. McIvor, 2005), a set of potential strategies for externalization can be identified:

Core capability-based externalization: Identify and retain core capabilities. Assess market availability of critical non-core capabilities, and consider externalization. Externalize non-critical non-core activities.

The core capability-based externalization strategy reduces the risk for unwanted knowledge leakage to competitors by identifying and externalizing only non-core activities (Quinn & Hilmer, 1994).

Capacity-based externalization: Perform a basic volume of all activities internally. Externalize peak volume activity execution.

The capacity-based externalization strategy reduces the risk for capability and knowledge loss. By retaining part of the activity, knowledge and absorptive capacity (Cohen et al., 1989, 1990) that enables learning is retained.

Procuring products: Replace internal product development with external procurement of products. The products procured can be standard or custom-designed.

The strategy to procure products enables more autonomous externalization (Chesbrough & Teece, 1996), thus simplifying the transaction. The firm should buy rather than make those parts that do not contribute to the firm's competitive advantage, and where external suppliers have a distinct comparative advantage (Venkatesan, 1992), enabling them to make these parts at a lower cost, faster, or with a higher quality. The firm should focus on making parts that do contribute to the firm's competitive advantage.

Procuring product development services: Replace internal product development with external procurement of product development services. The scope of the services procured can vary from complete product responsibility, including new product development, verification and maintenance, to only software coding or testing.

The strategy to procure product development services enables and requires the retainment of control and product development capability.

Development capability is necessary to be able to specify and procure product development services (Fine & Whitney, 1996, 1999).

Maturity-based externalization: Externalize product improvements and maintenance of mature products while retaining new product development internally.

The strategy to externalize improvements and maintenance of mature products enables the firm to focus on innovation and new product development, allowing the supplier to focus on the more process-oriented work of mature product maintenance (Utterback & Abernathy, 1975).

These different strategies are not mutually exclusive, but rather can be combined in a number of ways. For the most part, Ericsson applies core capability-based externalization, combined with a capacity-based externalization strategy. The firm consciously selects which products and technologies to keep internal, and which to consider for externalization. In many cases, Ericsson will externalize a part of a competence area, while retaining other parts, or closely related competencies. Ericsson often externalizes maintenance of mature products, retaining new product development in the same field. Ericsson to a large extent procures product development services. Procurement of products is done mostly when there are dominant designs in the open market (e.g. microprocessors from Intel, operating systems from Microsoft) not controlled by competitors. Ericsson has in several cases replaced previously proprietary internally developed components with commercially sourced components.

Ericsson can thus be seen to combine all the above strategies. The core capability-based strategy reduces the risk for leakage of core knowledge. The capacity-based strategy helps retain capability and avoid loss of competence. Procurement of product development services retains control over the product. Procurement of standard products enables Ericsson to leverage dominant designs. Maturity-based externalization enables Ericsson to focus internal product development as well as management resources on new product development.

5.3 EFFICIENCY AND FLEXIBILITY

Efficiency and flexibility are two of the objectives of externalization and offshoring. There are, however, several aspects to efficiency and flexibility. In this thesis, I distinguish between efficiency and flexibility in *operations*, and efficiency and flexibility in *organizing*.

Operations are an ongoing concern for the organization. Efficient operations are thus executed such that the ratio of output to input is high.

Flexible operations may, for example, adjust in volume or task to changed needs.

Organizing is seen here as the activity of reconfiguring resources and capabilities to enable operations. Organizing can imply, for example, redefining responsibilities, reallocating resources to tasks or transferring operations from one organization in one location to another organization in another location. Efficiency in organizing implies that the transfer of responsibility and the setup of the new operation are smooth, quick, and low-cost, and do not cause unnecessary disruptions in production.

5.4 EFFICIENCY AND FLEXIBILITY IN OPERATIONS

Operations are what a firm *does*. Capabilities are what a firm *can do*. Capabilities that enable the firm to operate efficiently and flexibly are key to the firm's success. A set of contingencies promotes as well as restricts efficiency and flexibility. Modularity, organizational alignment and interfaces are examples of such contingency factors.

5.4.1 Modularity and Organizational Alignment

Ericsson's dominant product architectures (e.g. AXE) are modular. Through the years, this has enabled Ericsson to develop and exploit a distributed global network of product development units (see Chapter 4). In the organizational preparation process of concentrating product development, the number of development units is reduced, and the development responsibility is streamlined.

The organizational preparation phase, which aligns organizational structure and product architecture, increases structural flexibility and supports divestiture of selected units and externalization of their product development activities (Paper IV). Modular externalization can increase efficiency as well as flexibility.

This supports the expected benefit of fit between organizational structure and product architecture (Chesbrough et al., 2001; Sanchez, 1995; Sanchez & Mahoney, 1996). Further, when organizing according to the product structure, not only the organization but also capabilities tend to be aligned with the product architecture, enhancing efficiency (Grant, 1996b).

Compared to externalization of integration activities (Paper IV), externalization of component development activities is more efficient and provides more flexibility. This can be partly explained by the more extensive communication needs in integration activities, which become more complicated if the integrators need to communicate with many extra-organizational actors, i.e. both component developers and the product owner.

Many scholars emphasize the importance of systems integration. Dosi et al. (2003) argue, contrary to other scholars' claims, that modularization does not remove the need for supermodular coordination. This is the role of the systems integrator. Others have pointed to the importance of retaining systems integration internal to the firm, as a means of retaining product development capability, since systems integration requires knowledge beyond the actual integration technology (Brusoni, Prencipe, & Pavitt, 2001). In order to perform integration, firms must know the actual technology of the components to be integrated. System integrators know more than they use in their own development and production (Brusoni & Prencipe, 2001b, 2001a; Granstrand et al., 1997). Brusoni and Prencipe argue that the need for coordination between integration and the various module development activities is so extensive that this precludes externalization, even of module development. Externalizing product development in a mature architecture, a dominant design (Utterback, 1994), or a modular architecture (Fine et al., 1999), where systemic interdependencies are more predictable, may require less frequent coordination and be more easily managed at arm's length. Systemic innovations should be retained internally, whereas autonomous innovations can be externalized (Chesbrough & Teece, 2002). This seems to both confirm the findings of my study, as well as lend credence to Ericsson's strategy-in-use for externalization.

Externalization is limited by asset specificity, as predicted by transaction cost economics. This can partly explain why externalization of hardware development can be more difficult than externalization of software development (see Paper III), or why externalization of systems integration is more difficult than externalization of module development (see Paper IV). Hardware development and systems integration have higher asset specificity than software and module development.

Chesbrough (2003) addresses a fundamental issue by pointing out the cyclical nature of technological evolution, where the level of modularity in a certain business not only changes over time, but also actually changes back and forth. The cyclical nature of technological structure implies a need for cyclical variations of organizational structure. At times a modular organization is more efficient, and at times an integral organization is required. This may perhaps seem at odds with Ericsson's strategy. However, by studying Ericsson's changes to its global product development organization, one can argue that, in fact, although prompted by the brutal environmental change, these changes have potentially also been warranted by emergent changes to the structure of

Ericsson's products, where the emergence of global standards has decreased the need for market modularity.

The cyclical nature of technological evolution is also observed by Svensson (2005), who finds that modular organizing is efficient when systemic interdependencies are reasonably predictable, but that a more integral organization is more effective in situations of extensive architectural innovation and related higher systemic uncertainties. In my study, the architectures are mature, although some architectural innovation is still ongoing. This does provide for sufficient predictability for externalized module development, but proves troublesome when integration is externalized.

5.4.2 Creative Destruction of Rigidities

When development and maintenance of more mature products is externalized and offshored, product development capabilities can be focused on new product development. Resources can be reallocated to new tasks. Externalization and offshoring enable the development of new, better, and more relevant capabilities, and reduce the dependence on certain existing organizational capabilities.

In the short term, major structural change damages capabilities (Beer & Nohria, 2000b). It can however also be observed that dysfunctional organizational rigidities are reduced or eliminated, thus allowing the development and deployment of new and more efficient procedures. Brutal change can be seen as both enabling and requiring subsequent organizational development in order to rebuild and augment capabilities.

The creative destruction of products (Granstrand et al., 1997) is actually accompanied by a related creative destruction of organizational rigidities, when dysfunctional routines are eliminated and replaced by other more appropriate procedures and methods. Firms need distributed capabilities beyond those that are core (Granstrand et al., 1997), but the specific capabilities needed vary over time, and each capability must continue to develop or otherwise retire or retrench (Helfat et al., 2003).

In some cases at Ericsson, certain development tasks are externalized, based on the assessment that these tasks no longer contribute to competitive advantage. In a typical case, the development is first concentrated to one location, then divested and externalized. Ericsson then procures product development services from the acquirer of the divested operation. In such cases, most of the previously internal capabilities are lost, although they are made available through the supplier. Routines and procedures specific to this operation are no longer part of Ericsson.

In other cases, a supplier of product development services now maintains and extends products that were originally developed inside the firm, allowing the internal product development organization to focus on new products, new technologies, and extending existing and building new capabilities.

Ericsson's divestiture and externalization leads to partial elimination of both capabilities and rigidities, but also to new opportunities for rebuilding and augmenting capabilities.

5.4.3 New Management Capabilities and Efficient Interfaces

Externalization and offshoring both leverage management capabilities and help to build and augment such capabilities (Paper III). External and offshore product development requires a set of additional new management skills, e.g. contract management, negotiation skills, cross-cultural management skills, etc. By repeated externalization and offshoring, experience is gradually accumulated and routines established, creating new management capabilities.

A broader interface (more people, more frequent interaction, more formal and informal communication) between the externalizing firm and the supplier of product development services contributes to flexibility, as well as reducing the risk for unforeseen problems (Paper IV). A narrower interface (fewer people, less frequent interaction, more formal and less informal communication) can be maintained at lower cost, and can possibly contribute to a more business-oriented relationship, but at the cost of less learning from the supplier, less advance warning of problems and issues, and less mutual coordination.

5.5 EFFICIENCY IN ORGANIZING

Flexibility is primarily a dynamic concept (Volberda, 1996). Above, I define flexibility as the ability to adapt to and possibly influence changes in the environment. Adaptation implies change. The more dynamic the environment, the more important the flexibility.

When change becomes part of the normal routine, then efficiency and effectiveness in changing becomes paramount. A flexible firm must be able to transform itself efficiently and effectively from one mode of operation into another. Cost, time and risk must be limited.

This should not be interpreted as meaning that change should be continuous. Change may well occur according to a punctuated equilibrium model (Abernathy & Utterback, 1978; Miller, 1982). Time-pacing of change is another way of making change effective in 'high-velocity industries' (Brown & Eisenhardt, 1997; Eisenhardt & Brown, 1998). Efficiency in the transition is a complement to the correct scheduling of change.

Based on experiences from a set of transitions (externalization or offshoring, or variants thereof), I describe in Paper III how different types of capabilities (see Figure 1, page 23) contribute to dynamic efficiency in organizing product development. Having or developing and leveraging capabilities can make externalization, offshoring, and thereto-related transitions more efficient: faster, at lower cost or with lower risk.

5.5.1 Organizational Transitions

For a firm in the traditional mode of organizing product development internally 'at-home', there are multiple paths for externalizing and/or offshoring. The firm may choose to move parts of product development to existing or new intra-firm product development organizations located offshore, in order to gain proximity to offshore markets and/or to gain the benefits of lower product development costs. Alternatively, the firm may choose to externalize parts of product development to an extra-firm product development service supplier, allowing the firm to concentrate on activities focused on its core competencies. Finally, the firm may choose to directly seek both lower costs and the ability to focus, by utilizing external offshore product development. I refer to these three paths of change as *externalization* (1) (see Figure 4 page 65), *offshoring* (2), and *concurrent externalization and offshoring* (3), respectively.

External product development performed in countries where costs are high may be transferred to low-cost product development offshore: *external offshoring* (4). Product development being performed in an internal offshore mode can be externalized: *offshore externalization* (5).

Sourcing decisions should be regularly reassessed. Is the external product development performed efficiently and does the organizing mode provide the firm the requisite flexibility? Such reassessment can lead to continuing with the existing arrangement, to reinternalizing the activity, or to continued external organizing but with a different supplier of product development services: *re-sourcing* (6).

At least in theory, these changes can also be reversed. Product development can be internalized from an external party (1, reversed) or from an offshore subsidiary (2, reversed), or from an external offshore party (3, reversed). Product development may also be brought back from an external offshore mode of organizing, to an external onshore mode (4, reversed) or to an internal offshore mode (5, reversed).

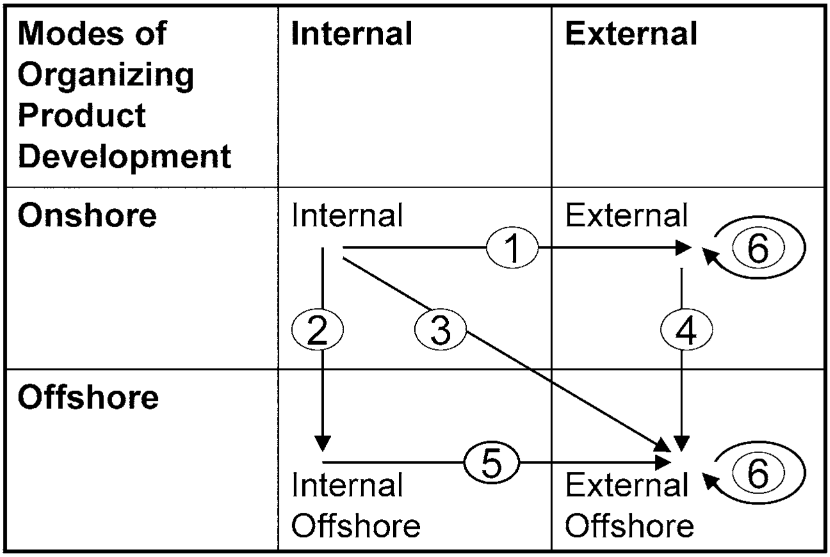

Figure 4. Transitions Between Organizing Modes

5.5.2 Externalization

The transfer of product development operations to an extra-firm organization (1,5 - see Figure 4) is conditioned on finding or establishing a requisite development capability (A - see Figure 1 page 23) in the supplier organization. Product development capabilities consist of capabilities that are generic, capabilities that are technology-related, and capabilities that are product-related. Through careful selection of the supplier of product development services, it can be possible to find a firm that has the requisite generic and technology-related capability, e.g. digital ASIC development capability or software development in C++ capability, but normally there will not be independent suppliers of product development services that have the product-specific capability. The process of combining divestiture of resources and subsequent externalizing of product development to the former internal product development unit offers one way of establishing a resource with all three requisite capabilities more or less instantly, through capability transfer. In addition to providing a solution to the specific challenge, this shows that externalization can be more efficient when the operational product development capabilities (A) are in place in the supplier.

5.5.3 Offshoring

Due to the inherent limited mobility of labor, preservation of operational product development capability is normally not possible when offshoring (2,3,4 - see Figure 4). The offshore organization must possess or develop this operational product development capability (A). Normally, at least the product-specific part needs to be developed, whereas the generic and technology components may exist.

When offshoring within a large global firm (2, 4), common procedures and routines for managing product development (B), common governance principles, and elements of a shared culture may help to make the offshoring more efficient. Internal offshoring within the source firm (2), or external offshoring within a global supplier of product development services (4), with both onshore and offshore operations, may therefore be more efficient than offshoring to another firm, i.e. combining offshoring and externalization (3).

5.5.4 Transfer of Product Development

Transfer of product development tasks and responsibilities does require specific skills and routines in both parties with respect to establishment of the relationship between source and supplier firms (D). Similar capabilities are needed for both externalization (1,3,5) and offshoring (2,3,4). The source firm must be efficient in providing all data required, supporting set-up of equipment and other resources, training the supplier staff when necessary, establishing an operational interface to the supplier, and last but not least in reallocating those who previously performed the tasks internally. The supplier - being internal or external to the source firm - must be efficient in organizing a product development group as well as a customer interface for the task in question, training the staff if necessary, and receiving and establishing the data and equipment from the source firm. Firms that perform these tasks repeatedly tend to develop improved routines that turn into dynamic management capabilities. Externalization and offshoring can be more efficient if these types of dynamic management capabilities are established in both the source and the supplier firms.

Large multinational corporations like Ericsson have, over time, developed capabilities the support the transfer of tasks and responsibilities between their different development sites, including internal offshore locations. These capabilities provide a basis for developing capabilities for externalization.

5.5.5 Re-sourcing

Switching suppliers of product development services (6) may be difficult if the source firm no longer has product development capability inside the firm. If the source firm has operational product development (A) as well as dynamic management capabilities (D), then this contributes to an efficient establishment at a new supplier. If the new supplier has similar dynamic capabilities, this also contributes. The involvement of the source firm in the details of the transfer may vary depending on the level of transfer support that the incumbent supplier provides, which may be contingent on the existing- as well as potential future relations between the source firm and the incumbent supplier.

5.5.6 Reinternalization

One of the risks with externalization is the loss of internal operational product development capability (A). There are many reasons why firms want to retain this capability: to reduce dependency on the supplier, to retain the ability to specify and assess the work of the supplier, as well as to preserve the ability to reverse the decision to externalize. Several authors address the potential irreversibility of externalization (Bettis et al., 1992; Lei & Hitt, 1995). Cohen and Levinthal (1990) stress the importance of knowledge in order to learn, and how internal product development contributes to the knowledge base allowing firms to learn from others. But few have explicitly addressed the process and implementation of reversal of externalization. Here, in my research, I can confirm the importance of retained internal operational product development capability in retaining the option for reinternalization.

Reinternalization (reversed transitions in Figure 4, page 65) can also benefit from shared operational management routines as well as from the existence of routines for managing a dynamic product development organization. If both the organization from which tasks and responsibilities are transferred out, and the organization into which they are transferred in, have the same management routines, for example, due to being part of the same multinational corporation, then this makes the reinternalization more efficient. If both organizations have dynamic management capabilities that support the transfer of development tasks and responsibilities, then this makes the reinternalization more efficient.

5.5.7 Path Dependency

Externalization is path-dependent (Bettis et al., 1992; Lei et al., 1995), and so is offshoring. In my research, I study externalization and offshoring in combination, and find that the choice of trajectories to follow in externalization and offshoring is contingent on a number of factors. Firstly, the objectives driving externalization and offshoring may vary. Externalization without offshoring (1) is unlikely to provide drastic reductions in cost per hour worked, but may provide increased flexibility and reduced fixed costs. Offshoring internally (2) may, in addition to potential cost savings, in some cases also include the benefits of presence in local markets. Together, offshoring and externalizing may provide increased flexibility and reductions in hourly costs as well as fixed costs.

Every change is associated with risks and costs. Externalizing concurrently with offshoring (3) is likely to take longer and be more risky than only externalization or offshoring in a first step. With increasing experience of similar transfers, accumulated into dynamic management capabilities, the risks associated with direct and concurrent externalization and offshoring are lower, while still providing all the benefits without having to go through yet another transfer process.

Concurrent externalization and offshoring (3) also reduces the number of transfers. Every transfer implies risk and cost. When both operational product development and dynamic management capabilities can be exploited, concurrent externalization and offshoring may therefore actually imply lower overall risk, and most certainly lower total cost.

In my research, I find that offshore externalization (5) is significantly less costly than onshore externalization (1) and, when possible, this (2+5) may thus be preferred over the alternative of first externalizing and then offshoring (1+4). Transfers of tasks and responsibility typically involve staff from both of the organizations involved: the sender as well as the receiver. If both are offshore, and thus entail lower costs, the entire transfer is significantly less costly.

Externalization linked to divestiture is an integral process in downsizing, and offers a fast and low-risk externalization, since existing product development capability can be exploited. Therefore, in a downsizing context, this path, starting with externalization (1) and possibly later continuing with offshoring (4), may be a more attractive alternative. The externalization of product development to be transferred offshore may be targeted at a global supplier of product development services, with a presence in both the country of origin of the source firm and with product development operations in low-cost countries offshore, thus simplifying the subsequent offshoring. Ericsson actively encourages its suppliers of product development services to establish offshore development centers to complement their onshore development centers.

Finally, although seldom articulated in the scholarly literature, all these organizational transitions may need to be reversed. There may be many different reasons for this: failure to meet the goals of the externalization or offshoring, changing market conditions, changing technological conditions that call for a more integral architecture and organization (Chesbrough, 2003), or changes in firm strategy. The firm can prepare for such reversals by actively managing firm capabilities to maintain reinternalization as a feasible option.

5.6 CAPABILITIES IN PRODUCT DEVELOPMENT

Capabilities in product development are important both with regards to task performance and task management and control, as well as both operationally and dynamically (see Figure 5 and Paper III).

Preservation of Capabilities Support Efficiency in ...	**Task: Product Development**	**Management**
Operational	Externalization, Re-Internalization and Re-Sourcing Ⓐ	Offshoring Ⓑ
Dynamic	Ⓒ	Externalization, Offshoring and Re-Sourcing Ⓓ

Figure 5. Preservation of Capabilities that Support Organizational Dynamics

5.6.1 Operational Product Development

Operational product development capabilities (A) are important in supporting actual product development work, as well as in teaching and training staff to develop products and specifying and ordering product development services. Substitution-based externalization (Gilley et al., 2000) can be combined with a transfer of staff, as is the case in some of Ericsson's externalizations of product development, allowing for a transfer of operational product development capability from the firm externalizing to the supplier of product development services. Transfer of responsibility becomes more efficient and less exposed to risk when combined with a transfer of operational product development capability. This would theoretically be the case for offshoring as well. It can however be assumed that it is less frequent that staff move with their task if it is moved to another part of the world.

5.6.2 Operational Management

Operational management capabilities (B) are important in controlling and managing product development. Such management capabilities are often embedded in and leverage corporate procedures and models for managing and coordinating product development. When tasks are moved between different entities of the same multinational corporation, a reasonable part of procedures and models are likely to be retained. This retainment of operational management capabilities makes the task transfer more efficient.

5.6.3 Dynamic Product Development

Dynamic product development capabilities (C) are closely tied both to the operational product development capabilities, and to the firm context. When a task is externalized together with staff, part of the dynamic capabilities will follow the operational capabilities. Over time, however, dynamic capabilities will change and adapt to- as well as influence the new firm context.

5.6.4 Dynamic Management

Dynamic management capabilities (D) are important in supporting the transfer of product development tasks and capabilities from one organization and location to another. Such management capabilities are in addition to- and slightly different from those developed by- and required to manage traditionally organized internal product development. These dynamic capabilities are developed and exploited in reorganizing product development. Firms that have repeatedly performed and learned from externalization and offshoring of product development activities, on both sides of the transaction, may have developed these capabilities. The capabilities support efficient externalization and offshoring, as well as re-sourcing.

5.7 CONTRIBUTION AND POSITIONING

Most previous research on externalization takes a static perspective, and studies issues like the pros and cons of external acquisition of knowledge and technology, the steady-state management of the relationship between source firm and supplier firm, the sectoral and/or geographic specificity of supplier firms, and the specificity of the activity performed (see Chiesa et al., 2004:66 for details). Chiesa et al. inform us about the growing market for product development services, or - as they refer to them - knowledge intensive services (KIS). There is, however, a lack of research on the actual dynamic change process, the actual transfer process of moving product development activity from a source firm to a supplier. In Paper IV, we study the complete externalization process, including organizational preparations, transfer, and steady-state ongoing business after the transfer. In Paper III, I specifically inquire into the dynamics of transferring product development tasks and responsibilities.

Starr (1965:139) as cited by Sako (2003:229), and Sako (2003) herself, find that 'going modular' may be associated with exceptionally high development costs. In my research, I focus not on the cost of rearchitecting the product, but rather on the actual transfer cost of a product that is architected to allow for a distributed organization of product development. In other words, I argue for a separation of the issue of integral versus modular product and organizational architecture, from the issue of internal versus non-internal (external and/or offshore) organizing of product development. A modular product can be developed internally or externally, onshore or offshore, and supports efficiency in modular innovation, in production, in logistics, and in servicing and upgrading. Depending on the stage of the technology and the business, modular component innovation or integral architectural innovation may be predominant. Chesbrough (2003) highlights the fact that architectural innovation is not only a part of early new product development, but may recur and dominate when the most promising modular component innovation options have been exploited and depleted. This then leads to a need to recentralize product development, to allow for and support integral innovation.

Sako (2003) identifies three paths to modularization and externalization: (1) first modularizing, then externalizing; (2) first externalizing an integral product, then modularizing; and (3) simultaneously modularizing and externalizing. In doing so, she makes an important and hitherto unique contribution by specifically addressing the dynamic aspect of modular product and organizational architecture. However, she fails to recognize the various types of modular organizational structures. In my research in general, I touch upon three types of modular organizations: local-modular, distributed, and external organizations. Local-modular organizations are simply geographically concentrated organizations structured along the lines of the modular product architecture. Distributed organizations are – as it sounds – geographically distributed organizations. External product development organizations are where some tasks have been moved to external suppliers of product development services. Sako also fails to describe the specifics of the transitions more in depth. She explicitly addresses externalization of development, production, and the combination of development and production, yet fails to distinguish between the three types of transitions that she discusses, thus disallowing for specifics.

The level of modularization in the product architecture, as well as in the organizational structure, should match the complexity of the environment and the evolution of technology (e.g. Chesbrough, 2003; Chesbrough et al., 2001; Ghoshal & Nohria, 1989, 1993). Offshoring and externalization are two options in modular organizing. However, most of the reasoning applies to integral organizing as well, with the exception that the entire operation would then be subjected to offshoring or externalization, whereas with a modular organizational structure, selected elements may be moved. For these reasons, I argue for separating the issue of modularization or non-modularization, from the issues of onshore versus offshore and internal versus external organizing.

My research provides some insights into the alternative paths firms take in externalizing and offshoring. I assume a pre-existing modular product architecture, partly because this is the case in Ericsson, and partly because this is often the case with product development of complex product systems in multinational firms. Keeping in mind the cyclical nature of the evolution of technology (Chesbrough, 2003), further research is needed in order to understand the role of externalization and offshoring in cases of integral product architectures. Tentatively, I propose that in most cases such development is performed in one of the main development centers of the firm, not externally and not offshore.

In my research, and in Paper III in particular, I focus on two aspects of modular organizing of product development – externalization and offshoring – and describe the possible transition paths involved. Further, I stress the fact that the organizing involves not only creation of a new organization, but also regular reassessments of the organization, at times additional new changes, and at times reversals of previous changes. It is important to recognize and prepare for these inherent dynamics of organizing. This is what flexibility in organizing is all about.

As Volberda (1996:362) puts it: “Flexibility is not a static condition, but a dynamic process. Speed is therefore an essential factor of organizational flexibility.” In this research, I specifically address the efficiency in organizational transitions. Efficient dynamics are in fact the essence of flexible operations.

Applying the capability perspective to structuring an organization, it is clear (see Paper III) that capabilities are critical from both static and dynamic perspectives of externalization and offshoring. In a static perspective, either transferring development capability to the product development services supplier, or developing a development capability in the self-same supplier, is a prerequisite for externalization. Capabilities can also be transferred to other organizations, for example, through a divestiture. Externalization combined with divestiture therefore offers a combined opportunity for increased efficiency and flexibility (by achieving lower costs and improved ability to ramp up or ramp down) and revitalization (by freeing up resources) of the source firm.

6 IMPROVING EFFICIENCY THROUGH CAPABILITY DEVELOPMENT

Transformational and structural changes tend to disrupt organizational routines and processes, and create both a need for- and an opportunity to augment and renew organizational capabilities.

In this chapter, I will describe efforts to augment organizational capabilities at the workgroup level, with the aim of improving efficiency, thus addressing the last of the items mentioned in the purpose of this thesis. I begin by revisiting the context of brutal change, then proceed by describing an intervention made in order to make sense of and improve efficiency, and reflect on the importance of how efficiency is conceived of. In concluding, I discuss the importance of the capability to reflect and learn, and how collaborative action research can be used as a tool to develop organizational development. In doing so, I address the fourth and final item in the purpose of this thesis.

This chapter is based on the research described in Papers I and II.

6.1 REVISITING THE BRUTAL CHANGE CONTEXT

The brutal environmental change and the transformational structural change inside the firm disrupt procedures and routines. The call for increased efficiency requires unchanged capability and capacity in the downsized organization.

6.1.1 Disruption

Major structural transformations lead to many individuals being reassigned to new tasks and roles, and to new workgroups, with new managers and new interfaces to their peers and suppliers as well as receivers of intermediate results. Brutal environmental change tends to require as well as lead to transformational change efforts. These change efforts break down established procedures and routines. Changes in roles and interfaces require new and changed routines and procedures.

In Ericsson's case, the administrative structures are reduced to a minimum during the downsizing, and administrative routines are centralized and streamlined. This leads to a significant reduction of administrative staff, yet at the same time to an increased administrative burden on the individual employee, who now increasingly has to personally administer purchases, travel arrangements, and reimbursements. In the past, there were administrators available to perform or support these tasks. The individual manager must now spend more time on finance as well as human resource management, where in the past support functions were available.

6.1.2 Creative Destruction

In the short term, the brutal change that hits Ericsson poses a grave threat to the firm. The actions taken to counter this threat imply a tearing down of capabilities. This forced dismantling of capabilities poses a threat that is more long-term. At the same time, it poses an opportunity to reduce organizational rigidities, routines and procedures that have developed over time, and that may have become overly bureaucratic or even dysfunctional.

In Ericsson's case, the brutal change forces the firm to take actions that had in the past been seen as impossible or unacceptable. Most employees are assigned new tasks, new roles, in new organizational settings. Many support functions are eliminated. Organizational complexity is reduced. New ways of working are a necessity.

6.1.3 Potential to Recreate

The creative destruction of old routines and procedures enables the creation of new ways of working. The call for cost reductions and improved efficiency and the reduction of support functions requires the creation of new ways of working. At Ericsson, the rapid, top-down transformational change that is implemented both enables and calls for a bottom-up evolutionary change effort focusing on leveraging the knowledge and experience of the employees, rebuilding and augmenting capabilities, to complement the structural change that provides the creative destruction of capabilities.

6.2 2X EFFICIENCY IMPROVEMENT PROGRAM

Ericsson defines a goal to double efficiency in product development in two years, the 2X program. All product development units initiate local programs to achieve the 2X objective. The four primary goal areas for the program are on-time delivery, quality, cost and employee empowerment. Activities vary between subunits, but range from process improvements to improved planning and tracking, and from product cost reduction projects to organizational changes and leadership development initiatives.

6.3 UNDERSTANDING AND IMPROVING EFFICIENCY

I initiate a collaborative action research program (see Papers I and II), linked to the firm's 2X program, to make sense of efficiency, to identify obstacles to efficiency, and to improve efficiency.

6.3.1 What is Efficiency?

Together with a fellow researcher and the director of organizational development, I initiate an effort to understand what efficiency is (see Papers I and II). The intention is to use this understanding to initiate actions to improve efficiency.

A total of 52 interviews are conducted (32 by myself) with software designers and their supervisors, asking about what efficiency is, and what prevents them from being even more efficient. Observations at meetings and seminars with workgroups of software developers and their supervisors complement the interviews.

The literature tells us that efficiency is about doing things right (Drucker, 1974), about the ratio of output to input. But the software developers say instead that efficiency is "*to get things done*" and "*to deliver on one's commitments*". Others state that efficiency is "*to have the right preconditions*" and "*to be allowed to work undisturbed*". Some say that efficiency is "*to work faster*". One individual expresses a more complex and comprehensive perspective, of efficiency as "*solving a task in the shortest possible time, utilizing people in a good way, whereby they can do their best.*" While all these comments are relevant and contribute to efficiency, they lack the comparison of output to input cited in the literature.

The software developers' ways of describing efficiency can be classified into four groups: (1) efficiency as goal fulfillment and meeting expectations; (2) efficiency as a prerequisite to working; (3) efficiency as a property of the results of working; and (4) efficiency as a composite measure of good work (see Paper I).

6.3.2 Obstacles to Efficiency

Following the initial interviews, we also inquire into the respondents' level of efficiency and what prevents them from being even more efficient (Papers I and II). The most frequent obstacle to efficiency mentioned is disruptions, especially so unplanned disruptions. We are told that "*I am interrupted*" and "*my time is so fragmented*". In a later study, we are able to find out that (in another software development workgroup) the average uninterrupted work session was 26 minutes. This confirms and explains the high frequency of the view that interruptions hinder efficiency.

The software developers interviewed attribute some inefficiency to lack of knowledge and experience. This comes as a surprise to us, since Ericsson has undergone a period of extensive downsizing and we had expected that those still with the firm would be quite experienced and knowledgeable. We later understand that the successive downsizings have led to most employees being reassigned to new tasks, new roles, new products, and new organizations. Therefore, it should not come as a surprise that many of them perceive a lack of knowledge and experience, in light of their new work assignments.

Many respondents also note the lack of information: "*There is no lack of tools, but there is a lack of information [about tools].*" They do not know who does what, and whom to ask about what. In addition, there are obstacles related to specific processes used.

One product development project refuses to include corrections to existing code, thus forcing the developers to maintain the old uncorrected code as well as redo the correction to the code on a later code generation at a later point in time. This is not necessarily the wrong thing to do, since including too many changes - and a correction is a change - may jeopardize the overall software quality, but it does lead to inefficiencies in development.

Obstacles to improved efficiency and change are classified into five groups: (1) lack of management commitment in action; (2) lack of tradition as well as forums for knowledge creation and use; (3) established practices; (4) rigid planning; and (5) lack of true and full participation (see Paper II).

In general, the respondents claim that efficiency is not measured, being at best difficult or at worst impossible to measure, but that if efficiency could be measured, then this could help drive improvement efforts.

6.3.3 Self-assessment, Improvement and Reflection

In an attempt to circumvent the apparent disbelief in efficiency measurements, and to support self-improvement of efficiency in software development, I initiate a procedure of self-assessment of efficiency and recording of obstacles to efficiency, combined with group reflection sessions (see Paper II). This is first carried out in one workgroup of some 15 software developers.

Everyone is asked to assess their own efficiency on a daily basis using a web-based questionnaire, either before leaving the office in the evening or when arriving the next morning. The assessment is made by stating one's level of agreement, on a 6-point Likert-type scale, with three statements: "*I have achieved today's targets*", "*I have been efficient* *today!*" and "*I have been as efficient as I wanted today!*" In addition, each developer at the same time records answers to: "*What prevented you from being even more efficient today?*" and "*What in particular happened today?*" The self-assessment data is used to compare individuals, trends for each individual, and group trends. The essay data (i.e. from the respondents' written responses) is collected and grouped by day, for later use in the reflection sessions.

Every week, normally on Fridays, meetings are held where most or all group members attend. Their supervisor chairs the meetings, but I, as a researcher, seed the discussion by providing feedback from my analysis of the data collected during the past week. Typically, I try to identify change patterns and to link events in the self-assessed efficiency to obstacles or other events in the event log. For example, I may note that the self-assessed efficiency on a particular day drops, as an average as well as among most respondents. By studying the event log, I might find that on that particular day there was a long meeting that many of the developers attended, or disruptions in the computer network.

The numerical data, based on the self-assessed efficiency scores, attracts significant attention and is perceived as a sign of the scientific nature of the whole exercise. It is the essay data that provides the most significant input prompting group discussions and reflections though. By bringing perceived reasons for efficiency drops and obstacles to improved efficiency into the open and discussing what the group can do to improve their efficiency, two main results are achieved. First, through these conversations, important transfer of knowledge and experience is carried out, resulting in individual- as well as group learning. Second, through joint agreement about obstacles to improved efficiency, the group is able to identify and agree upon a prioritized list of efficiency improvement activities, that they then plan and agree how to execute.

In one meeting where developers are reflecting on what prevents them from being even more efficient, the following episode occurs:

> Developer A: *Yesterday, I wasn't as efficient as I would have liked to be. I needed to test my new code on a target machine, so I had to go to the lab.*
>
> Developer B (across the table): *Why?*
>
> Developer A: *Well, I can't test on target from my office…*
>
> Developer B: *Why not? I always do.*
>
> Developer A: *You do? How can you do that?*
>
> Developer B: *I'll show you as soon as the meeting is finished…*

This short and simple episode exhibits sharing of experience. It exhibits learning catalyzed by joint reflection. The interesting thing is not that learning takes place, but that this experience had not already been shared. The two developers work in the same workgroup, and have done so for quite a while, and their offices are close to each other. But still, there is obviously - at least in this workgroup - a lack of opportunities and arenas for sharing knowledge and experiences. There is a need for a catalyst in the form of a forum for reflection. Unfortunately, this episode is not unique, but rather quite typical for these reflection meetings.

6.4 EVALUATING THE RESULTS

For the most part, the results of this study are in line with other studies. This study highlights the potential of concurrent concept elaboration and improvement, as well as the importance of the capabilities to reflect and learn.

6.4.1 Measuring Efficiency

This study exhibits clear qualitative indications of efficiency improvements, but I cannot substantiate them in quantitative terms. However, a number of examples of obstacles to improved efficiency are identified and eliminated. A number of cases of exchange of experiences and development of new knowledge are observed.

Efficiency and effectiveness are in theory simple constructs to measure and compare. The more, the better. However, the operationalization has proven difficult, and many organizations do not use formal measures or do not use quantitative measures (Cordero, 1990; Schainblatt, 1982; Szakonyi, 1994). A number of scholars and consultants have tried to provide partial solutions to this shortcoming. However, few have provided a comprehensive and practically operationalizable measurement system that can guide action. See Cordero (1990) for a rare exception, which is both practical and comprehensive.

Quantitative measures in particular are often claimed to not measure the underlying property correctly, or to not be comparable between different contexts. In my research, I use self-assessment of personal efficiency (see Paper I), and find it a useful tool to drive incremental improvements. Especially in combination with group reflection sessions the quantitative self-assessments, and the related perceived obstacles to improvements, serve as important tools in identifying and motivating improvement activities (see Paper II).

6.4.2 Measuring Obstacles to Efficiency

In my research, obstacles are identified through the intervention process, and then acted upon by group members themselves. They perceive these obstacles as preventing them from being more efficient. I am, however, unable to identify any quantitative measure to support a statement that efficiency has been improved. Keller and Holland (1982) show a correlation between self-assessment and objective measurements in their research on innovativeness. Social cognitive research (see e.g. Bandura, 1997 for a review) also demonstrates a correlation between belief about one's own performance and actual performance. Gibson (1999) shows that group self-confidence and performance correlate when task uncertainty is low, group members work together and collectivism is high. That is, self-confidence is important in groups, but less so in collections of individuals.

In her study of how software developers use their time, Perlow (1999) finds a large potential for productivity enhancement by changing the work patterns of individuals in the group. She observes the criticality of both 'quiet time' and 'interaction time'. Quiet time, when the individual is allowed to work undisturbed, is essential for performing cognitive and creative activities. Interaction time, when individuals interact with each other and have an opportunity to consult with each other and share experiences, is essential for problem solving and development. Perlow finds that by increasing the awareness of the relationship between quiet time and interaction time, individuals are able to increase their collective productivity, which I interpret as their efficiency and effectiveness.

Self-assessment and group reflection as used in my study can be seen as techniques that support increased individual awareness of efficiency and effectiveness, conceptually as well as with respect to actual performance. In this study, the main perceived obstacle to improved efficiency is interruption. Developers describe how they were interrupted often, and seldom had any long, uninterrupted work sessions. Another study, not reported here, shows that the average uninterrupted work session is 26 minutes long - or should I say short? It is reasonable to think that this is far too short when performing a creative task like software development.

6.4.3 Concurrent Elaboration and Improvement

By stimulating reflection individually as well as in the group I am able to support a shared sense-making (Weick, 1995) and collectively refined conception of the concept. As described in Paper I, concept creation, concept deliberation and continuous improvements can be concurrent and reinforcing processes.

This implies that managers should act to improve the understanding of efficiency and the actual efficiency in product development concurrently. This can be integrated into daily work activities, rather than separated out into training classes or separate organizational development projects. Thus the ability to concurrently shape and improve the understanding and at the same time improve the actual results of the work process can be seen as an important dynamic management capability.

Through furthering knowing-in-action (Orlikowski, 2002), a triply concurrent process of furthering knowing, action as well as conception, is implemented. Knowing is more than knowledge. It is processual and dispersed knowledge situated in 'communities of knowing' (Boland & Tenkasi, 1995). Knowing is 'effective action' (Maturana & Varela, 1998:27,29, cited in Orlikowski), focusing on knowledge for action and knowing-in-practice. In his seminal article, Lewin (1946:42) calls for keeping "action, research and training" together. Today, Hatchuel and colleagues (2004; 2002; 2003) argue the interrelationship of furthering concepts and furthering knowledge. My research indicates that, in a process of creation of collective knowing (see Papers I and II), the furthering of concepts and knowledge, and improved action can occur concurrently and be mutually reinforcing.

6.4.4 Conceiving of Efficiency

By applying phenomenographically inspired analysis methods (see Chapter 3), I am able to identify various ways of conceiving of efficiency (see Papers I and II): Efficiency as Goal Fulfillment and Meeting Expectations, Efficiency as a Prerequisite to Working, Efficiency as a Property of the Result of Working, and Efficiency as a Composite Measure of Good Work.

This study illustrates the discrepancy in this organization between individual conceptions of efficiency and the conventional, established view of the concept. This indicates to me the potential for improving both the conception as well as the actual concept, in this case efficiency, through a participative and concurrent elaboration of the concept as well as of the actual performance according to the concept. By inviting the group of software designers to collectively elaborate on the concept of efficiency, as well as on their own efficiency, I enable them to develop a clearer conception that is more in line with the generally accepted perspective, and at the same time improve their efficiency, at least according to their own self-assessment. This is in line with Nonaka's (1994) claim that organizational knowledge is created in a continuous dialogue between tacit and explicit knowledge.

My research on the efficiency of software developers confirms the importance of how individuals and groups conceive of their work. This is in line with what is seen in studies of engine optimizers at Volvo (Sandberg, 2000), stockbrokers (Blomberg, 2004), and product developers using formal product development models (Paper V). As Sandberg argues, conceptions rather than attributes should be the basis for describing as well as developing competence. This has potentially far-reaching implications for both training staff and organizational development. As in my research, and as proposed by Lewin (1946), it is time to integrate action, knowledge production (research), and training, where we take an active view of knowledge as knowing-in-action (Orlikowski, 2002). Augmentation of conceptions is potentially a more efficient way of improving performance than traditional staff training programs (Sandberg, 2000). Learning is about changing conceptions, changing the way one experiences something (Marton & Booth, 1997).

6.4.5 Capability to Reflect and Learn

My research results support the call for reflective capability in groups in an industrial context (e.g. what Fisscher et al., 2001, refers to as eccentric organizations).

Product developers in the same workgroup clearly learn to cope with various challenges in their work in different ways. Normal, everyday work routines do not provide sufficient incentive or opportunity for sharing of experiences and joint problem solving. There is great potential in unleashing the knowledge and experience held by the members of the group, and making it available to all group members. Direct transfer of knowledge and experience between group members enables knowledge to be refined and situated in the transfer process. A reliance on more formalized procedures and methods leads the group: firstly, to suffer from the difficulties of transferring knowledge that is often partly of a tacit nature; secondly, to suffer from an inability to support knowledge refinement and adaptation to the situation; and thirdly, to incur time and cost penalties.

By providing an arena, the meeting, and seeding the discussion with feedback on the past week's self-assessment statistics, I am able to initiate group reflection where group members discuss the results. Why is a certain day perceived as less efficient? What happens that day? How could they be more efficient? And how can they act in order to be more efficient in the future?

In Paper II, I identify a number of obstacles to successful organizational renewal: lack of management commitment in action, lack of a tradition of- as well as forums for knowledge creation and use, established practices, rigid planning, and lack of true and full participation. Following Beer and Eisenstat's (2000) advice to transform obstacles to change into dynamic capabilities supporting change, I identify the need to create an organization that supports learning and to exploit knowledge and experience of the entire group.

Further, in Paper II, I identify three tentative dynamic capabilities that may be crucial to successful micro-organizational change efforts: the capability to learn, the capability to explore and exploit everyone's knowledge and experience, and passionate capability. The capability literature focuses mostly on firm-level or business-level operational capabilities, such as low-cost production or international sales. The capabilities identified here are dynamic capabilities (Teece et al., 1997), focusing on changing action and capabilities inside groups of product developers. Rather than specific firm-level processes, such as alliancing or strategic decision making (Eisenhardt & Martin, 2000), however, these capabilities constitute routinized behaviors and attitudes within an organization, from the highest macro- to the lowest micro-organizational levels, critical to the ability for self-renewal. In order to build these micro-level capabilities, managers should pay attention to and seek to eliminate the identified obstacles to change: by explicitly supporting change in action; by supporting the creation of forums for knowledge exchange; by questioning the established way of doing things; by being visible and accessible; by allowing and encouraging more emergence and incrementality in planning; and by participating and encouraging broad participation.

This study only indicates the potential in this area. More research is needed in order to better understand the role of dynamic micro-organizational capabilities and their relationship to operational capabilities and macro-level dynamic capabilities.

The dynamic micro-organizational capabilities identified in this study could be understood as components in a firm's 'combinative capabilities' (Kogut et al., 1992), which augment and recombine operational capabilities. In practical problem solving, learning, knowledge exploration and knowledge exploitation leverage and recreate organizational capabilities (Iansiti et al., 1994). The proposed capabilities support Kaplan et al.'s (2002) six capability operators: creation, destruction, integration, absorption, replication and protection. The proposed dynamic capabilities also enable and support the evolution of capabilities, or 'capability life-cycle' (Helfat et al., 2003).

In order to develop product development, the firm and its subunits must have or develop a capability to learn, a capability to explore and exploit the knowledge and the experience of the members of the group. This is what I find in my study of a group of software developers (see Paper II for details). These are cognitive capabilities, focusing on knowledge creation, knowledge exploitation, knowledge diffusion, and knowledge elaboration. Knowledge integration, intra-group, intra-firm as well as extra-firm, is critical for renewal of development capability. My findings primarily illustrate the need for intra-group cognitive capabilities. This extends and complements the 'integration capabilities' identified by Iansiti and Clark (1994) who identify the need for three classes of integrative capabilities: external technological integrative capabilities, external market integrative capabilities, and internal integrative capabilities. They define internal integration as "the capacity for extensive coordination between different specialized subunits within an organization." In my study, I identify a need at a micro-level for integration between individuals in a workgroup. Further, I see in my research a greater need for cognitive and conceptional integration than for coordination in a more formal sense. Kogut and Zander's (1992) focus falls somewhere in between. Their 'combinative capabilities' inform us about the criticality of being able to integrate the various types of learning or integration, from internal as well as external sources, and exploit that new knowing in action. My proposed cognitive capabilities are related to Danneels' (2002) 'second-order competences'. However, he limits the scope of second-order competencies to integration of technological and market competencies, whereas I argue again that the integrative capabilities need to include also other aspects of the work process and the individuals in the organization.

6.5 COLLABORATIVE ACTION RESEARCH AS A POTENTIAL HIGHER-ORDER CAPABILITY

The use of collaborative action research enables both me as a researcher and the participating software designers to make sense of efficiency, to augment our conceptions of efficiency, individually and collectively, as well as to improve actual efficiency in software development in the workgroup (see Papers I and II, cf. Paper V). Collaborative action research methods offer great potential for organizational development efforts. If these methods are internalized and routinized in such a way that they can be used autonomously from the researcher that first introduced them into the organization, then they will constitute a valuable capability for developing product development. Collaborative action research can constitute a method for augmenting and reconfiguring the product development organization, enabling it to manage new future challenges. Seen from the perspective of the firm, collaborative action research would be a higher-order capability, which changes, augments, and enhances the product development capabilities.

Higher-order capabilities are intrinsically contradictory. On the one hand, their very nature and purpose is change (see e.g. Collis, 1994; Winter, 2003). They should support Schumpeterian 'creative destruction' as well as recreation of capabilities. At the same time, they should provide predictably repetitious procedures, rather than 'ad-hoc' problem solving (Winter, 2003). Higher-order capabilities need to walk a tightrope between routinization and renewal, between formalization and 'adhocratization' (Hedberg, Nyström, & Starbuck, 1976). They must not fall into the core rigidities trap (Leonard-Barton, 1992), nor must they become so ad-hoc that actions cannot be repeated and neither contribute to nor leverage learning and experience.

From a management perspective, my research indicates that it is possible to leverage collaborative action research to concurrently improve action, improve knowledge, and augment ways of conceiving important phenomena. More specifically, this study stresses the importance for management of showing passion for learning – from and by everyone. Management must talk about learning, reward learning as well as sharing knowledge, and support joint knowledge creation and knowledge dissemination through the creation of forums and through allowing time and resources (see Paper II).

The literature on collaborative research (see e.g. Shani et al., 2004 for an overview) and action research (see e.g. Reason et al., 2001a for an overview) focuses primarily either on the generation of scholarly knowledge (e.g. Argyris et al., 1985) or on helping the client (e.g. Schein, 1987). Most streams of the literature have a component of both but are far from the integrated view of "action, research and training" as advocated by Lewin (1946). Limited attention is paid to the dissemination of knowledge produced in various forms of action research. In fact, action research offers a great potential as a catalyst and tool for dissemination of knowledge created in action research projects. Installing action research methods in the firm would enable both continued collaborative knowledge and action generation, as well as provide a tool for furthering knowledge dissemination.

Organizational capabilities enable the firm to go about its day-to-day business, but the potential competitive advantage created by organizational capabilities is easily made obsolete through the creation of superior capabilities by others who command dynamic capabilities (Collis, 1994). It is important to understand the need for continuous improvement of, and sometimes replacement of, capabilities (Helfat et al., 2003), as capabilities move through their life cycle. Those who command a dynamic capability to develop product development autonomously and continuously, adapting to new challenges in the environment, they hold the key to the future. Collaborative action research can contribute to developing this capability renewal.

7 CONTRIBUTION: IMPLICATIONS FOR MANAGEMENT PRACTICE AND FOR RESEARCH

This concluding chapter consists of three sections. First, I summarize the contribution of this thesis. Secondly, I elaborate on managerial implications of the results, for application in practical development of product development. I aim to contribute to an improved actionable understanding of how product development capabilities contribute to efficiency, effectiveness and flexibility. Through an improved such understanding, managers can improve both strategic choices on which capabilities to develop, augment and sustain, as well as how to develop and leverage such capabilities. I also aim to contribute to actionable methods for organizational development on a workgroup level. Finally, I make proposals for further research.

7.1 SUMMARY OF CONTRIBUTION

This thesis takes its point of departure in the brutal change that Ericsson experienced during the first semi-decade of the 21st century. The description of this change process, and Ericsson's response to it (see Chapters 1 and 4), serves as an illustration of some of the challenges a firm subjected to brutal change faces. It also illustrates the challenge of, as well as potential in, the almost inevitable capability and rigidity destruction that follows. This description is unusual since researchers are not normally afforded close and continuous access to the change processes in times of brutal change. My continuous presence, as well as my access to actors on all levels of the firm, has enabled me to observe and describe both the emergent, ongoing process as well as selected individual cases of externalization and offshoring of product development, in a longitudinal fashion.

The purpose of this thesis is "to contribute to an improved understanding of how product development capabilities contribute to efficiency and flexibility in times of brutal change." To do this, I focus on efficiency and flexibility as measures of product development performance. I develop concepts and terminology that support the sense-making of aspects of product development. The development of product development described includes both structural development, in particular the role of capabilities in externalization and offshoring (see Chapter 5), and organizational development, with a focus on capability improvements on a micro-organizational level (see Chapter 6) that leverage the knowledge and experience of the individual employee.

In this thesis, I introduce a typology of modes of organizing product development onshore or offshore, internally or externally (see Figure 2, page 27). This typology is derived from Cronin et al. (2004), and stresses the two independent dimensions of onshore-offshore and internal-external, and thereby enables clear communication about the concepts, by both practitioners and scholars. There is a strong tendency to indiscriminately take for granted, implicitly or explicitly, that external means offshore, or that offshore means external (see e.g. Preston, 2004), that needs to be counteracted. The four modes of organizing all have their strengths and weaknesses, and the choice of mode must be contingent on the actual situation.

I show that modularity in product and organization, as well as broad interorganizational interfaces, may support flexibility when externalizing product development (Paper IV and Chapter 5). The research (Paper IV) indicates that externalization of modular product development can contribute to flexibility, whereas externalization of architectural development does not. Systems integration should normally be retained inside the firm boundary. This confirms and supports the recommendations by Chesbrough and Teece (2002), Fine and Whitney (Fine et al., 1996), Granstrand et al. (1997), Mikkola (2003), Prencipe (Prencipe, 2003), and Sanchez and Mahoney (1996).

The findings regarding the interorganizational interface should be seen as tentative. It is reasonable that an interface where communication is more frequent, involves more actors, and covers more different issues is likely to promote flexibility, coordination, and learning. At the same time such an interface may increase the risk for unauthorized knowledge leakage, and may be more costly than a narrower, more tightly controlled interface. This is an area for further research.

Further, I go beyond the static perspective and focus on a dynamic perspective on product development organizing. I identify a set of transitions between modes of organizing product development (see Figure 4, page 65), and formulate propositions for how different types of capabilities moderate the efficiency in different such transitions (see Chapter 5 and Paper III). These propositions are grounded in my research and are deemed reasonable by several practicing managers, but do call for further validation. The propositions articulate previously tacit knowledge and constitute a new contribution to dynamic theory of product development capabilities.

The strengths of combining externalization and divestiture are illustrated through my description of the benefits of sustained product development capabilities when externalizing through divestiture (Paper III and Chapter 5). This complements the description by Rumyantseva (2005), where she argues that the externalization and divestiture combination, at least in the case of Ericsson, is a more strategically motivated and aware decision than 'traditional' externalization ('outsourcing' in her terminology). Rumyantseva also argues that the managerial temporal perspective of the process makes a difference. By extending the temporal scope from short-term efficiency into strategic long-term issues of vertical integration and firm development, managers can use externalization as a tool for renewal of the firm.

I argue that the actual capability retention is a critical advantage. By choosing adequate combinations of externalization strategies (see 5.2), the firm can achieve focus, leverage external resources, and yet minimize the risks associated with knowledge and capability leakage and loss. In the literature, sourcing strategies are often recommended based on strategic importance combined with capability strength (see e.g. McIvor, 2005). Based on Cohen and Levinthal's (Cohen et al., 1990) identification of absorptive capacity, some externalization researchers argue the importance of retaining internal product development in order to be able to learn. In this thesis, I argue for the combination of these two perspectives. By combining the core capability-based strategy, with a capacity-based strategy as described in this thesis, the risks for capability loss and core knowledge leakage can be minimized concurrently.

There is, in fact, no contradiction between the two explanations, Rumyantseva's and mine. This combination of externalization and divestiture of product development is a concept that has not been extensively reported on in the past, and both theses contribute to its conceptualization.

Both efficiency and effectiveness need to be considered in a static perspective, and efficiency in a dynamic transitory perspective. Such dynamic efficiency is really the key to flexibility, since flexibility requires that the cost of change is low (Thomke et al., 1998). The identification of and the focus on the importance of efficiency in dynamic transitions is new, calling for further theoretical and empirical investigation. Narula (2001) highlights the need to complement the static perspective of internal versus non-internal R&D with a dynamic view. Narula limits the discussion to a semi-static perspective, however, by discussing changes in the static view rather than the actual dynamic change process required to implement the change. Wasner (1999) also advocates a processual perspective on externalization, but does not elaborate on the transitional efficiency. I illustrate the role of operational product development capabilities, operational management capabilities, as well as dynamic management capabilities in supporting efficient organizational transitions with respect to the structuring of product development (see Chapter 5 and Paper III). This is in line with the argument by Fine and Whitney (1996) that the same skills are needed to perform and to order and procure product development.

In this discussion of efficiency in exercising flexibility, I also contribute to the need for further elaboration of the relationship between efficiency, effectiveness and flexibility (Suarez, Cusumano, & Fine., 1991). Flexibility is related to efficiency and effectiveness, sometimes contributing to- yet at other times conflicting with those other concepts. Flexibility implies and requires efficiency in change. In order to sustain efficiency and effectiveness in a changing environment, flexibility to change both how things are done and what things are done is required. Flexibility is also different from efficiency and effectiveness in that more is not always better. The requisite flexibility that can be exercised is useful and valuable. Flexibility options that will not under any circumstance be exercised are useless and valueless.

Finally, I describe how self-assessment, concept deliberation and group reflection can catalyze and support improvements, through augmenting conceptions, leveraging the knowledge and experience of individual employees (Papers I and II and Chapter 6).

I illustrate the potential of complementing structural change with organizational development, and show how deliberation and reflection can be used to concurrently augment conceptions, knowing and efficiency (Paper II and Chapter 6). I also indicate how collaborative action research can be used as a tool for this purpose, and that it is a candidate higher-order capability (Paper II and Chapter 6).

Throughout my research, I draw inferences that can be translated into guidance for management action. These inferences are summarized in the next section.

This thesis is based on studies of Ericsson's response to brutal change over a period of five years. This period of brutal change is rare, yet is expected to be applicable to many other firms sooner or later (see 3.7 for a more elaborate discussion of generalizability). Many of the observations and recommendations can in fact be expected to be valid and relevant in other dynamic contexts, including periods of prosperity. As long as there is brutal change in the environment, the firm will need to change as well. In such situations, this thesis aims to contribute to guide the requisite development of product development.

7.2 IMPLICATIONS FOR MANAGEMENT PRACTICE

Based on the research behind this thesis, I make the following recommendations to practicing managers developing product development in dynamic environments.

I choose to be rather concise, even at the risk of missing some details in this section. As one executive told me: "*I want more details, how to do it....*" I want to avoid a verbose description here, but do urge the interested reader to contact me for further details or even assistance.

7.2.1 Make Sense of and Elaborate on Concepts

Concepts are important as they form a language and a terminology, enabling communication about abstract notions. Concepts support the transformation from abstract knowledge into practical action. Through conceptualizations and shared sense-making, group members can create a common language and terminology, and concurrently develop a sense of ownership of this terminology, increasing motivation. Concept elaboration helps to improve understanding. Combined with practical actions based on the concept, this gives a more concrete meaning to the concept. This process can contribute to augmenting the conception of work as well as the work itself. Augmenting conceptions may be a more powerful approach to improvements than traditional training. *Managers should explore and exploit the opportunities to augment conceptions of work through joint sense-making and elaboration of concepts.*

Understanding the role of employees' conception of work enables managers to improve both motivation and performance. By enabling employees to view work differently, managers can work with motivation and performance in a new way. Failing to recognize the role of how work is conceived tends to focus motivational improvements mainly on benefits and less on the actual work, and make performance improvements directive rather than cognitive. By working with conceptions of work, managers are able to integrate motivation, understanding and action.

7.2.2 Consider Capabilities when Externalizing and Offshoring Product Development

Externalization of product module development can increase efficiency as well as structural flexibility, and should be preferred over externalization of integration activities. A good fit between product architecture and organizational structure should be sought. A broad interface between the source firm and supplier of product development services can contribute to flexibility and learning, possibly at the cost of efficiency.

Transferring product development capabilities, e.g. through the transfer of staff, makes externalization more efficient.

Shared management capabilities, e.g. shared routines and procedures, make offshoring more efficient and less exposed to risk. Thus offshoring within one firm should normally be more efficient than offshoring between firms. Offshoring within the boundary of a multinational firm or an external, globally distributed supplier of product development services should normally be more efficient than offshoring to another independent supplier.

Retaining internal product development capabilities supports reinternalization and re-sourcing. By combining a core capability-based and a capacity-based externalization strategy, the risks for both knowledge leakage and knowledge loss can be minimized.

Dynamic management capabilities make the transfer of development tasks between different locations and organizational forms more efficient as well as more effective.

Therefore: *Managers should retain operational product development capabilities in the firm, and should develop dynamic management capabilities inside the firm as well as at its main suppliers of product development services.*

Lack of operational product development capabilities can make it very difficult to switch product development services suppliers, and can make it impossible to reverse externalization and move product development back inside the firm, should this be needed. Lack of dynamic management capabilities can reduce the efficiency and increase the risk in each organizational transfer.

In addition: *Managers should be aware of the alternative paths from internal development to external offshore development, and should understand the contingencies inherent in the choice of path.*

If alternative paths are not properly understood, this may lead to inefficiencies through unnecessarily complex or costly transition paths, as well as to exposure to unnecessary risks.

In a static world, firms would be able to analyze the situation and make an optimal trade-off between internal and external product development, implement this, and nurture operational product development as well as management capabilities. In a dynamic world, this is not enough. Firms must always be ready to adapt to change and reorganize. The focus on dynamic management capabilities is therefore expected to increase.

Successful firms not only need to be good at what they do today, but also need to be good at improving both how they do things and where they do things.

7.2.3 Support Listening and Learning

There are two predominant logics of change: one top-down transformational cost-focused, and one participative incremental capability-focused. In this thesis, I argue that learning is equally important to both. Learning by definition is important to the participative incremental logic. However, as illustrated in Papers I and II, learning capabilities have great potential to improve an organization that has undergone a transformational change. Using examples, I describe how learning can be catalyzed, and argue that: *Managers should encourage and support listening to and learning from members of the organization, in order to support the learning of organizational members. Forums for learning and exchange of knowledge and experience should be created and integrated into daily operations.*

Inefficiencies and underutilization of firm and organizational resources may result from a lack of sharing of knowledge and experience. Knowledge and experience are among the firm's most important assets. Still, it is not uncommon that individuals underestimate the value of both their own knowledge as well as that of their peers. Uncertainty, directive management styles, and lack of encouragement to communicate openly often stifle communication.

7.2.4 Empower the Organization to Act to Self-Improve

Through shared sense-making and concept elaboration, complemented by joint reflection, organizations can identify obstacles and potential improvements, as well as develop knowing and action plans to implement improvements themselves. It is important that this type of activity is allowed and encouraged. Shortage of organizational slack may prevent internal organizational improvement efforts. Some incentive systems counteract incremental self-improvements: *Managers should support and encourage organizations to self-improve.*

Failure to support self-improvement at best prevents improvements, and at worst leads to declining performance.

7.2.5 Use Management Models Pragmatically

The use of management models in product development is illustrated in Paper V. Management models contribute a common language shared by most individuals in the organization. Management models are used and conceived of differently by different individuals. Experienced and inexperienced individuals look upon the models differently. Common to most usage, however, is a pragmatic application. Models are used when helpful, and violated when there are better ways to go about a task. This use of models is both efficient and flexible. Models should be guides for action, rather than rules that prevent action: *Managers should allow and support a pragmatic use of models in product development.*

Rigorous and literal use of management models tends to lead to excessive bureaucracy, unnecessary activities, and long product development lead times.

7.2.6 Collaborate and Participate in Research

Action research is a way of combining knowledge creation and practical improvements in collaboration between researchers and practitioners. Collaborative action research can contribute to a more research-oriented style of management and organizing, where organizational members analyze the outcome of organizational action, augmenting future action.

By extending this collaboration and participation into all phases and levels, from research planning through execution and governance, to analysis and documentation and dissemination of results, outcomes can be improved for both research and practice. The dissemination and use of the results can be improved by integrating research more into operations of the firm. Therefore: *Managers should specify, jointly with researchers, desired outcome as well as integration between research and operations at an early stage.*

Independent and autonomous research decoupled from operations increases the risk for lack of relevance as well as for lack of dissemination and use of the results.

7.3 IMPLICATIONS FOR RESEARCH

Based on the research behind this thesis, I make the following recommendations for further research.

7.3.1 Co-evolution of Concepts, Knowledge and Creation of Meaning

Conceptions of work and work-related concepts, such as management models and efficiency, matter (Papers V, I and II). I concur with Sandberg's (2000) view that augmenting conceptions may be a more fruitful improvement activity than formal training.

Collective reflections on and elaboration of the meaning of a concept, in this case efficiency in product development, co-evolve with knowledge creation and creation of meaning (Paper II). This is in line with Lewin's plea to "consider action, research and training as a triangle that should be kept together for the sake of any of its corners" (Lewin, 1946:42). This can also be seen as an extension of the conception of design as a co-evolution of concepts and knowledge (Hatchuel et al., 2004; Hatchuel et al., 2002; Hatchuel et al., 2003). My research integrates the recognition of the co-evolution of concepts and knowledge with the process of sense-making (Weick, 1995) and creation of meaning. This co-evolutionary process clearly can be at least influenced, if not controlled, and could be a candidate for how to augment conceptions (Sandberg, 2000) in order to improve organizational- as well as individual performance.

I hope to have made a contribution to these emerging thoughts, which, however, need further elaboration and clarification. Several studies have been done on how employees conceive of their work and aspects of their work (see e.g. Blomberg, 2004; Engwall, Kling, & Werr, 2005; Sandberg, 2000), in some cases indicating the correlation between different conceptions and work performance. Sandberg (2000) posits that augmenting conceptions may be more effective than traditional employee training for improving performance. Further work is needed to describe in more detail how such augmentation can be achieved. Pava's proposal for a socio-technically based process for improving office work (Pava, 1983a, 1983b) should be applicable to product development and could serve as a starting point. I propose that such methods could leverage the co-evolution of concepts and knowledge using sense-making through group reflection as a tool. Improved methods for classification of conceptions could facilitate experimental quantitative research on methods for augmenting conceptions, the results of which could possibly be correlated to actual performance data

7.3.2 Conceiving of Flexibility as Dynamic Efficiency and Effectiveness

Dynamic efficiency and effectiveness of transitions between different modes of organizing are important properties for an organization in a dynamic environment. Dynamic efficiency and effectiveness are key components of flexibility (Chapter 5).

There is a need for more research on the relationships between various types of efficiency and effectiveness, with a particular focus on dynamic aspects. Flexibility is often seen as contradictory to efficiency. How can firms strike the optimal balance between efficiency, effectiveness and flexibility? How can firms ex ante identify requisite flexibility? And how can flexibility options be made more efficient and effective? By increasing the awareness as well as the understanding of these relationships, research can help guide action in dynamic organizing.

The literature on flexibility is comprehensive yet concise. The literature on efficiency and effectiveness is much more heterogeneous. There is a need to link flexibility to efficiency and effectiveness. In this thesis, I specifically address structural organizational flexibility, and study capabilities as contingencies for efficiency and effectiveness in such change processes (Paper III). I propose that dynamic efficiency - that is efficiency in dynamic change processes - can be seen as an indicator of flexibility, provided that the dynamic process is also effective.

7.3.3 Integrating Action, Research and Training

Reflection and concept elaboration can be used as tools to further knowledge creation, knowing as well as doing, integrating action, research and training (Paper II), in line with the call by Lewin (1946). Using a collaborative action research approach, focusing both on integrating action and research, and on collaborating with participating research subjects, I try to meet the triad of goals in an integral fashion: doing, creating knowledge and internalizing knowledge or – in other words – creating action as well as knowing (Chapter 3).

I propose that there is great potential in research that integrates knowledge production and action, for the benefit of practice as well as academia, and at the same time builds on the broad participation of the many actors involved and affected, integrating collaborative research, action research and participative research. Despite claiming to integrate knowledge production and action, much research labeled action research shows great similarities with conventional research. Despite reassurances that "action research is participative research, and all participative research must be action research" (Reason et al., 2001b:2), in the real world, there are lots of examples of research described as action research and/or participative research that fail to meet the criteria for one or both of these labels. Lately, the notion of collaborative research has been promoted (Shani et al., 2004), arguing the importance of research in collaboration between practice and academia. This is touted as participative, but studies of actual projects fail to convince me as a reader that collaborative research is by definition participative.

Starkey and Madhan (2001) call for closer cooperation between researchers and firms and managers in practice, in order to "bridge the relevance gap" between research and practice. Starkey and Madhan specifically point to the Fenix Program at the Stockholm School of

Economics and Chalmers University of Technology as well as Hatchuel's work at Ecole des Mines as examples of how to bridge this gap. Research results emanating from new or traditional forms of research need new ways to reach out beyond the walls of academia (Starkey, 2001). They must be put to use and subjected to critical testing, verification, falsification and augmentation. I hope that future doctoral candidates from industry will have both better ability and more encouragement to write and disseminate their findings in other, less traditionally academic ways, than what I have had.

There is a difference between collaborating and participating. And there is most certainly a need to be more explicit about which type of research one performs. Not in order to choose one or the other, but in order to explicate intent and thus materialize that intent. In this thesis, I advocate the benefits of participative action research for reasons of access to knowledge and experience, but possibly even more for the ability to, in the process, internalize the knowledge produced to create enhanced knowing. I also recognize the benefits of collaboration with management, in soliciting support for the research and, possibly even more important, in soliciting support for the deployment and use of research results.

I argue that collaborative and participative action research in combination offers benefits that surpass any research stream that names just some of these words. *Collaboration* with management is important for research support as well as broad exploitation of knowledge (Björkman & Sundgren, 2005). *Participation* of the staff involved is important for access to knowledge, creation of knowledge, as well as internalization and local exploitation of knowledge. *Action research* creates not only actionable knowledge but also actual action, thus contributing directly to practice as well as to knowledge validation. I hope that future doctoral candidates will be more capable than me in practicing collaborative participative action research from the start of their research efforts.

Action research has come to mean many different things to different individuals. Several recent attempts (e.g. Adler, Shani, & Styhre, 2004; Dick, 2002; Reason et al., 2001a) have been made to provide an overview of- and, in some cases, consolidate and structure this diversity. I believe that action research is now mature enough to benefit from further classification and clarification. I call for explicit clarity on the issue and benefit of collaboration, participation, practical results and knowledge.

In order to make action research sustainable, it must always deliver on triple objectives: action-enhancing practice (not only actionable knowledge), knowledge, and training. If it fails to deliver useful action, it is unlikely to attract continued interest from practice. If it fails to deliver knowledge, it is unlikely to attract continued interest from academia. If it fails to deliver training, or in some other way internalize knowledge and create knowing, it will fail to sustain. Only by satisfying all stakeholders and the triad of objectives can the method as well as the results be sustained.

I call for future publications in this field, such as the forthcoming Handbook of Collaborative Research, to speak out in favor of the triple goals, and for the explication of broad collaboration as well as participation.

7.3.4 Conceiving of Collaborative Action Research as a Higher-Order Capability

Collaborative action research provides tools and processes that can generate both action and knowledge (Paper II and Chapter 6). These tools are processes that can be applied in developing organizational development activities, as described in Paper II. If these tools and processes can be institutionalized in an organization, they become routinized ways of revitalizing organizational development, i.e. capabilities to renew organizational- as well as dynamic capabilities. Collaborative action research is therefore a candidate higher-order capability.

I call for more systematic research on the application of collaborative action research in developing and augmenting operational and dynamic capabilities. It is not enough to show that collaborative action research can occasionally augment capabilities. There is a need to verify that collaborative action research can be internalized and sustained in such a way to be seen as routinized internalized procedures that the organization is capable of repeating. This would contribute to the knowledge of capability development. In addition thereto, it could also contribute to the understanding of how to sustain collaborative action research as a method, and results from this type of research as a finding, in the organization.

Finally, I have seen collaborative action research in action. I have been enacting it. Conceiving of it as a higher-order capability, I therefore dare to challenge the conventional wisdom that capabilities are tacit and cannot be perceived. I side with Oliver, the young Ph.D. student in Barney's column (2003), who found a capability on the sidewalk. I found this capability in the literature. I tried it, and it works. It sounds like blasphemy. And maybe it is. But, friends, the story is true. I know. I experienced it in real life. Whether you will believe me more than the academic establishment believed young Oliver remains to be seen.

EPILOGUE

Efficiency is doing things right.
Effectiveness is doing the right things.
Flexibility is the ability to adapt to and possibly influence changes in the environment.

This thesis is not efficient. Writing a thesis is a learning process, and as such filled with experimentation and prone to errors. The research behind this thesis is not minimalistic, in the sense that it has used a minimum amount of resources to produce this thesis text, and thus does not qualify to be called efficient.

Considering the thesis process as a learning process, this thesis text is just one out of at least two results. The other result is the researcher, who – I hope – is by now a more capable and knowing researcher as well as practitioner. Seen in this way, I hope the research process has been efficient.

This thesis is effective if it contributes both to practice, in terms of understanding how to be more efficient, effective and flexible, and to academia, in terms of contributing to improving the understanding of primarily the dynamic aspects of product development organizing, with respect to efficiency, effectiveness and flexibility. I hope this thesis will prove to be effective.

I hope this thesis can contribute guidance for managerial action in dynamic organizing of product development. I hope it can guide Ericsson, my colleagues and me, in more efficient, effective and flexible development of product development. If so, it is effective for practice.

I hope this thesis can contribute to the scholarly understanding of different ways of developing product development: firstly in a static sense, but primarily in a dynamic sense. If it does, and if it allows others to extend, partly repudiate and partly augment my results, then it is effective for academia.

The research process has been like a constant exploration in a jungle of opportunities and challenges. Without flexibility, in all senses of the word, this thesis would not exist. This thesis is the result of a flexible process, is about flexibility, and positions flexibility as dynamic efficiency and effectiveness.

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APPENDIX I. SUMMARY OF CONDUCTED RESEARCH AND PAPERS

In this appendix, I summarize what I believe to be the most important findings from my research, based on the five appended papers and their underlying research studies.

As outlined in the Introduction, my research focus emerged throughout my time as a Ph.D. student. I conducted my first study (Study 1, see Figure 6, page 120) together with Charlotta Svensson. Together we studied the use of management models in product development. We interviewed various managers: project managers, product managers, line managers and other key project members, in order to understand how they used management models in their work. I interviewed managers in Lotta's organization, and Lotta interviewed managers in my organization. We were thus both partly insiders, partly outsiders, with the pros and the cons related to these roles (see Chapter 3, Methodological Framework, for a more elaborate description of this situation). At the time of the study, my research focus was on lead times in product development projects. Our interviews and observations were analyzed to identify a number of different ways of conceiving of projects, project management, and the role of models in product development. This study resulted in Paper V, as well as a project report (Kling, Svensson, & Engwall, 2001).

My second study, on Ericsson's corporate transformation (Study 2), was done in the wake of the drastic downturn in the telecommunications market in the year 2001, focusing on the impact of the downturn on product development. The transformation included downsizing through closure, divestiture, and lay-offs. I studied both firm-level decision processes and strategy implementation. I also studied selected cases of externalization of product development in more detail (Study 3). One externalization case I followed longitudinally from 2002. These studies resulted first in Paper IV, and later in Paper III.

Finally, I studied and at the same time tried to improve efficiency in product development groups (Study 4). Applying a collaborative action research methodology (see Chapter 3, Methodological Framework, for more details), I tried to concurrently understand how product developers conceived of efficiency as well as to help these developers improve their own efficiency. This study resulted in Papers I and II.

Study	Period	Paper I	Paper II	Paper III	Paper IV	Paper V
1. Conceptions in Product Development	2000-2001					X
2. Corporate Transformation	2001-2002			(x)	X	
3. Externalizing Product Development	2002-2005			X	X	
4. Improving Efficiency	2004	X	X	(x)		

Figure 6. Mapping Studies to Papers

X indicates a major contribution from the study to the paper, (x) indicates a minor contribution.

PAPER I: IN SEARCH OF EFFICIENCY: CONCURRENT CONCEPT ELABORATION AND IMPROVEMENT.

Accepted for publication in Technovation.

In an aim to increase competitiveness, efficiency is coming more and more into focus in product development. In this article, the author studies the view of efficiency in software development groups, and identifies a strong ubiquitous yet implicit strive for efficiency improvements. 'Efficiency' appears a somewhat elusive, omnipresent concept, which is not explicitly talked about, but is often implicitly alluded to. How can software developers become more efficient if they do not know what efficiency means? The author proposes a change strategy that concurrently furthers the local understanding and meaning of efficiency and improves actual efficiency, through a collaborative, participative change program. Conceptions of efficiency are claimed to moderate efficiency as well as learning processes. Four different conceptions of efficiency are identified.

PAPER II: EFFICIENCY IN A PRODUCT DEVELOPMENT ORGANIZATION: CREATING DYNAMIC CAPABILITY THROUGH COLLABORATIVE ACTION RESEARCH.

Submitted to Industrial and Corporate Change.

Efficiency is a concept ubiquitous in strategic management discourse, but according to this study rather vague in everyday engineering talk. In this article, efficiency and the conception of efficiency are shown to improve concurrently through reflection and concept elaboration.

The author describes a collaborative action research project aimed at improving efficiency in a software development group by building on the competence of the members of the group. First, the conception of efficiency is investigated. Then, self-assessment of efficiency and group reflection is introduced to the group to further the conception of efficiency as well as actual individual- and group efficiency.

Obstacles to successful change are identified, and then reinterpreted in terms of requisite dynamic micro-capabilities for successful change and renewal.

The action research process itself is interpreted as a potential higher-order organizational capability.

PAPER III: EXTERNALIZING AND OFFSHORING PRODUCT DEVELOPMENT: TOWARDS A DYNAMIC FRAMEWORK.

Submitted to International Journal of Product Development.

Externalizing product development has been touted as a way of making the firm more efficient, as well as more flexible. Offshoring product development, moving to low-cost regions of the world, has been proposed as one way of reducing product development costs.

In this article, a dynamic view of organizing product development is proposed. A typology of modes of organizing based on geographical (onshore or offshore) and firm-relative location (internal or external) is presented, and organizational transition paths are identified. Propositions regarding the role of capabilities for efficient organizational transitions are then formulated based on participant observations and interviews with product development managers in a telecommunications infrastructure firm.

Preservation of operational product development capability contributes to efficiency in organizational transitions, and preservation of operational management capability contributes to efficiency in offshoring. Dynamic management capabilities contribute to efficiency in externalization and offshoring. Reversal of externalization and offshoring leverages operational product development as well as dynamic management capabilities.

PAPER IV: EXTERNALIZING PRODUCT DEVELOPMENT FOR FLEXIBILITY: EXPERIENCES FROM THE TELECOM INDUSTRY.

Submitted to Long Range Planning.

Co-authored with Håkan Linnarsson.

An earlier version of this paper was presented at the 10th International Product Development Management Conference, Brussels, Belgium, 2003.

Externalization can be used as a tool for restructuring, downsizing and focusing product development. In combination with divestiture of operations and creation of a contractual alliance with the externalized unit, externalization offers a way to manage downsizing of internal product development. The externalizing firm retains control over and access to the development capability, although the operation has been divested.

Externalization through divestiture and alliance creation creates flexibility. In this article we analyze this type of externalization, based on three cases from the telecommunications industry. An organizational preparation process is found to precede and prepare for the individual externalization processes. This process is found to be the primary enabler and creator of flexibility in both internal as well as external product development. Externalization of module development is found to leverage the results of the organizational preparatory phase, and contribute to structural flexibility. No such effect is seen for externalization of integration. A broad interorganizational interface, with many actors communicating, frequently, about various aspects of the interorganizational relationship, is found to contribute to all types of flexibility.

PAPER V: MODELS IN ACTION: HOW MANAGEMENT MODELS ARE INTERPRETED IN NEW PRODUCT DEVELOPMENT.

*Published in R & D Management, **35**, 4, 427-439.*

Co-authored with Mats Engwall and Andreas Werr.

An earlier version of this paper was presented at the 9th International Product Development Management Conference, Sophia-Antipolis, France, 2002.

This paper studies the *use* of product development management models. Through an interpretive research approach based on in-depth interviews with 22 middle managers in two product development organizations, five ways of conceiving projects, project management and the role of models are identified – administrative, organizing, sense giving, team building and engineering – all representing different perspectives on- and ways of using models. The findings question essentialist views of models, common in the literature, as either normative guides for action or symbolic tools decoupled from action. Instead, the study indicates a large variety in the use of models mediated by the user's conception of the situation and the model. The study highlights the communicative role of models as boundary objects, enabling coordination of- and communication about different conceptions of the development task. Rather than contributing to behavioral standardization (an implicit assumption that underlies most formal models), this study suggests that models support cognitive standardization by providing a common set of concepts and a framework that may be drawn upon in making sense of complex product development projects.

APPENDIX II. APPENDED PAPERS

Paper I: Kling, A. R., forthcoming 2006. In Search of Efficiency: Concurrent Concept Elaboration and Improvement.
Accepted for publication in Technovation.

Paper II: Kling, A. R., 2005. Efficiency in a Product Development Organization: Creating Dynamic Capability through Collaborative Action Research.
Submitted to Industrial and Corporate Change.

Paper III: Kling, A. R., 2005. Externalizing and Offshoring Product Development: Towards a Dynamic Framework.
Submitted to International Journal of Product Development.

Paper IV: Kling, A. R. & Linnarsson, H. 2005. Externalizing Product Development for Flexibility: Experiences from the Telecom Industry.
Submitted to Long Range Planning.

Paper V: Engwall, M., Kling, R., & Werr, A. 2005. Models in Action: How Management Models are Interpreted in New Product Development.
Published in R & D Management, 35, 4, 427-439.

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In search of efficiency—concurrent concept elaboration and improvement

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Abstract

In an aim to increase competitiveness, efficiency is coming more and more into focus in product development. In this article, the author studies the view of efficiency in software development groups, and identifies a strong ubiquitous yet implicit strive for efficiency improvements. 'Efficiency' appears a somewhat elusive, omnipresent concept, which is not explicitly talked about, but is often implicitly alluded to. How can software developers become more efficient if they do not know what this means? The author proposes a change strategy that concurrently furthers the local understanding and meaning of efficiency and improves actual efficiency, through a collaborative, participative change program. Conceptions of efficiency are claimed to moderate efficiency as well as learning processes. Four different conceptions of efficiency are identified.

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Keywords: Participation; Efficiency; Improvement; Process; Product; Software; Development

1. Introduction

Efficiency is about doing things right;
Effectiveness is about doing the right things.
Peter Drucker (1974).

Efficiency and effectiveness are critical to business success, and seemingly simple concepts to grasp. Scholars have long searched for ways to measure efficiency and effectiveness using various perspectives and different methods. Still, we are grasping for practical, useful ways of understanding, assessing, comparing and improving efficiency and effectiveness.

Modern times seem to have increased market- and industry dynamics, with ever-increasing requirements for faster, more radical innovation and ever-increasing efficiency in development and effectiveness of the finished product.

In assessing the performance of a product development unit, it is desirable to focus on aspects controlled by, or at least influenced by, product development. Product development efficiency is to a large extent controlled internally, by the organization, whereas product effectiveness is determined in interaction between marketing, product development and other inter- as well as intra-organizational actors.

The more and better the results, the higher the efficiency. The more resources consumed in the production of those same results, the lower the efficiency. Efficiency can be seen as an output to input ratio. Efficiency improvements can be achieved either by increasing the output, by decreasing the input, or through a combination of these two actions.

Efficiency improvements can be pursued in several different ways, employing different perspectives on change. In this article, the author studies efficiency improvements at Ericsson, a leading supplier of telecommunications infrastructure equipment. Ericsson, along with the entire industry, went through a major downturn in the early 2000s. Revenues dropped dramatically, turning former high profits into huge losses over night. The company was forced to take forceful action to radically and promptly reduce costs. This resulted in dramatic downsizing, with reduction of the workforce as well as outsourcing. The change was, by necessity, fast, forceful, and implemented in a top-down manner, with little participation by other members of the organization. The logic used was based on economic value, which Beer and Nohria (2000) call 'theory E'. Necessity compelled the company to make quick decisions, allowing no time for deliberation or participation by the organization. The situation called for dictatorial transformation (Dunphy and Stace, 1993), implementing radical corporate-wide change using a directive style.

Having successfully implemented a corporate transformation, and starting to see revenue growth and move back into

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profits, Ericsson faced the challenge of delivering the same amount of products and services to the market with half of its past organization. This challenge called for major improvements to efficiency throughout the entire organization. This article examines one attempt to achieve this and, in particular, how efficiency was understood by a group of software developers. How did their understanding of efficiency influence efficiency improvements? And how did efficiency improvements influence their understanding of efficiency?

The article starts by reviewing some views of efficiency found in the scholarly literature. After a brief description of the setting and the methods used for this study, we proceed by seeking the understanding of efficiency held by a group of software developers at Ericsson. Finding that the software developers were concerned with efficiency, though without explicit reference to efficiency, we then seek to help improve efficiency through self- and group-reflection. We conclude with a discussion of the role of sense-making and concept elaboration in organizational improvement efforts.

2. Efficiency in product development

Efficiency—what is it? We find that different authors perceive efficiency quite differently. Some maintain a predominantly internal focus on capabilities, whereas others advocate a more external focus on results and satisfying external needs or requests, from customers or owners (e.g. Tipping, 1993). In the literature, we find efficiency and effectiveness closely linked to performance and productivity. There is also an extensive related stream of literature on measurements, metrics and assessments (see e.g. Brown and Svenson, 1988; Kerssens-van Drongelen and Bilderbeek, 1999; Szakonyi, 1994a; Werner and Souder, 1997).

Peter Drucker (1974:572) defines the difference between efficiency and effectiveness clearly and almost intuitively: '*Efficiency in concerned with doing things right. Effectiveness is doing the right things.*'

Efficiency can be seen as the 'production of required output at a perceived minimum cost, measured by the ratio of quantity of resources expended to plan,' whereas effectiveness can be seen as a measure of 'how closely an organization's output meets its goal and/or the customer's requirements' (Schmidt and Finnigan, 1992).

Communicating about efficiency and effectiveness can be difficult in an international setting. In English, the two concepts are reasonably distinct. In several other languages (such as for example Swedish), there is just one word (*effektivitet*) for both concepts, and in scholarly writings new concept labels therefore need to be devised (*inre-* and *yttre effektivitet,* internal and external efficiency/effectiveness, respectively). This may seem like only a linguistic detail. It can however be assumed that a lack of words to differentiate specific concepts in everyday language may result in reduced differentiation of meaning as well. Hatchuel and Weil (2002) has shown us how knowledge and concepts co-evolve. Language limitations may well make this co-evolution of concepts and knowledge more difficult.

Productivity is defined as '*the quality of being efficient,*' and is a measure of the rate of production, output per unit input. Productivity and efficiency are often used more or less synonymously.

Brown and Svenson (1998) argue that effective measurement systems must focus on external- rather than internal measurements and outcomes rather than activities, must measure valuable outcomes, and must be simple and objective as well as contingent.

Szakonyi (1994a), on the other hand, argues that too much focus has been placed on measurement of outputs, and too little attention paid to how well the R&D organization operates. Szakonyi shifts the focus to measurement of R&D capabilities, and in a second article (Szakonyi, 1994b) provides an instrument to grade the maturity of R&D capability. Yet, by still focusing primarily on outwardly directed capabilities, e.g. project selection and integration with other company functions, such as marketing, Szakonyi joins the effectiveness-focused authors.

Brown and Gobeli (1992) provide a concise overview of R&D productivity measurement methods and, based on this and interviews with R&D managers, devise a composite measurement instrument that focuses on quality, quantity, timeliness and cost. Based on an input-throughput-output-outcome framework, they conducted structured interviews to assess R&D productivity.

Werner and Souder (1997) review techniques for measuring R&D performance. In their work, performance seems to be a combination of effectiveness and organizational capability. They propose an overall metric for R&D value based on the sum of an effectiveness index, which is a qualitative measure of past performance and the product of project timeliness, potential for the future, and lack of obstacles to exploitation. McGrath and Romeri (1994) propose an R&D effectiveness index that compares profits from new products to investment in new product development. Wörner and Grupp (2003) proposes using a real options framework to assess R&D effectiveness.

Chiesa and Masella (1996) claim to address both effectiveness and efficiency of R&D, by measuring both the success of R&D as such, as well as how well R&D is integrated with the rest of the firm. Technical success, productivity and adherence to schedules on a project level, and synergies and risk balancing on a portfolio level, are proposed as measures under the control of R&D. Time-to-market, number of redesigns, development performance, number of new products, percentage of sales from new products, and customer satisfaction, are measures under partial control of R&D.

In their review of product development literature, Brown and Eisenhardt (1995) identify the importance of process performance as well as product effectiveness, stressing the efficiency aspect of the development process combined with the effectiveness aspect of the product. Process performance is often measured as lead time and productivity.

There is a set of authors who criticize the excessive focus on efficiency, arguing for a longer time horizon to complement the ubiquitous search for efficiency (Tranfield et al., 2001) or for a contingency approach where different activities are managed by finding the appropriate balance in each case between efficiency and effectiveness as well as between long-term and short-term perspectives (Hauser, 1998; Karlsson et al., 2004). There is a need to walk the tightrope between efficiency and long-term effectiveness (Kumpe and Bolwijn, 1994).

In this article, we are interested in how to enable an R&D unit to improve the efficiency of its operations. To this end, we must focus on what is under the control of the R&D unit. This is in line with Collier's (1977) argument that R&D performance evaluation should be made on R&D alone, and thus that R&D should not be measured on actual exploitation of R&D results, but rather on the potential value of results of R&D work. We focus on R&D efficiency, and how to improve and assess this. In particular, we seek to understand how software developers make sense of efficiency and, based on this, how their efficiency can be improved.

3. Method and empirical setting

During the years prior to this study, like most of its competitors, Ericsson had experienced a dramatic downturn in the telecommunications market, and had been forced to concentrate and reduce its product development organization dramatically. In just a few years, Ericsson reduced its head-count from 107,000 to approximately 47,000, and the number of sites doing product development from 80 to 20. Most of these changes had to happen quickly, and had to be implemented from the top-down with little involvement or participation by the employees. Now, with a much-reduced product development organization, a similar output was needed from an organization half the size. This called for a dramatic improvement in productivity.

This study was performed in collaboration between a researcher and a manager at a product development unit at Ericsson. The researcher also had extensive experience of product development at Ericsson. The study was part of a larger collaborative action research project at Ericsson, studying efficiency improvements in product development at Ericsson.

The project was performed at Ericsson within the organization of a colleague of the practitioner. He was responsible for an organization of approximately 1200 employees worldwide, the majority of whom were based in Stockholm, and most of whom worked with development and verification of servers and platforms for telecom infrastructure networks.

Collaborative research is defined as 'an emergent and systematic inquiry process, embedded in a true partnership between researchers and members of a living system for the purpose of generating actionable scientific knowledge' (Shani et al., 2004:83-84).

Collaborative management research traces its roots back to the works on minority problems by Kurt Lewin (Lewin, 1946) and John Collier (1945) in the middle of the 20th century. Lewin stressed the need to combine the study of general laws with a diagnosis of the specific situation (1946:36). Further, he advocated the need to '*consider action, research and training as a triangle that should be kept together for the sake of any of its corners*' (1946:42). Lewin stressed the advantage both to science and to practice, from combining these three aspects. This heritage has later been repeated by a number of action scientists, though at times with a tendency to primarily stress the research side, and in other cases to place the stress on the action itself. Even Chein et al., (1948), disciples of Lewin, primarily stressed the scientific aspects, and '*[betrayed] a more conventional view of action research than Lewin's view of its potential*' (Kemmis, 1988:33). Schein (1987; 2001) advocates a clinical perspective whereby the focus is on solving the problem as identified and defined by the client/practitioner. In doing so, he argues, knowledge production will be a by-product of problem solving. In his description of 'intervention research' Hatchuel (2000) argues that it is '*grounded in both an epistemology of action and an epistemology of knowledge.*' He further claims that intervention research '*is not a means of producing knowledge for action but is rather a constitutional process of action*'. Thus Hatchuel does not stress the dual goals, but the actual integration of the two goals into one combined entity.

Within the project, various methods were applied, ranging from semi-structured interviews to questionnaires, from reflection groups to managed process review and improvement methods. All along, the intention was to apply a collaborative approach, aiming to both improve the organization and create knowledge.

4. Interviewing to understand efficiency

In order to gain a better understanding of efficiency in product development, two interview studies were initiated, where a total of approximately 60 software developers and their immediate supervisors were interviewed about their understanding of efficiency, what hindered them from being more efficient, and how they measured efficiency in their work. By limiting the study to software development, we aimed to eliminate differences due to the use of different technologies and product development methods. The interviews were semi-structured, partly open-ended, and lasted approximately 20 min. All interviews in each group took place in a two to four-day period. The interviews were recorded. After the interviews, the interviewer wrote a brief, 2-page summary of each interview. The interviews were then analyzed through multiple listenings to the recordings, readings of the transcripts and summaries, and use of the N-Vivo text analysis tool (http://www.qsr.com.au/) to cluster and group statements to support the analysis.

In summary, the analysis showed that the software developers had a fairly simplistic and unreflected view of efficiency. Instead of talking about efficiency as a relationship between results and effort, they talked about efficiency as generally positive attributes of their work.

Many developers stressed the importance of meeting expectations. Efficiency for them was '*to do the right thing,*' '*to get things done,*' and '*to complete my tasks on time.*' Others stressed boundary conditions. For them, efficiency meant '*to deliver quality on time*' and '*to deliver on one's commitments.*' To be efficient meant doing and delivering what was expected.

Instead of talking about what to do to be efficient, numerous developers chose to talk about the prerequisites for efficiency. To them, the key to efficiency was '*to have the right preconditions: no obstacles, appropriate working processes, avoiding waste,*' '*to be allowed to work undisturbed,*' and '*that everyone knows what is expected of them.*' Efficiency was seen as something that appeared as soon as the right conditions for it materialized. Removing obstacles to efficiency would enable efficiency to appear.

A smaller number of developers also expressed a more traditional view of efficiency, such as saying that efficiency was '*to work faster.*' On a similar- but more elaborated note, one supervisor expressed that efficiency in product development meant '*to solve a task in the shortest possible time, utilizing people in a good way, whereby they can do their best.*' This perspective focuses on both capabilities as well as outcomes, and, of those seen in this study, is the closest to a holistic view of efficiency, and at least approaches the ratio of output to input that is so often seen as the definition of efficiency.

In our view, the developers did not talk about efficiency. They talked about aspects related to efficiency. They talked about what was required in order to be efficient. They talked about how to be efficient. But they did not talk about efficiency per se.

Further, the developers described what prevented them from being more efficient. The most frequent hinder mentioned was disturbances, especially so unplanned disturbances. '*I am interrupted; My time is fragmented.*' They also mentioned a lack of knowledge and experience. This came as a surprise to us, since the firm had recently undergone a multi-year period of extensive downsizing, and it was our perception that those still with the company were extremely skilled and experienced. However, when analyzing the interviews, we realized that the downsizing had forced many employees to move to new positions, and, in many cases, to work with new products and new technologies. It was therefore not surprising, after all, that many employees perceived a lack of knowledge and experience, considering their changed work assignments. Many developers also cited a lack of clear and articulated requirements. Their primary concern was not the dynamics of requirements, but rather the lack of clarity. Most developers did not complain about tools, but they did lack information about- and support for tools. This could be understood as a consequence of the radical downsizing, during which many support functions were eliminated. '*There is no shortage of tools. There is a shortage of information.*' At the same time, they also espoused the need for extensive change, and complained about the consequences of the quick and comprehensive changes that had been implemented. We interpreted this as a result of imperfections in the implementation of past changes. With more effort on information and participation, it may have been possible to gain more extensive support for the changes. At the same time, it could be argued that, due to the urgency for change, time did not allow for a more participative approach. Following the extensive changes, developers perceived a lack of clear roles and responsibilities. They expressed that they did not know whom to ask about certain issues. '*Who does what?*'

We had expected that developers would complain about meetings, as obstacles to efficiency. But this was not the case. So, after hearing what they perceived to be hinders to efficiency, we asked—What about meetings? They replied that there were meetings, lots of meetings, but they also told us that many meetings were necessary and even helpful. However, they did tell us that many meetings were not efficient—with too many people called to the same meeting, meetings that did not start on time, meetings that ran late, participants who were not well prepared, and an excess of written material distributed with no clear instruction of what a specific participant should read. Unplanned meetings, in particular, were perceived as a significant hinder to efficiency. Unplanned meetings contribute to time fragmentation, which was seen as the biggest obstacle to efficiency.

Finally, the analysis clearly showed a consensus among the software developers that measurements of efficiency in software development are at best difficult, and perhaps impossible. They also stated that their organization did not measure efficiency in software development. They did add, however, that if we could find ways of measuring software development efficiency, then that would support improvement efforts.

One of the advantages of doing this type of explorative study in the form of interviews, rather than as a traditional survey, is that it enables a dialogue and a deeper level of communication between interviewer and respondent. This was clearly illustrated several times in these interviews, when respondents gave us further reflections and observations, furthering our understanding of both the concept of efficiency and possible ways of improving efficiency in a software developing organization. While talking about ways of measuring efficiency in software development, one respondent, a first-level supervisor, proposed that if we were unable to find effective and generally accepted ways of measuring efficiency in a traditional, objective way, then maybe we could build an efficiency improvement effort on self-assessment of efficiency in one's own work? Several respondents expressed a positive view about the interviews as such: *'It is good to talk about efficiency like this. It is not often that anybody asks.'* And: *'Talking about efficiency helps to improve efficiency.'* A comparison to conventional employee surveys was also noted: *'These interviews enable a better understanding of the concept of efficiency than traditional surveys.'*

5. Making sense of efficiency

Prior to our intervention, the software developers did not talk about efficiency. They interpreted efficiency as generally positive attributes of development. When we talked about efficiency, they talked about requirements and expectations, indicators of good development, pre-conditions to effective development, and about working harder or faster. They did not explicitly relate efficiency to the output to input ratio. However, given a specific level of resource consumption, increased output naturally translates into increased efficiency.

Is it possible to discuss the software developers' view of efficiency, despite the fact that they did not normally use this terminology? Yes, it is. By examining statements that can be described as related to what we normally refer to as efficiency, we are able to construct their views and understandings of efficiency (compare Huxham and Vangen, 2000:1162 on describing and understanding leadership in collaborations from documents and interviews where the respondents rarely talked about leadership explicitly) without explicit reference thereto.

By studying how software developers talked about efficient software development, and interpreting these texts, we identified the following tentative, different conceptions of efficiency:

5.1. Efficiency as goal fulfillment and meeting expectations

Software developers talked about the importance of doing the right thing, of getting things done, of completing tasks on time. They stressed the importance of keeping one's promises, of meeting expectations, of delivering on one's commitments. These software developers focused on delivering what was expected, delivering what was required and needed. They wanted to satisfy the needs of their manager or the receiver of the result of their work. They made sense of efficiency as a matter of satisfying requests, goals and needs.

This view of efficiency is closely related to effectiveness. Meeting expectations and delivering on commitments are critical but not sufficient for effectiveness. This view demonstrates a lack of proactivity to deliver more than expected.

5.2. Efficiency as a prerequisite to working

Another way of making sense of efficiency in software development was to focus on what is needed to enable one to be or to become efficient. Developers stressed the importance of pre-conditions, such as good working processes, removal of hinders and avoiding waste. They stressed the importance of contiguous uninterrupted time, being allowed to work undisturbed. According to this view, an important prerequisite to efficiency is for everybody to know what is expected of them. The primary focus of these software developers was not how they could improve their efficiency, but rather, in the context of work, what hindered them from being more efficient. Efficient work is thus performed by default unless prevented by external hinders or disturbances.

With its focus on contextual hinders, this view also demonstrates a lack of proactivity to improve the work process.

5.3. Efficiency as a property of the result of working

Yet another way of conceiving efficiency linked it to quality, and to properties of the result. Efficient product development was seen as development of a quality product. Products with few faults were seen as efficiently developed. In essence, developers advocating this view argued that an effective product was by definition developed efficiently.

This view is clearly focused on product effectiveness, and sees efficiency as a way to achieve effectiveness. This group of developers works proactively to improve the effectiveness of the product.

5.4. Efficiency as a composite measure of good work

Finally, a small number of software developers presented an emerging perspective of efficiency that described it in composite terms, implying a combination of solving the task in the shortest possible time, based on good utilization of the available resources, and empowering and enabling all participants to do their best. These software developers and supervisors believed that efficient software development placed requirements on the environment, but also on the work organization and work methods, and did result in time-efficiency.

This group of software developers were those closest to the traditional, more holistic view of efficiency as 'doing things right'. Meeting requirements and commitments and delivering an effective product was seen as the task. In addition, these developers aimed to perform this task in an effective way, with a minimum of time and resource consumption.

6. Intervening to catalyze efficiency improvements

In two different software development groups, we intervened in order to catalyze efficiency improvements through reflection and participation. In one group, inspired by a proposal from one of the supervisors, daily web-based self-assessment of efficiency and recording of efficiency hinders, complemented by weekly group reflections on the past week, were implemented.

The statistics extracted from the self-assessment stimulated interest and seemed to lend credibility to the effort. The most important effects, however, were drawn from the discussions about hinders and actions to eliminate hinders and improve efficiency. These reflections and discussions clearly led to knowledge transfer, intra-group learning, and direct problem solving, as the following simple dialogue example illustrates:

> Software Developer I: I was inefficient since I had to go to the lab to do final on-target testing. I wish I could do this from my workstation.
> Software Developer II: Why don't you? I always run my on-target testing from my workstation.
> Software Developer I: You do? I didn't think you could...
> Software Developer II: I'll show you after the meeting...

The interventions and reflection sessions were perceived as helpful, and the software developers did perceive that they had improved their efficiency. At the same time, however, they seemed to have developed their understanding of efficiency as a concept and increased their requirements on their own efficiency. This is most likely what led to the improved efficiency—not that it was measurable through self-assessment. As self-required efficiency increased, developers tended to continue to rate themselves equally efficient or inefficient as at the start of the project.

The reflection sessions created lists of proposed improvements. These improvement proposals were implemented in part during the intervention period, and in part after termination of the intervention. The group themselves continued with semi-weekly meetings to follow-up on implementation of these and new improvements. The improvements consisted mostly of elimination of hinders, and in some cases of proposed improvements to the application of work processes and routines. One example of the latter, is a proposal to request that the development project incorporate more fault corrections than planned, in order to improve quality as well as reduce future maintenance costs. The actual work processes, as such, were not, to any significant degree, improved and reviewed as part of these efforts.

7. Discussion

The software developers in this study presented an initially surprising lack of conceptualization and explication of the efficiency concept. We found that they held a set of varying views of efficiency: efficiency as goal-fulfillment, as a prerequisite for work, as a property of the output of work, and as a composite measure. Each view is linked to a particular way of making sense of the work situation in product development, as well as focusing attention and setting the locus of action. The implicit and unconscious choice of perspective on efficiency is influenced by- and influences how the developer acts, what skills he seeks to build, and what skills he applies.

Thus, if we want to perform improvements in a particular part of the organization, we may want to use individuals with the most appropriate view for the purpose, or—if possible—influence those to be involved by offering them a complementing or augmented view. Based on his study of engine optimizers at Volvo, Sandberg (2000) showed us how augmenting perspectives on work should be seen as a more plausible way of building competence than formal training.

In our intervention study, we use reflection, individually as well as in groups, to promote and assist shared sense-making and reconceptualization. A continuous dialogue about the concepts, their meaning and effects, is ongoing in this process. The process includes elements of tentative explication and elaboration of the concept, and regular testing of intermediate results. The evolving views of efficiency will carry in them the increasing knowledge and experience about the concept of efficiency. Gradually, a more holistic perspective can be internalized and made actionable.

So, can software developers improve efficiency without explicating efficiency? This study would tend to answer both yes and no. Yes—software developers who do not and can not explicate the concepts may still have- or develop a shared sense-making of the concepts, in such a way that allows collective action. However, in the process leading up to collective action, explication of the concept will tend to occur. The process therefore offers dual results, both improved efficiency, and a furthering of the understanding of the efficiency concept. And thus: No—improvement does not occur without at least some implicit explication and elaboration of the concept of efficiency.

The interventions described seemed to improve efficiency, although the evidence is inconclusive, and to some extent it may be too early to render a final verdict on the success of the project. The direct effect of the interventions was not what was expected or planned. Thus, according to the view that efficiency is about goal-fulfillment and meeting expectations, this effort was not efficient. However, the interventions did lead to talk and dialogue about efficiency. This talk and dialogue generated tentative answers, some of which were tested within the project, which in turn furthered the question-answer dialogue.

We thus see that concept elaboration goes hand in hand with improvement of the content of the concept. In this case, efficiency improvement work tended to further elaborate and contribute to a shared understanding of the concept of efficiency. Activities targeted at creating an elaborated view of efficiency contributed to efficiency improvements. The two processes of improvement and concept elaboration were parallel and mutually reinforcing. Just as Hatchuel and Weil (2002) shows us how concepts and knowledge co-evolve, we argue that concepts and action do in fact co-evolve through instant application of knowledge and experiences. Explication and dialogue are tools to further both the concept itself, as well as the understanding of the concept, and thus the usefulness and practical implications of that same concept. Through concept deliberation through dialogue and reflection, individually as well as in groups, abstract concepts can be made less abstract and at the same time better understood.

The process cycle, was not the straightforward plan-do-check-act (PDCA) of the TQM movement, nor the learning cycle described by Kolb (1984), but rather a combination of the two, building on both single-loop and double-loop learning (Argyris, 1982). Adapting actions to achieve the desired results was combined with more fundamental adjustments to how actions were defined and evaluated. The sense-making process, individually and in the group, initiates further pondering of the individual's own understanding of the concept, and how the individual frames the concept, in a sort of triple-loop feedback (Torbert, 1999). Like Torbert, we seek a way of moving beyond '*impersonal research for the sake of valid, general theory to personal learning for the sake of more effective local practice*' (1999: 202).

In this study, we find that software engineers do seek to be efficient, without a conscious and explicit understanding of the concept, but also that through concept deliberation, individually as well as in the work-group, further efficiency improvements can be identified and implemented. Sandberg (2000) argues that the conception held by an individual defines what competence he or she develops and uses. He further proposes developing competence through chaining or evolving how individuals conceive of their work. We believe that our findings support this suggestion. This is also in line with Lewin (1946), in his argument for combining action, knowledge creation and training.

8. Conclusions

Concept creation, concept deliberation and sense-making of concepts are potentially parallel processes that, when possible, interact and reinforce each other. As an example, efficiency improvements and furthering the understanding of the concept of efficiency can be achieved in parallel, mutually reinforcing processes. Similarly, it would seem reasonable, although we cannot prove it with this study, that other significant concept development and sense-making goes hand in hand with actual productive work. In other words, action, knowledge creation and creation of meaning take place in parallel, interacting processes.

Just as we, in new product development, may exploit the co-evolution of concept development and knowledge development, in organizational development, we may also exploit the co-evolution of concept development, knowledge development and creation of meaning (sense-making).

Through the creation of forums for dialogue and reflection, managers can simultaneously support sense-making and learning, concept creation, and thus creation of an improved language for communication, as well as organizational development. Managers can seed the process, in order to influence the direction of concept deliberation, but need to allow the group to orchestrate the concept deliberation and sense-making, in order that the group can claim ownership of and institutionalize the concept. The process can be influenced, but not controlled. It is more like a free jam session than a precisely orchestrated symphony orchestra.

Managers should understand and utilize the moderating role of how concepts are understood, as well as the co-evolution of concepts, knowledge and action. By working with concept deliberation, they can influence how concepts are perceived by group members.

In this article, we have shown that it is possible to make improvements without consciously deliberating on concepts, although it is also noted that this may lead to unintended concept deliberation. This concept deliberation may in itself drive further improvements.

We have also identified four ways of understanding efficiency: as goal-fulfillment and meeting expectations; as a prerequisite to working; as a property of the result of working; and as a composite measure of good work. Managers can use these and other conceptions of efficiency as tools to guide action towards greater efficiency.

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Efficiency in a Product Development Organization: Creating Dynamic Capability through Collaborative Action Research

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Abstract

Efficiency is a concept ubiquitous in strategic management discourse, but according to this study rather vague in everyday engineering talk. In this article, efficiency and the conception of efficiency are shown to improve concurrently through reflection and concept elaboration.

The author describes a collaborative action research project aimed at improving efficiency in a software development group by building on the competence of the members of the group, utilizing self-assessment and group reflection.

Obstacles to successful change are identified, and then reinterpreted in terms of requisite dynamic micro-capabilities for successful change and renewal.

The action research process itself is interpreted as a potential higher-order organizational capability.

Keywords: micro-capabilities, collaborative action research, product development efficiency

Introduction

Many businesses are becoming increasingly competitive, for a number of reasons. New low-cost actors push prices down. New innovative solutions, sometimes built on new technologies, threaten to oust incumbent products and suppliers. Incumbent firms are forced to both improve efficiency and increase innovation.

“Efficiency” is about doing things right (Drucker, 1974). It is about getting more for less, about cutting costs and increasing speed. A focus on efficiency is known to hamper innovation at times (e.g. Benner & Tushman, 2003). Efficiency improvements may include staff- or expenditure reductions. At the same time, firms need to rebuild and strengthen capabilities, to sustain and improve innovation, and to create flexibility to handle market dynamics (Grant, 1996; Volberda, 1996). How might the inherent tension between the two logics be resolved? How might the focus on efficiency and cost be combined with the need to develop and sustain capabilities?

In this article, we seek answers to these questions not on a macro- or firm level, but rather on an intra-firm or workgroup level. Often organizational improvement efforts are pursued top-down, in centrally controlled projects and programs. Here, on the contrary, we seek improvements that can leverage the local knowledge and experience in the workgroup. It may also be reasonable to assume that efficiency improvements pursued locally may interact better with innovation efforts.

To do this, we study a firm that was very successful, and the clear market- and technology leader in its business, telecommunications infrastructure: Ericsson. In the year 2001, the telecommunications and IT markets dropped into a recessionary slump, forcing all actors in the market to make drastic changes. Change was focused on cost reduction and survival. There was no time to spare and there was no time to seek staff participation. The result was a clear case of “transformational change” (Dunphy & Stace, 1988, 1993). Two years later, having survived the crisis, Ericsson and other actors in the business needed to continue improving efficiency, at the same time as creating flexibility as well as sustaining and improving innovation. How could the focus on efficiency and cost be combined with the need to develop and sustain organizational capabilities? How could the inherent tension between the two logics be resolved?

In order to find a way of doing this, the author initiated a collaborative action research project (Adler & Norrgren, 2004) in an aim to understand how software developers conceived of efficiency, and through interventions seek to augment this conception. Through concept deliberation and first- and second-person inquiry into the concept, the author sought to empower the group of developers to improve their own efficiency, while at the same time strengthening organizational capabilities. The results were mixed, with some indication of efficiency improvements, but also a number of learnings about how to improve the improvement process.

This article begins with a brief review of theory on efficiency, capabilities and change. Following this, we present a collaborative action research project aiming at participatory evolutionary change. First we describe the background, then the efforts to set up the change project, and finally the change project itself. We proceed thereafter by analyzing the results, identifying obstacles to successful change, and discussing the dynamic micro-capabilities needed to avoid these obstacles. We conclude with an analysis of the research process itself and a presentation of our conclusions.

Theory

Efficiency

"Efficiency" and "effectiveness" are related concepts, dealing with *how* things are done, and *what* things are done, respectively. Efficiency is about productivity, and effectiveness is about yield (Foster, Linden, Whiteley, & Kantrow, 1985). Productivity is an inward-oriented measure, a measure of how well things are done: minimum time, minimum cost, minimum faults. Yield is more externally oriented: the rate of successful exploitation of results produced. In a product development environment, efficiency can be seen as a performance measure of actual development, e.g. software coding or hardware design, whereas effectiveness can be seen as a measure of the interaction between product development, marketing and other firm operations, enabling development of the products that can later be marketed and sold successfully. Success hinges on a combination of development efficiency, product effectiveness and a munificent market (Brown & Eisenhardt, 1995).

In this article, the focus is on a group inside a product development organization. The focus therefore rests primarily on efficiency and less on effectiveness. Most of the engineers in the group can potentially have a big impact on product development efficiency, both personal- as well as intra-group efficiency, and to some extent also inter-group efficiency. Their influence on decisions of what to develop is limited, however, let alone on how the product is marketed, thereby limiting their influence on product effectiveness.

Dynamic Capabilities and Change

Distinctive or specialized competencies are characterized as being difficult to replicate or imitate (Barney, 1991). We call configurations of such competencies that enable routinized performance of an operational activity, e.g. manufacturing a product, "operational capabilities" (Helfat & Peteraf, 2003). If these capabilities are strategic differentiators for the firm, then we refer to them as "core capabilities" (Leonard-Barton, 1992). "Dynamic capabilities" form the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments (Teece, Pisano, & Shuen, 1997). Dynamic capabilities thus create and recreate operational capabilities. Higher-order capabilities (Collis, 1994) analogously create and augment dynamic capabilities.

In this article, we are concerned with product development. We will argue – in contradiction to some other authors – that product development is an operational capability, since product development is the focal activity of a product development organization, which is the unit of analysis for us. We see the capability level – operational or dynamic – as locally defined (Winter, 2003) and contextual.

Neither operational nor dynamic capabilities are typically easy to trade and they are normally built dynamically within the firm, often over a long period of time. Building and rebuilding capabilities follows the logic of incremental change, and is jeopardized by transformational change processes (Beer & Nohria, 2000b). However, in extremely turbulent environments, transformational change may still be necessary, due to organizational resistance or lack of time (Dunphy et al., 1993), or to the former core competencies having become an obstacle to innovation, having turned into "core rigidities" (Leonard-Barton, 1992). When the environmental turbulence is limited, however, the building or rebuilding of dynamic capabilities and core competencies must receive renewed focus.

Applying Collaborative Action Research

This article is based on observations from a collaborative action research project, aimed at increasing organizational efficiency in software development groups in Ericsson, a leading telecommunications infrastructure provider. The author, a manager at Ericsson R&D, and also a researcher, initiated this project together with two practitioners who were senior managers at one Ericsson R&D unit, one being the Director of Organizational Development, and the other being Vice President of Development. Three other researchers provided support with interviews, and with the analysis and reflection.

Collaborative research is defined as "*an emergent and systematic inquiry process, embedded in a true partnership between researchers and members of a living system for the purpose of generating actionable scientific knowledge*" (Shani, David, & Willson, 2004:83-84). The method used here stresses both the collaborative element as well as the aspiration to combine action and knowledge creation.

Collaborative action research traces its roots back to the works on minority problems by Kurt Lewin (1946) and John Collier (1945) in the middle of the 20th century. Lewin stressed the need to combine the study of general laws with a diagnosis of the specific situation (1946:36). Further, he advocated the need to "*consider action, research and training as a triangle that should be kept together for the sake of any of its corners*" (1946:42). Lewin stressed the advantage of combining these three aspects, to both science and practice .

The Vice President of Development, in whose organization this project was to be carried out, argued that the dual goals normally ascribed to collaborative action research – action as well as knowledge creation – were not good enough. He also wanted the collaborative action research project to install a capability to repeat the improvement process, independently of the researchers, into the organization. Thus, he was implicitly asking for the third corner of the collaborative action research triangle, as described by Lewin, combining not only action and research, but also training. According to him, collaborative action research should thus provide practical improvements, knowledge and an institutionalized capability for repeated further improvements, i.e. a dynamic capability.

Within the project, various methods were applied, ranging from semi-structured interviews to questionnaires, and from reflection groups to managed process reviews and other improvement methods. The intention all along was to apply a collaborative approach, aiming to both improve the organization as well as create knowledge. This article is based on participant observations, transcribed interviews, and joint discussions of the findings as well as analysis.

A Change Project

Empirical Setting and Background

The telecommunications market saw a major downturn in the first few years of the 21st century. Many telecommunications equipment suppliers were forced to drastic downsizing, often reducing staff by more than 50%. In a matter of only a few years, Ericsson reduced its head-count from approximately 107,000 to 47,000, and the number of product development sites from 80 to 20. Changes focused on formal structures and systems, were implemented rapidly and top-down, and were planned and programmatic. There was neither time for broader participation nor for eliciting the support of broader groups. The logic of the change process was focused on economic value and survival.

Within three years, the telecommunications market started to rebound. Still, there was extreme caution about the future strength of the market, and it was critical to keep cost levels down. In essence, as expressed by one Ericsson executive, "*we need to do at least as much as before the crisis, with half the staff.*" There was a strong need to increase efficiency and effectiveness, while retaining flexibility in Ericsson overall, and in product development in particular.

During the downturn, to enable downsizing, the product portfolio was pruned, platform reuse increased, and more products were based on fewer platforms. Some products were dropped altogether. The internal product development organization was concentrated to fewer sites, with clearer responsibility and accountability at each site. Divestiture and outsourcing of product development operations were used as tools to support the downsizing. Outsourcing was perceived as better than closure, both for the firm, since it allowed a gradual phasing out, and for the employees, since it gave hope of continued employment, though not limited to working on Ericsson products. The combination of divestiture and outsourcing was also seen as an enabler for an emerging future product development services market, which would serve as an option for volume flexibility in product development, making it easier to manage the dynamics of the marketplace. This aspect is growing in importance, as product development constitutes an increasing share of the firm, making it more difficult to manage a market slowdown without significant cuts in product development.

After the downsizing, concentration and streamlining of the product development organization, there was a need for a dramatic increase in efficiency, in order to increase output with no significant increase in costs, staffing and resource usage. An output equal to that before the cutbacks was needed from an organization half the size. In one product development unit at Ericsson, a 2X efficiency program was launched, "*to double the efficiency in product development in 2 years*".

Within the framework of this 2X program, a collaborative action research project was initiated in collaboration between researcher and managers, with the aim of exploring and exploiting the local knowledge and experience in small software development groups to enable these groups to improve their work methods and increase their efficiency. The project was carried out within the product development organization that the Vice President of Development headed. This organization consisted of approximately 1200 employees worldwide. This article describes these efforts, with the purpose of understanding what prevents success in organizational change efforts, focusing on the micro-organizational level. How can workgroups and teams improve their ability to explore and exploit change? How can capability development be combined with a focus on cost and efficiency?

Setting Up the Project: Understanding Efficiency in Software Development

The project aimed to implement participatory improvements to leverage the knowledge and experience of the individual employees. The managers wanted to complement the previous top-down, programmatic, transformational change efforts with something different, something new. They wanted to focus on improving organizational capabilities rather than on reducing cost. They wanted to enable the firm to produce more with the same number of employees, not produce the same with fewer employees.

In the first phase of the project, the researcher and the managers sought to gain an understanding of how efficiency was conceived among software developers. They conducted 39 interviews with software developers and their immediate supervisors about their perception of efficiency, what prevented them from being more efficient, and how they measured efficiency. By limiting the study to software development, they aimed to eliminate variations due to differences in technologies and methods. Two researchers and one of the managers conducted the interviews in the organization of the second manager. The interviews were semi-structured and lasted approximately 20 minutes. All interviews were recorded and took place during a 4-day period. Following each interview, the interviewer wrote a brief, 2-page summary of that interview. The interviews were analyzed by listening to the recordings, reading the summaries, as well as using N-VIVO text analysis to cluster and group statements.

In summary, the analysis of the interviews showed that the software developers had fairly diverse views of efficiency. Instead of talking about efficiency as a relationship between outcome and effort, they talked about efficiency as meeting the expectations: *"doing the right thing", "getting things done", "completing my tasks on time";* as boundary conditions: *"delivering quality on time", "delivering on one's promises"*; and as prerequisites: *"being allowed to work undisturbed", "ensuring that everyone knows what is expected of them"*; but also more traditionally as: *"working faster"*; and more elaborated: *"solving a task in shortest possible time, utilizing people in a good way, whereby they can do their best"*.

Performing this type of explorative study in the form of interviews, rather than as a traditional survey, enables a dialogue and a deeper level of communication between the interviewer and the respondent. This furthers both the understanding of the researcher, as well as the understanding of the respondents. This was illustrated several times in these interviews, when respondents provided further reflections and observations, furthering our as well as their understanding of both the concept of efficiency, and possible ways of improving efficiency in a software developing organization. Two software developers explicitly and spontaneously stated that "*talking about efficiency helps improve efficiency*" and that "*interviewing like this is better than the standard employee survey.*" While talking about ways of measuring efficiency in software development, one respondent, a first-level supervisor, proposed that "*if we cannot find good and generally accepted ways of measuring efficiency in a traditional, objective way, then maybe we could base efficiency improvement efforts on self-assessment of efficiency in one's own work.*"

The researcher and one of the managers designed a project to use participation and reflection as tools to access and leverage the knowledge and experience of the software developers. During a long period of time, they sought the support of operational managers interested in participating, until they finally found the support of a first-line supervisor. In collaboration with this supervisor, they devised an improvement method based on daily self-assessment of efficiency, complemented by weekly group reflection sessions.

Intervening to Improve

In collaboration with the supervisor, the researcher and the Director of Organizational Development developed a one-page, web-based self-assessment questionnaire on personal efficiency at work. The questionnaire asked the respondents about their perception of meeting the targets of the day and their personal efficiency, by asking to what extent they agreed with the statements: *"I have achieved today's targets!", "I have been efficient today!"*, and "*I have been as efficient as I wanted today!*". The questionnaire also asked about obstacles to increased efficiency: *"What prevented you from being even more efficient today?"*

In a seminar with the software development group headed by that same supervisor, the researcher and the manager presented their perspective of efficiency and their commitment to leveraging the local knowledge and experience to support local incremental improvements of efficiency. The self-assessment questionnaire was presented to the software developers, who completed it during the seminar. The results from the questionnaire were analyzed and immediately fed back to the group, and reflection on the results was initiated.

The developers were asked to fill in the web-based questionnaire on a daily basis for two months after the seminar, either prior to leaving the office in the afternoon, or when returning in the morning. Once a week, the data was gathered, analyzed and presented to the group at a meeting, enabling and encouraging reflection. After three weeks, through working with the group to continuously improve the details of the method, an integrated approach emerged. In the weekly meetings one day at a time was presented, analyzed, and jointly reflected upon. Developers started asking for individual feedback prior to the weekly meetings. The supervisor initiated a pattern of a rolling action list to follow up items identified in the analysis and reflection. Many of the software developers took responsibility for different tasks on the action list. When the supervisor was on vacation, two developers volunteered to manage the action list.

One question that arose in one of the weekly meetings was "*Can I really write what I think? What if I think that something my supervisor did sucks?*" And "*Isn't there a risk that any critique, implicit or explicit, that I may voice, could have a negative impact on my salary review?*" These concerns came as a surprise, primarily due to the fact that this particular supervisor seemed to have a very open and trusting relationship with- and between his staff. The concern nevertheless surfaced and was discussed in one of the weekly meetings. The supervisor assured his staff that he had other sources for assessing them and did not use this self-assessment for his assessment. But it was clear that this statement was not enough. The researcher then clarified that only the researcher and the manager participating in this part of the study would see the individual data, and the supervisor, like all the others in the group, would only see aggregated data, where any references to specific individuals had been removed. This explanation seemed to settle the issue. At the same time, however, this created a long-term need for a tool to control access to the data if this method was to be disseminated broadly without always having researcher attendance, thus fulfilling the third requirement on collaborative action research, as specified by the other practicing manager, in line with the views of Lewin: creating a capability that the organization can use independently of outside resources for further improvement efforts in the future.

Analyzing the Results: Obstacles to Change

Where performed, the intervention with its reflection sessions clearly raised the awareness of efficiency in the organization. Developers can now be heard discussing efficiency, and obstacles to efficiency, in the corridors and in the lunchroom. The intervention has raised attention and encouraged talk. But has it led to efficiency improvements? The self-assessments are non-conclusive on this point. No clear improvement trend can be identified. There are many potential reasons for this. It may be so that increasing awareness of efficiency and obstacles to efficiency naturally raises people's expectations and ambitions regarding efficiency, thus, despite increasing their efficiency, no increase is seen in their self-assessment of this efficiency. It could be argued to the contrary that when doing regular self-assessments like this, people tend to want to see improvements, and thus adapt their assessments to reach the desired results. But we have seen no signs of this. Self-assessments vary by day and week. In some cases variations can be easily and clearly attributed to certain events, such as computer network downtime or department meetings. Measurements of time utilization are also inconclusive with respect to efficiency improvements during the intervention. The intervention has clearly made efficiency explicit, and has contributed to a local discourse on efficiency. It is also clear that, as a result of the weekly meetings, a number of obstacles to efficiency – some previously known but not acted upon and some not explicitly known – have been identified and in some cases eliminated. It is reasonable to assume that elimination of obstacles to efficiency leads to an increase in efficiency (cf. Lewin's force-field theory 1952). It is also possible that some effects of obstacle removal are more long-term, and could not be observed during the period of study.

When looking back at this attempt to enable efficiency improvements in a software development group, we can identify a set of factors preventing these improvements.

Lack of Management Commitment in Action. The upfront involvement and participation of two senior managers in the organization should have been a success factor. However, at the same time, it seems as though this led to an underestimation of the need to solicit support and guidance from middle management. Strangely enough, it seems as though participation and support of senior management in the project made the project members unaware of the need to show and use this support towards the organization, to gain attention and participation. The Vice President of Development allowed interventions in his organization, but did not actively promote this or show it to his organization. The manager left it to the researcher and the other manager to convince the organization of the merits of the project.

When the researcher and the other manager finally succeeded in convincing a first-line supervisor of the potential merits of their proposal, then the intervention was implemented. And here, within this group, the commitment of management was perceived as strong, since their supervisor was very much in favor of carrying out this intervention and also actively engaged in- and driving the project, taking responsibility for the weekly meetings, and incorporating the activities of the project into the regular group activities.

Lack of Tradition as well as Forums for Knowledge Creation and Use. In implementing self-assessment and reflection, the involvement of developers became extensive. This led to more opportunities for learning. By requiring the developers to assess their own efficiency on a daily basis, as well as to record the things that prevented them from being more efficient that day, the researcher continuously raised their awareness of the importance of efficiency. When providing an analysis of- and feedback on the self-assessment of efficiency, the researcher met with the group of software developers, and many times found that the most important results of these meetings were not the data and analysis presented, nor the reaction to these, but instead the discussion and dialogue that occurred around the table, initiated and fuelled by the recorded notes from the self-assessment. These dialogues could lead to both knowledge creation and knowledge use. In one case, a software developer noted that his efficiency had been reduced "*because [he could] not do target testing from his computer, but had to walk to the lab.*" Across the table from him sat another developer who asked "*Why? I always do it from my computer!*" And he offered to show the first developer how to do it after the meeting. Numerous examples of knowledge transfer and joint knowledge creation occurred during these meetings.

This type of dialogue was common in the project and, although seemingly rather trivial, it illustrates a lack of dialogue and exchange in normal work situations. Traditions as well as culture may hamper the likelihood of sharing successes or failures and problems. Yet, when sharing is enabled like this, we clearly see the benefits with respect to problem solving, learning, as well as network building. The exchange of knowledge, as well as joint knowledge creation, can be encouraged and supported through the establishment of forums or arenas where this can take place, like the weekly reflection sessions in this project.

Established Practices. Well-established and mature groups may have gained a high efficiency institutionalized in established practices, but they may also have lost some of their ability to question taken-for-granted roles, processes and ways of working. It seems reasonable to attribute significant parts of what took place in the interviews and the interventions to the fact that someone external to the local environment brought in new perspectives and initiated questioning and reflection about often taken-for-granted methods and practices. The manager active in the interviewing and the intervention, himself an experienced developer but having worked in a senior management position for several years, was seen as a relative outsider. The same was true of the researcher who, although employed in the firm, was still quite distanced from the day-to-day issues of software development. The relative outsider perspective of these actors helped them to introduce new routines, which enabled new types of dialogue outside the group's own routinized practice. An external researcher colleague who participated in the project was even more of an external actor. This enabled him to pose questions unbiased by previous knowledge of how things were normally done. In some situations, however, it did make it more difficult for him to understand the respondents, and for them to understand him.

Questioning established practices may require a certain distance to those practices, yet, at the same time, too great a distance may make it difficult to carry out a constructive review of the merits of the practices.

Rigid planning. Despite the outspoken aim of collaborative action research of being "*an emergent and systematic inquiry* *process, embedded in a true partnership between researchers and members of a living system for the purpose of generating actionable scientific knowledge*" (Shani et al., 2004:83-84), the group started to agree on the goal and definition of the methods to be used, between the researcher and the managers, with no involvement of either middle management or groups of software developers – the actual research subjects!

However, the actors realized the shortcomings, and agreed to drop the programmatic, non-participative approach in favor of an approach where the individual software developers would develop the methods and tools jointly with the researcher and the manager, and participate in the actual inquiry into the efficiency of software development. The originally programmatic approach gradually evolved into a more organic one.

Being open to new insights and new knowledge, and augmenting plans accordingly, would appear critical for successful adaptation to changing environments.

Lack of True and Full Participation. Originally, there was collaboration between the researcher and senior managers. The involvement of software developers was limited to their being subjected to interviews about efficiency and obstacles to efficiency. However, even the interviews themselves were a form of intervention, in that they encouraged the developers to elaborate their perspective on efficiency, and also led to attempts by the developers to improve efficiency. The interviews provided the researchers and managers with a better understanding of what the developers saw as important to be efficient at work. In the intervention that used self-assessment and reflection, the developers were encouraged to participate in developing both the method and the shared view of efficiency. The method was organic in both process and content.

The study indicates that participation of not only managers but also software developers themselves improved both process and outcome. The understanding of the importance of participation emerged gradually. Still, analysis and documentation of the project were to a large extent performed by the researcher. It could be argued that participation also in these final phases could improve both the analysis results, as well as the developers' understanding of the results and thus their ability to take actions based on them.

Discussion: Transforming Obstacles into Capabilities

Beer and Eisenstat (2000a) identify the tendency of firms to define but fail to implement new strategies. A number of barriers to successful implementation or, as Beer and Eisenstat referred to them, "silent killers", were identified: top-down or laissez-faire senior management style, unclear strategy and conflicting priorities, ineffective senior management, poor vertical communication, poor coordination across functions and organizational borders, and inadequate down-the-line leadership skills and development. Beer and Eisenstat argue that these silent killers must be transformed into core capabilities. According to Beer and Eisenstat, managers should "engage their organizations in an honest conversation about the barriers and their underlying causes" (2000a:29). They should be engaged, meet the silent killers head-on, and transform them into core capabilities. Firms should embrace an abductive leadership style, combining top-down direction with upward influence. Strategies and priorities must be clear. Executive management as well as middle management must be effective. Communication should be open and coordination effective. However, although in agreement with Beer – and who wouldn't be? – we still lack direction for action and for building capabilities.

Beer studied silent killers of strategy implementation and identified core capabilities, primarily at a firm level. In this article, we maintain an intra-firm focus and concentrate primarily on the individual software developer and the software development workgroup. We have identified a set of obstacles or "killers" of successful improvement implementation in such workgroups. Just as at the firm level, the obstacles must be understood and managers must engage in honest conversation about these obstacles and their causes. Managers should not seek to merely circumvent the obstacles, but to transform them into core dynamic micro-capabilities.

This study focused on participatory efficiency improvements in software development through collaborative action research. Above, we identified five obstacles to success: *lack of management commitment in action, lack of tradition as well as forums for knowledge creation and use, established practices, rigid planning, and lack of true and full participation.* These obstacles were seen at a workgroup level, but could possibly also be seen at the firm level. The point here is not that they are unique, but rather that they are identified from a different perspective, i.e. from a bottom-up perspective. In fact, the obstacles identified in this study align well with those identified by Beer from a more top-down perspective.

We could take these obstacles, negate them, and normatively prescribe what managers should do, and claim that this knowledge will enable more successful improvements. However, the value of this type of knowledge, or “know-what”, is limited. If know-what can be transferred into know-how, it can form the basis for action and for the formation of specific capabilities (Kogut & Zander, 1992). We can see capabilities as the active and dynamic equivalent to the passive know-what. Despite – or maybe because of – being know-how, capabilities are more tacit that know-what. Capabilities enable action and creation of knowledge, but are more difficult to create and recreate than knowledge. Capabilities are intrinsic to and embedded in the organization where they exist.

This article illustrates an attempt to retain a focus on exploiting while further developing organizational capabilities and competencies, in an environment that moves from extreme turbulence to a more normal dynamic environment. In doing so, we have identified a set of obstacles to the success of change initiatives. How can these obstacles be transformed into capabilities and micro-level competencies in organizational change?

Dynamic Capabilities

Software development processes and practices were the primary operational routines seen in this example. Our intervention strategy did not address, to any deeper extent, the detailed contents of the development process. The content of the development process would be operational, potentially core, capabilities. However, in our study, we were able to address some issues pertaining to personal efficiency. Efficiency in planning both collective work as well as personal time usage is an important capability in almost any type of work role. The traditions and culture around time usage, and the difficult trade-off between time for individual work achievements and interaction with colleagues have been surveyed and documented by Perlow (1999).

However, as pointed out by Collis (1994), for example, the value of operational capabilities is potentially short-lived in a dynamic environment. We should primarily focus on dynamic or higher-order capabilities, which can create and recreate operational capabilities through combinations and recombinations of existing resources and competencies.

In this study, a set of obstacles to successful change were identified. If the organization can be managed in such a way as to avoid these obstacles, then success becomes more likely. This can be done in an ad-hoc way, or by investing in learning to avoid the obstacles as a repeatable process, as what can be referred to as a "dynamic capability" (Winter, 2003).

In the project studied, in collaboration between practitioners and researchers, we can identify ways of improving the chances for successful change, and overcoming the five obstacles. By grouping these improvement practices (See Table 1) we identify three capability areas: The need to improve *the readiness and willingness to learn*. The need to tap into the vast potential *of exploring and exploiting the combined knowledge and experience of members of the organization*. And, finally, the need for *passion*. Just as in the development of private relationships between individuals, passion is critical to relationship building as well as to creating and sustaining action in professional and organizational relationships.

Capabilities / Obstacles	Capability to Learn	Capability to Explore and Exploit Everyone's Knowledge and Experience	Passionate Capability
Lack of Management Commitment in Action			Lead-by-example: show passion, create motivation, encourage action
Lack of Tradition as well as Forums for Knowledge Creation and Use	Encourage and reward exchange – giving as well as receiving – of experience	Create forums for reflection and exchange of experience	
Established Practices	Encourage critical review of established practices and experimentation with new practices	Use cross-organizational groups to gain new perspectives on practices	Allow and encourage action experiments
Rigid Planning	Compare outcome and plan in order to learn and improve	Solicit input from actors with different skills and experience in validating plan	
Lack of True and Full Participation	Use cross-organizational groups to improve and disseminate knowledge	Broad participation benefits knowledge exploitation and creation	Motivation through participation

Table 1. Transforming Obstacles into Capabilities.

Capability to Learn. Many organizations strive to become learning organizations. But what does that imply? This study points to the need to be prepared for, encourage and exploit the emerging new understanding, knowledge and experience that is continuously available to us. Even though individuals may think they are ready and willing to learn, evidence shows that they often take actions contrary to learnings (Argyris & Schön, 1974; Kylén, 1999). In practice, this means continuously reassessing planned actions, rather than first planning and then doing. It also means continuously reflecting on actions and experiences, first person (self), second person (intra-group) and third person (extra-group), in order to improve future action as well as organizational routines and practices. Such continuous reassessment of future action and reflection on past action can be actively supported through institutionalized routines and the creation of reflection forums.

Concurrent concept elaboration and reflection on action can improve both understanding of concepts and actual performance in action. Organizational knowledge is created in a continuous dialogue between tacit and explicit knowledge (Nonaka, 1994).

In order to have the collective knowledge and experience available, as well as to encourage members to contribute to the collective learning, organizations should first and foremost encourage wide participation of organizational members in change and learning programs. Through extensive participation, collective knowledge creation as well as collective knowledge dissemination and exchange are maximized.

Organizations can benefit from building a capability to learn, based on openness to new approaches, reflecting and learning from internal as well as external action, and allowing work procedures to evolve and emerge, supporting continuous improvement.

Capability to Explore and Exploit Everyone's Knowledge and Experience. Participation is an espoused value in many organizations and settings. It is also stressed as an important part of continuous improvement programs (Axelsson & Bergman, 1999; Hart, Berger, & Lindberg, 1996) as well as in organizational development (OD) programs, by advocates of Sociotechnical systems (STS) approaches (Dunphy, 2000), as well as in general by a large group of action researchers and collaborative researchers (Fals-Borda & Rahman, 1991; Whyte, 1991; Whyte, Greenwood, & Lazes, 1989). Reason and Bradbury (2001) claim that action research is participative research, and all participative research must be action research. Warren Bennis (2000) argues that post-bureaucratic organizations require a new kind of alliance between leaders and the led, thus increased participation. The extent of that participation varies, however. In action research, participation varies from collaborating about or approvingly being subjected to an experiment, to participation in planning and/or research governance, and possibly also participating in analysis and the drawing of conclusions (Chisholm & Elden, 1993). The most extreme forms of action research argue for total equality between researchers and practitioners (Brown & Tandon, 1983). The same sort of variation can be seen in change programs.

Participation in action is more problematic, however, as has been illustrated by this study. Even with the best intentions, and with a solid base in the literature, there is inertia that tends to limit participation, with respect to who participates and on what aspects they are invited to contribute. Established practices and organizational routines, in many cases based around rigid planning, often prevent rather than support the exchange of knowledge and experience. Both change management and action research can benefit from participation by broader groups of actors in more phases of the project. Bringing in more actors means bringing in more knowledge and experience, and at the same time means activating more channels for knowledge dissemination. Opening the way for participation in more phases of the project opens up more opportunities to leverage everyone's knowledge and experience, not only during project execution, but also during project set-up, analysis and conclusion.

One way of encouraging and supporting participative exchange of knowledge and experience is through the creation of forums for dialogue. Dialogue forums enable and support the participants in talking about issues relevant to their work tasks. For example, a possible topic can be: 'What prevented me from being more efficient [in developing software] this week?' This study provides results from such dialogue forums that both support experience exchange and enable learning between members, as well as serve as a tool to identify improvement proposals.

Organizations can benefit from building a capability to explore and exploit the knowledge and experience in the organization by institutionalizing dialogue forums as tools for learning and improvement activities.

Passionate Capability. Many books on change management (e.g. Kotter, 1996) provide what Collins (1998) critically refers to as "n-step guides" for change. A number of the steps proposed tend to be common to many of these guides. Collins also calls into question the value of these guides, based on their omission of key social dimensions and the context of change. They do, however, often stress many of the reasons for failure found in actual change programs, e.g. failure to establish a sense of urgency, failure to develop a compelling vision, or failure to communicate the vision and empower broad-based action.

Some of the actions prescribed in the n-step guides relate to providing support and guidance to the change program, indicating emotional as well as factual commitment. It is much easier to tear down than to build up a sense of commitment and passion for change. Managers and leaders must be bearers of a passion for change, and "walk the talk" to spread this passion to organizational members.

In this study, there was management support, through dedication of time as well as enabling and allowing the project, but it was not visible enough to the organization, and thus did not provide the infusion of passion needed. Passion requires constant attention and perseverance, and thus very much needs presence. Passion can make the difference between knowing and doing (Pfeffer & Sutton, 2000), between talking and acting.

Established practices can prevent creation of the passion for change and action. Routines and set practices tend to reduce or eliminate emotions. Also, if participation is limited, then passion, even if exhibited, is still not infused to larger groups of employees.

Organizations can benefit from recognizing the value of passion as well as striving to build passion into their activities, standard operating procedures and culture. The capability to exhibit as well as infuse passion is key in motivating and enabling change and improvements.

Creating dynamic micro-capabilities

The aim of this project was to create knowledge, as well as practical actions and improvements locally, but also to institutionalize a method to allow the organization to revitalize itself. This ability for local self-revitalization we call a "dynamic micro-capability".

In this project, individual software developers' talk and reflections about their work were observed, leading to the identification of three candidate micro-capabilities: the capability to learn; the capability to explore and exploit everyone's knowledge and experience; and passionate capability. These and other micro-capabilities can play an important role in creating a dynamic organization able to self-revitalize and adapt to changes in the environment.

The capability literature focuses mostly on firm-level or business-level operational capabilities, such as low-cost manufacturing or international sales. The capabilities identified here are dynamic capabilities (Teece et al., 1997). Rather than specific firm-level processes, such as e.g. alliancing or strategic decision-making (Eisenhardt & Martin, 2000), however, these capabilities constitute routinized behaviors and attitudes within an organization, from the top to the lowest micro-organizational levels, critical to the ability for self-renewal. These capabilities could be seen as critical to the capability for continuous change (Prastacos, Söderquist, Spanos, & Van Wassenhove, 2002), in line with the eccentric organization's (Fisscher & Weerd-Nederhof, 2001) ability for reflection-in-action.

The identified dynamic micro-capabilities in this study could be understood as components in a firm's "combinative capabilities" (Kogut et al., 1992), which augment the operational capabilities. In practical problem solving, learning, knowledge exploration and knowledge exploitation leverage and recreate organizational capabilities (Iansiti & Clark, 1994). The capability to learn and to explore and exploit everyone's knowledge and experience encompasses the knowledge creation, absorption and integration capabilities identified by Verona and Ravasi (2003), but also extends this view into knowledge exploitation. Dynamic capabilities are higher-order cognitive processes, rather than practices or structures (ibid.).

The proposed capabilities in this study support Kaplan et al.'s (2002) six capability operators: creation, destruction, integration, absorption, replication and protection. The proposed dynamic capabilities enable and support the evolution of capabilities, or "capability life-cycle" (Helfat et al., 2003). These micro-capabilities must be dynamic in nature to handle the complexity of knowledge creation and dissemination (Ingelgård, Roth, Shani, & Styhre, 2002). This dynamism can be supported by higher-order capabilities.

It cannot be proven now whether the project has indeed instituted these micro-capabilities into the organization. It may be so that the change was realized through the support of the researcher, but without institutionalizing the process and thus without enabling the process to be repeated without continued support. If so, this would be what Winter (2003:992-993) classified as "ad-hoc change". Winter argues that change can be initiated by extreme environmental conditions, and that the firm may succeed in radically transforming itself to meet and survive these conditions, even without building and exercising dynamic capabilities (2003:992). However, the same change can also be realized as a concurrent creation and exploitation of dynamic capabilities. We argue that these candidate dynamic capabilities should be seen as possible micro-capabilities, and that the findings from the project illustrate the difficulty of actually creating and installing, as well as observing, truly sustainable dynamic capabilities.

Higher-order Capabilities

Higher-order capabilities are intrinsically contradictory. One the one hand, their very nature and purpose is change. They should support Schumpeterian "creative destruction" as well as recreation of capabilities. At the same time, they should provide predictably repetitious procedures, rather than 'ad-hoc' problem solving. Higher-order capabilities need to walk a tightrope between routinization and renewal, between formalization and "adhocratization" (Hedberg, Nyström, & Starbuck, 1976). They must not fall into the core rigidities trap (Leonard-Barton, 1992), nor can they become so ad-hoc that actions cannot be repeated and neither contribute to nor leverage learning and experience.

Collaborative action research is a process that can enable an organization to repeatedly, and in a systematic way, jointly investigate a problem, try out candidate solutions, and then, after evaluation, implement the best proposals. It could be seen as a "candidate higher-order capability", able to create and augment dynamic micro-capabilities.

However, to be able to claim creation of a higher-order capability, the process would have to be institutionalized, so that it seems likely that the organization could and would implement change using this process in the future, independently of the researchers in this project. In this case, there are indications of successful change, but there is a risk that this may turn out to be a one-time change effort that does not lead to sufficient institutionalization to enable repetition. Looking back, this change project may possibly be classified as an ad-hoc effort (Winter, 2003). In order to successfully create a higher-order capability, there is a need to have a champion participating in the effort, someone who will bear the knowledge and methods, a capability bearer, throughout the entire project. In this project, we had the participation of a senior manager who explicated a requirement for institutionalization of the process, thus in line with Lewin (1946:42) who argues for the integration of training into collaborative action research, and still institutionalization could not be undoubtedly ascertained.

Further, we see that despite access to and participation from several senior collaborative action researchers, the planning, analysis, conclusions and documentation of collaborative action research projects can easily end up being non-participative. Increased participation should contribute to internalization of the methods, to moving from ad-hoc change to the creation of both dynamic and higher-order capabilities.

The collaborative action research method used in the project could be seen as a candidate for a higher order micro-level capability, able to potentially develop as well as internalize and institutionalize new methods of changing how an organization operates.

Conclusions

This study has illustrated the discrepancy in this organization between individual conceptions of efficiency and the conventional, established view of the concept. It has shown the potential for concurrent improvement of efficiency and the conception of efficiency.

In addition hereto, the study indicates three tentative dynamic capabilities that can be crucial to successful micro-organizational change efforts: the capability to learn, the capability to explore and exploit everyone's knowledge and experience, and passionate capability.

In order to build these micro-capabilities, managers should pay attention to and seek to eliminate the identified obstacles to change by explicitly supporting change in action, by supporting the creation of forums for knowledge exchange, by questioning the established way of doing things, by being visible and accessible, by allowing and encouraging more emergence and incrementality in planning, and by participating and encouraging broad participation.

In order to better understand the role of dynamic micro-organizational capabilities and their relationship to operational capabilities and macro-level dynamic capabilities, more research is needed. We propose that micro-organizational capabilities may plan an important role in the evolution of firm capabilities. This study only indicates the potential in this area.

This study proposes that the collaborative action research process could be seen as a candidate higher-order capability, which could be used as a tool for creating and augmenting dynamic and operational capabilities. One major challenge lies in the institutionalization of the process in the organization, i.e. in turning it into a repeatable process independent of external actors, yet at the same time avoiding the core rigidities trap.

From a managerial perspective, this study indicates that it is possible to leverage collaborative action research to concurrently improve action and improve knowledge and ways of conceiving important phenomena. More specifically, this study stresses the importance for management of showing passion for learning – from and by everyone.

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Externalising and Offshoring Product Development: Towards a dynamic framework

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Abstract

Externalising product development has been touted as a way of making the firm more efficient, as well as more flexible. Offshoring product development, moving to low-cost regions of the world, has been proposed as one way of reducing product development costs.

In this article, a dynamic view of organising product development is proposed. A typology of modes of organising based on geographical (onshore or offshore) and firm-relative location (internal or external) is presented, and organisational transition paths are identified. Propositions regarding the role of capabilities for efficient organisational transitions are then formulated based on participant observations and interviews with product development managers in a telecommunications infrastructure firm.

Preservation of operational product development capability contributes to efficiency in organisational transitions, and preservation of operational management capability contributes to efficiency in offshoring. Dynamic management capabilities contribute to efficiency in externalisation and offshoring. Reversal of externalisation and offshoring leverages operational product development as well as dynamic management capabilities.

Keywords: Outsourcing, Externalising, Offshoring, Product Development, Capabilities, Dynamic Capabilities

Introduction

Lower trade barriers lead to increasing globalisation of trade and competition. The development in the telecom sector in the 1990s illustrates this process, where international standardisation increased economy-of-scale effects, enabling product development costs to be amortised over larger volumes, and contributed to a consolidation of the number of suppliers of telecommunications infrastructure products to a smaller number of dominant firms.

Globalisation and deregulation of previously regulated economies led to new markets opening up. New types of competition emerged: between local, regional and global actors, and between incumbent actors from the industrialised world and new actors from the developing world with significantly lower cost structures.

In order to compete successfully, firms invested large sums of money in product development of new-to-the-world, advanced products, as well as in market expansions. Operators invested large sums of money in licenses for the new third-generation mobile networks. This wave of expansion and investment collapsed in 2001, forcing firms to make drastic cost reductions.

One way to reduce costs is to *externalise* activities (sometimes referred to as 'outsourcing') to other firms that, through specialisation and economies of scale, have the potential to achieve higher productivity and lower costs than the vertically integrated firm. The trend to externalise activities started with non-core support activities, such as facilities management, and expanded to include things such as reception and canteen services. Later, externalisation also became common in IT services and manufacturing. Now, externalisation is applied to activities like product development, in the past often seen as a core activity. Firms start to examine which parts of product development are really core to their business.

Another, potentially complementary, way of reducing costs is to *offshore* activities to locations with lower operating costs, often in developing countries. In addition to reducing costs, offshoring can play an important role in creating access to markets previously not accessible. Many multinational corporations have made direct offshore investments to establish a local presence and open up new markets for their products, even when costs are not reduced, or in some cases even at an increased cost. In addition to marketing and sales, these offshore operations often include local manufacturing and sometimes also local product development or product adaptation.

In addition to potentially providing increased productivity and lower costs, externalisation and offshoring are also warranted because they enable firms – both those who externalise product development and/or move it offshore, and those who provide product development services to this first group of firms – to focus on their core competencies. The capability to develop new products is increasingly identified as based on such core competencies. The increasing challenges of global competition have meant that product development has grown in volume. At the same time, in many firms, product development as a share of the firm's added value has increased concurrently with the externalisation of other firm activities, e.g. manufacturing. Therefore firms now increasingly seek to reduce costs and increase productivity in product development.

In this article, I review the options available for increasing product development efficiency through externalisation and offshoring. I see *externalisation* as the dynamic processes of replacing previously internal activities, in this case product development, with external procurement of product development services. *Outsourcing* is treated as synonymous to externalisation. *Offshoring* is analogously seen as the dynamic process of transferring activities earlier performed onshore to an offshore location.

In reviewing these options, I propose a typology of modes of organising product development. In the choice between different forms of organising, both steady-state and dynamic effects need to be considered. I will focus and further elaborate on the dynamic effects of the organising mode chosen. The management of organisational transitions is critical and relies on organisational capabilities. Based on participant observation and interviews with senior product development managers in a large telecommunications firm, I formulate a set of propositions about the role of organisational capabilities in supporting efficiency in organisational transitions.

Organising Product Development

In the 20th century, the product development of large firms was predominantly centralised and internalised (DeSanctis, Glass & Ensing 2002; Steele 1988), contrasting with the dominant perspective of the 19th century when R&D efforts were more independent (Sanderson 1972, quoted in Howells 1990). Even as firms grew, diversified and spread across the globe, product development initially remained centralised. There were, however, some opposing yet complementary trends. Some firms internationalised product development and moved it offshore. Others externalised product development as an alternative or complement to hierarchical organising. These firms began to question location and ownership aspects (Buckley & Casson 1979) of product development.

Internationalisation of product development was driven by two major objectives: access to competence and buyer markets (Florida 1997). Establishing international product development organisations allowed firms to build networks and access the specialised competence available in certain locations, such as California's Silicon Valley (Lee et al. 2000; Saxenian 1994) or along Route 128 in the Boston area (Saxenian 1994). Establishment of international product development also resulted from the need to be close to local markets in order to develop products to local needs and standards (Behrman & Fischer 1980), and to be close to local customers. International product development operations sometimes developed as spin-offs from local manufacturing operations (Behrman & Fischer 1980). Globalisation furthered internationalisation by moving away from adaptation to a multitude of national contexts and markets towards one integrated strategy for a global market context (Behrman & Fischer 1980; Gassmann & von Zedtwitz 1999; Hedlund 1986; Yip 1998).

The need to reduce costs in product development has been added to the motives for internationalisation. Moving product development to sites with lower costs, often in countries such as India, China or Russia, with lower development costs than the firm's home location, e.g. Western Europe, North America and Japan, is referred to as *offshoring*. In some cases, product development offshoring comes in the wake of manufacturing offshoring. Manufacturing sites in these offshore countries are replaced or complemented by product development sites. Many firms find that they are able to access engineers in offshore countries at a fraction of the cost of having an engineer at firm headquarters.

Externalisation or outsourcing follows the trend of focusing on core competencies (Prahalad & Hamel 1990). By externalising activities that are not based on core competencies, firms focus on those activities where they can achieve pre-eminence and provide unique customer value (Quinn & Hilmer 1994). Externalisation often starts with peripheral activities, only later moving closer to the heart of the firm, e.g. from facilities management and logistics, to manufacturing, human resource management, marketing or even product development.

Capabilities in Product Development

Organisational capability has been defined as a "generally reliable capacity to [make something happen] as a result of intended action" (Dosi, Nelson & Winter 2000:2), with capabilities being "complex routines that determine the efficiency with which firms physically transform inputs into outputs" (Collis 1994:145). *Operational capabilities* relate to "the basic functional activities of the firm", whereas *dynamic capabilities* deal with "dynamic improvements to the activities of the firm" (ibid.).

Product innovation and product development capabilities are seen by many as the most important capabilities to possess (Hayes & Pisano 1994; Nelson 1991; Stalk, Evans & Shulman 1992; Winter 2003). In addition to their direct role in augmenting the firm's product portfolio, they are seen as engines of organisational renewal (Bowen et al. 1994; Dougherty 1992).

Product development per se is seen by many scholars as a dynamic capability (e.g. Nelson 1991; Winter 2003), who argue that "capabilities that would change the product" are dynamic capabilities (Winter 2003). From the perspective of the product development organisation, I argue in this article that product development is what the organisation does to "earn a living now" (ibid.), and should thus be seen as an operational capability, just as it should for an independent R&D lab (ibid.). The operational or dynamic character of capabilities is "only locally defined" (ibid.).

Capabilities can be classified as either task-oriented or management-oriented (see Figure 1). In this case, task-oriented capabilities are those needed to perform product development, e.g. software coding or hardware design. Management capabilities focus on organising, control and coordination of task performance.

Operational product development capabilities (A) are important in supporting and enabling the actual product development work, in teaching and training staff to develop products, as well as in specifying and ordering product development services.

Operational management capabilities (B) deal with management, control and coordination of the product development work. Such management capabilities are often embedded in and leverage corporate procedures and management models.

Dynamic product development capabilities (C) deal with creating, improving, augmenting and recombining operational product development capabilities. These capabilities are important in improving ways of working in product development.

Dynamic management capabilities (D) deal with organising, and are important in that they support the transfer of product development tasks and capabilities from one organisation and location to another one. These management capabilities exist in addition to those developed by and required to manage traditionally organised internal product development, but are slightly different from them, and are developed and exploited through reorganising product development. Firms that have performed externalisation and offshoring of product development repeatedly, and learned from it, have often gradually established routines and developed these capabilities.

Capabilities for product development have received significant attention (see e.g. Bowen et al. 1994; Clark, Kim B. & Fujimoto 1991; Clark, Kim B. & Wheelwright 1993; Iansiti & Clark 1994; Leonard-Barton 1992; Marsh & Stock 2003; Pisano 2000; Verona 1999; Verona & Ravasi 2003; Wheelwright & Clark 1992). In most cases, however, capabilities are seen as static routines for exploring and exploiting product development knowledge. Capabilities are "learned, highly patterned, repetitious, or quasi-repetitious, founded in part in tacit knowledge" (Winter 2003:991).

In some cases, the focus is on recombining knowledge from various sources to create new capabilities (Iansiti & Clark 1994; Marsh & Stock 2003; Verona 1999; Verona & Ravasi 2003). However, little attention is paid to capabilities for structural recombination of product development organisations. Therefore, in this article, the focus is on the role of capabilities in supporting such structural recombinations and transitions between modes of organising.

Capabilities are Processes and Routines for ...	**Task: Product Development**	**Management**
Operational	...Performing Product Development Ⓐ	...Control and Management of Product Development Ⓑ
Dynamic	...Development of How Product Development is Performed Ⓒ	...Development of How Product Development is Managed Ⓓ

Figure 1. Operational and Dynamic Capabilities

Research Method

This article is grounded in existing theory as well as my own more than two decades of practical experience in the field of product development organising. I deploy here a typology of modes of organising product development, enabling me to identify a set of organisational transitions related to externalisation and offshoring.

I have used this framework in a series of interviews with senior product development managers from a major telecommunications infrastructure supplier. These interviews have allowed me to see that the framework is relevant, at least in this setting. Furthermore, I have been able to use the framework when mapping and analysing my observations, as well as the experiences described by the managers, into typical characteristics of the different transition paths. Based on these results, I make a set of propositions pertaining to the role of capabilities in externalisation and offshoring.

The propositions have received explicit management support in interviews and workshops with product development managers. However, they are just propositions and further validation in other contexts and with larger data sets is called for. The propositions aspire to contribute to an emerging dynamic framework for product development organising, as well as to a more efficient, effective and flexible practice, in both operational and dynamic processes.

The perspective taken in this article is that of a firm in the industrialised world. The terminology is accordingly based on this perspective. Most of the results are valid, though need to be reformulated, if seen from another perspective, e.g. a firm with its headquarters in a developing country.

A Typology of Modes of Organising

Based on the above-mentioned processes of externalisation and offshoring, product development organising can be classified by two dichotomous variables: geographical location (onshore or offshore) and firm-relative location (internal or external), in turn defining four different ways of organising product development: internal (onshore), external (onshore), internal offshore and external offshore (see Figure 2 below adapted from Cronin, Catchpowle & Hall 2004).

Externalisation is frequently also used to imply offshoring, and *offshoring* to imply externalisation. I argue here that *external* and *offshore* are two different options for organising product development, and should be recognised as such.

Ways of Organizing Product Development	**Internal**	**External**
Onshore	Internal	External
Offshore	Internal Offshore	External Offshore

Figure 2. Ways of Organising Product Development (adapted from Cronin, Catchpowle & Hall 2004)

Internal (onshore) product development is performed using hierarchical governance, utilising resources controlled by the firm in one or several of its onshore development sites, e.g. in North America, Western Europe or Japan. Capabilities developed in the organisation can be exploited, and new experiences can be accumulated and contribute to further development of product development capabilities.

External (onshore) sourcing, often referred to as "outsourcing", of product development is performed using market governance mechanisms. The firm contracts an extra-firm organisation to perform product development for and on behalf of the firm. The extra-firm organisation provides resources and its product development capabilities are exploited. New experiences tend to contribute to an augmentation of the capabilities, primarily of the extra-firm organisation. The firm may be able to access these in the future based on renewed contracting for product development services.

Internal offshore product development is based on the firm's captive product development resources offshore, in low-cost regions (sometimes referred to as "direct offshore investment"). Accumulation of experience primarily contributes to improved capabilities in the foreign subsidiary controlled by the firm. Internal offshoring seeks to provide the benefits of lower costs for product development, while still retaining the control through hierarchical governance structures.

Finally, *external offshore* (often referred to as "offshoring") product development is based on market-based procurement of product development services from an extra-firm organisation that performs the development activities at a lower cost based on resources in low-cost regions.

In addition to these four forms, there are also hybrid forms that fall in between internal and external (Williamson 1991). Similarly, there are intermediate cost regions. For the sake of introducing an organising framework, in this article, I will discuss only the pure forms, as depicted in Figure 2. There is, however, nothing preventing the framework proposed in this article from being extended to cover these hybrid forms and variants as well.

As an alternative to outsourcing and offshoring, product development can be reduced in scope by buying components and subsystems, thus replacing internal development. This process of raising the level of input material, thus reducing the scope of product development, will not be further elaborated in this article. It can, however, be combined with development performed according to any one – or combination of several of the four modes of organising product development.

The choice of mode of organising is contingent on the type of product development in question, e.g. modular vs. integral (see e.g. Brusoni & Prencipe 2001; Chesbrough 2003; Mikkola 2003; Muffatto & Roveda 2002; Sako 2003), software vs. hardware. The mode of organising product development is also contingent on the mode of organising other related activities, e.g. manufacturing (Bengtsson, Berggren & Lind 2005; Ulrich & Ellison 2005).

Efficiency, Effectiveness and Flexibility

Efficiency, effectiveness and flexibility are sought independently of the product development organising mode, possibly with a slightly different emphasis depending on the mode. Efficiency is concerned with doing things right; effectiveness is doing the right things (Drucker 1974:572). Flexibility is the ability to adapt to environmental change (Aaker & Mascarenhas 1984).

Offshore product development is often used in order to reduce costs, and thus managed with a focus on efficiency. Externalisation is sometimes pursued in order to increase innovation, and thus managed with a focus on effectiveness. Many firms expect their external suppliers of product development services to provide greater volume flexibility than what they can achieve from their internal development organisation.

Efficiency, effectiveness and flexibility in the resulting operation, after externalisation and/or offshoring, are potentially complementary driving forces for these changes. Flexibility connotes an ability to change. If cost and time required for change are low, then flexibility is high (Thomke & Reinertsen 1998). In other words, flexibility is about change efficiency.

Rather than focusing on the operational results of the transition, in this article, I want to investigate the efficiency of the dynamic process of transferring the product development task from one location to another and, specifically, the role of different types of capabilities in this process. The focus here is therefore on the efficiency of the effective transitional process in organising product development.

Towards a Dynamic Framework

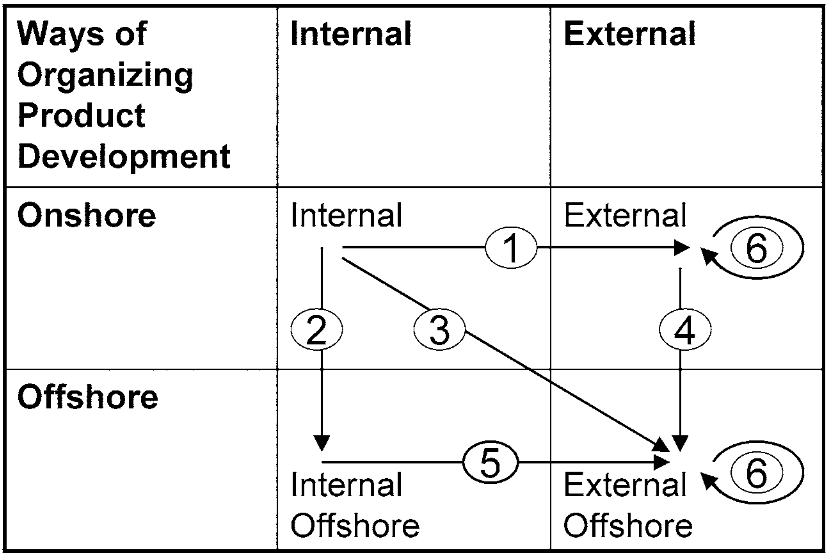
Externalising and *offshoring* are words that literally describe an ongoing change process, moving from a previous state of sourcing from within to sourcing from outside and performing activities offshore, respectively. In much of the literature, academic as well as non-academic, these words have come to be used not only for the respective ongoing change processes but also to describe a new state, a way of performing the activities.

In this article, I use *internal* and *external*, and *onshore* and *offshore* product development to denote the mode of organising, and reserve the active form of *externalising* and *offshoring* to describe the change processes involved. The firm from which product development is externalised and/or offshored is referred to here as the *source firm*, or simply the *firm*, and to the firm to which product development is externalised as the *supplier of product development services*, or simply the *supplier*.

For a firm using the traditional mode of organising product development internally onshore, there are several potential paths of externalising and/or offshoring. The firm may choose to move parts of product development to existing or new intra-firm product development organisations located offshore, in order to gain proximity to offshore markets and/or to capitalise on lower product development costs. Alternatively, the firm may choose to externalise parts of its product development to an extra-firm supplier of product development services, allowing the firm to concentrate on the activities focused around its core competencies. Finally, the firm may also choose to directly both seek lower costs and enable this focus on core activities by utilising external offshore product development. I refer to these three change paths as *externalisation* (1) (see Figure 3 below), *offshoring* (2), and *concurrent externalisation and offshoring* (3), respectively.

External product development performed in countries where costs are high may be transferred to low-cost offshore product development through *external offshoring* (4). Product development performed internally offshore may be subject to *offshore externalisation* (5).

Sourcing decisions should be reassessed regularly (Bettis, Bradley & Hamel 1992; Lacity, Willcocks & Feeny 1995). Is the external product development performed efficiently, and does the organising mode provide the requisite flexibility to the firm? Such reassessment can lead to sustaining the existing arrangement, to reinternalising the activity, or to continued external organising but with a different supplier of product development services, *re-sourcing* (6).



Ways of Organizing Product Development	**Internal**	**External**
Onshore	Internal	External
Offshore	Internal Offshore	External Offshore

Figure 3. Transition Paths in Organising Product Development

In theory, these changes can also be reversed. Product development can be internalised from an external party (1, reversed), or from an offshore subsidiary (2, reversed), or from an external offshore party (3, reversed). Product development may be brought back from an external offshore mode of organising to an external onshore mode or to an internal offshore mode.

This reversal of offshoring and externalising is not necessarily an easy process (Bettis, Bradley & Hamel 1992; Wasner 1999). Externalisation is a path-dependent process (Lei & Hitt 1995; Levinthal 2003; Wasner 1999), where each step is performed in a context partly created by previous steps and previous actions. Externalisation can become a self-reinforcing process (Bettis, Bradley & Hamel 1992), where each decision to externalise logically and automatically leads to the next, without a holistic and strategic review on a global firm level. Externalisation and offshoring enable the firm to concentrate on other activities, releasing certain in-house resources. If these resources are later needed to perform or support a reversal of the previous externalisation or offshoring, they may have left the firm or be otherwise unavailable due to their having now been reallocated to some other task. Even if the resources are in fact still available, the staff may no longer possess up-to-date knowledge about the externalised or offshored activities due to the activities having evolved and the related operational capabilities having been augmented since the time when they were performed in-house.

Cases of Organisational Transitions

This section describes examples of transfers of product development operations. Some of the cases presented are abridged summaries of one case. Others have been compiled from several actual cases deemed typical for the category.

Onshore Externalisation (1) (see Figure 3). One development unit within the firm was divested to a large consultancy company as part of a downsizing of the firm. A buy-back agreement was signed with the consultancy company, whereby the firm had the right to and made a commitment to buy a specified volume of development at a specified price over a specified period of time. Staff was transferred and continued with the same development work, using the same routines and processes, as in the past, only now with a new employer.

The transfer of development responsibility was quick and simple. As one manager put it: “It was not really a transfer. We just needed to modify our governance forms.” What was needed was the creation of new interfaces and ordering routines, and this was done in parallel with and without disturbance to ongoing product development.

Combining externalisation and divestiture made the transfer efficient. Product development capabilities were transferred from the firm to the supplier through the transfer of development staff.

The firm has made several externalisations to the same supplier. Over time, the transfer has become more efficient and smooth. Experiences of previous transfers, as well as emerging shared routines and processes for the management of the transfer supported these repeated externalisations.

The combination of externalisation and divestiture, combined with an unchanged location, enabled the transfer of staff and with it also product development ability. In cases where this is not the case, the benefits of onshore externalisation are less clear.

Concurrent Externalisation and Offshoring (3). The firm externalised maintenance and limited development of mainly software blocks to two main suppliers in an offshore location. The transfer of software was more successful than the transfer of hardware development. The supplier had limited previous experience of hardware development and thus no previous routines for hardware development and no previous experience of transferring in hardware development.

Software development transfers were efficient, and grew increasingly efficient as routines and processes were developed jointly between the firm and supplier, based on the experience gained from these activities: "We have learned. We have created our own outsourcing strategy. Each new transfer goes better and better."

Transfer of maintenance was more difficult than transfer of new product development "since it requires more systems knowledge, deep and in all areas of the system" and it "takes time to develop – it is experience-based."

External Offshoring (4). The development of one product had been externalised, and the firm later wanted to further reduce development costs. When first externalising the product, the firm had failed to retain development capability. Due in part to this, the firm chose to have the onshore external supplier subcontract development to an offshore location, rather than the firm itself assigning the development directly to an offshore supplier. The supplier supported the transfer with onshore development resources. These onshore developers also acted as a potential additional resource in case problems that could not be solved by the offshore supplier surfaced. The offshore supplier had general capability for this type of product development, but needed to learn specific skills from the onshore supplier.

The transfer efficiency was supported by both the general development capability of the supplier's subcontractor, and the specific skills and capabilities of the supplier. Had the supplier not actively supported the transfer, then product development capability in the firm would have been critical.

Internal Offshoring (2). The firm began to develop a global network of product development centres several decades ago. In this network, product development tasks and responsibilities were regularly reassigned to fit with then-current needs. Over time, the firm developed experience, routines and procedures for such product development transitions. Today, this experience supports both internal offshoring as well as other internal and external transfers.

One development manager with extensive transfer experience argued that internal transfers benefited from shared information system infrastructure, shared routines and processes, as well as knowledge of the firm's main product and system architectures.

Due to their greater permanence, internal development centres were more likely to provide the requisite general- and specific product development capabilities.

New internal development centres to some extent exhibit the characteristics of external suppliers since they have not yet internalised company culture and ways-of-working.

See also under Internal Re-sourcing below.

Offshore Externalisation (5). The firm externalised one offshore development centre. The centre was located close to two offshore suppliers of product development services and was divested to one of them. In many ways, this offshore externalisation was similar to the onshore externalisation through divestiture described above.

By combining divestiture and externalisation the transition is made simpler. The staff moves with the product and the task, carrying capabilities with them. In many cases, they retain, at least initially, their work location and internal organisation. All that changes initially is the employer.

Re-sourcing (6). The firm studied regularly assesses supplier performance and feeds back the results to its suppliers. If performance is not perceived as improving sufficiently over time, a request for quotes from other suppliers is often made as a basis for possible initiation of a new procurement process.

In one case, the firm moved development of both hardware and software of a system to India. Production was retained onshore. This implied that the offshore supplier had to interact with the onshore production plant. In this case, it is currently being argued that hardware development and production should be geographically close, and thus that either development should be moved back onshore, or production should be moved to India as well.

Transferring product development away from somewhere where it has recently been transferred in is more difficult. Capabilities have not yet been developed within the supplier. This limits efficiency in re-sourcing, but also has implications for serial transfers, first externalising and later offshoring, or vice versa, or for reversing transfers.

Transferring product development away from somewhere where it has been for a long time can also be difficult, as seen above in the external offshoring case, where capabilities were no longer available within the firm.

Internal Re-sourcing. Internal transfers in general, between onshore as well as offshore sites, were described as more difficult than externalisation and offshoring. Internal transfers were claimed to be more politicised: "External product development does not contribute to headcount, and headcount is power." Internal division of responsibility and transfer of resources were described as of interest to many stakeholders, whereas externalisation was to a large extent a local decision made by the manager responsible. According to one manager, "internal fights never end"; subsidiaries constantly battle to strengthen their position. Decisions to externalise, on the other hand, are not questioned continuously, but rather at discrete points in time.

Internal re-sourcing is similar to both external re-sourcing and internal offshoring (see above). The transfer benefits from product development capability in the firm, centrally or in the current location, as well as in the new location.

Reinternalisation. During the period studied, reinternalisation was not frequent, and was normally driven either by externalisation and/or offshoring that failed to deliver the benefits expected, or by changes in the strategy of what should be seen as the firm's core activity. In one case of externalisation, product development and product management had been externalised completely, and the firm lacked product development capability in this area. Managers argued that, if the firm wanted to change the way it was organised, the lack of product development capability left it with only two options: to either rehire the staff from the supplier, or let the supplier subcontract the development elsewhere. In other cases, reinternalisation did occur. This was possible due to similar activities still being performed within the firm, or to the activities not having been external for too long, and therefore the development capability still being available within the firm.

In situations of downsizing, externalisation and offshoring provide tools to support headcount reductions as well as to potentially reduce development costs. However, in such situations, it is difficult to reduce external development. As one manager put it: "Either I have to cut four engineers offshore, or cut one engineer at home." In practice, this reduces the flexibility of offshoring. Due to the cost differences, cutting down on offshore development does not save money – on the contrary, it increases cost. Yet, for strategic reasons, managers hesitate to cut internal resources.

From External Onshore to Internal Offshore. In addition to the identified transition paths, an additional path was identified in the interviews. In two cases of externalised product development, there were concerns both about the suitability of performing this particular development outside the walls of the company for strategic reasons and, at the same time, about the cost of the onshore external development operation. The firm therefore considered reinternalising and offshoring these development efforts, moving from external onshore to internal offshore development. This type of transition was expected to pose the same capability requirements as ordinary reinternalisation. This transition is not included in the typology as it is seen primarily as a corrective transition to compensate for previous suboptimal decisions rather than as a normal and recommended transition.

The cases are summarised in Table 1.

Case	Situation	Change	Operative Prod Dev Capabilities	Operative Management Capabilities	Dynamic Management Capabilities
1	ON	EXT	Exploit in firm and supplier; Transfer capabilities	Exploit joint routines and processes developed over time	Exploit experience of other transfers
2	INT	OFF	Exploit in both existing and new firm location	Exploit firm routines and processes	Exploit experience of other transfers
3		EXT& OFF	Exploit in firm and supplier	Exploit joint routines and processes developed over time	Exploit experience of other transfers
4	EXT	OFF	Exploit in firm or existing supplier as well as new supplier location	Exploit firm routines and processes	Exploit experience of other transfers
5	OFF	EXT	Exploit in firm or offshore subsidiary, and supplier; Transfer capabilities	Exploit joint routines and processes developed over time	Exploit experience of other transfers
6			Exploit in firm or existing supplier and new supplier		Exploit experience of other transfers
Reinternalisation			Exploit in firm, new location and supplier; Transfer capabilities		Exploit experience of other transfers

Table 1. Case Synthesis

Efficiency in Organisational Transitions

From the cases described above and summarised in Table 1, the role of capabilities in supporting efficiency in organisational transitions can be further elaborated.

Externalisation, onshore (1) as well as offshore (5), or concurrently with offshoring (3) (see Figure 3), requires the existence or creation of product development capabilities in the supplier of product development services.

In most cases, the selected supplier possesses general product development capabilities of the types relevant – otherwise this supplier would not have been chosen – but lacks specific capabilities related to the process used by the firm or related to the firm's product architecture. These capabilities must then be created with the support of resources from the firm. In cases where the externalisation is one in a series of externalisations, from the firm to this specific supplier, the supplier may already possess the requisite specific capabilities.

Externalisation is less efficient when the supplier lacks the requisite capabilities, as seen in the case of externalising hardware maintenance to a supplier with limited capability in this area.

Offshoring analogously requires that product development capabilities exist or be created in the offshore product development unit.

> *P1. All product development transition processes are more efficient if operational product development capabilities in both the source and the target organisations exist and can be exploited.*

When onshore (1) or offshore (5) externalisation is combined with divestiture and transfer of staff from the firm to the supplier, then capabilities are carried from the firm to the supplier by the staff transferred.

> *P2. The externalisation process is more efficient if operational product development capabilities are preserved, e.g. through the transfer of staff from the source firm to the supplier of product development services.*

Internal offshoring (2) transfers product development to an internal offshore unit of the firm, and benefits from the fact that many routines and procedures for management in general, and product and project management in particular, are shared between the source and the target organisations, due to both being part of the same corporation. Start-up inertia can be reduced and the establishment can be simplified through a common company culture and company routines, e.g. operational management capabilities.

External offshoring (4), if performed within one firm from an onshore to an offshore location, although external to the firm procuring product development services, can provide similar benefits as in the case of internal offshoring. By building on existing company infrastructure and a common company culture, risks and costs are reduced, and existing operational management capabilities can be leveraged. In some cases, strategic alliances between external onshore and external offshore suppliers of product development services may provide a similar level of shared routines and procedures.

> *P3. The offshoring process is more efficient if operational management capabilities are preserved, e.g. through retaining corporate and ownership structures.*

Concurrent externalisation and offshoring (3) provides a one-stop shop for external offshore sourcing of product development services. If this is the ultimate goal, it may be more efficient to go there directly. However, this direct approach does introduce all challenges at the same time, and thus requires more from both the firm and the supplier. If the firm and the supplier have an established relationship, joint experience and established routines for transferring product development tasks, then risks, costs and lead-times can be minimised. If both parties have previous experience and developed routines for such transfers, though not necessarily between each other, the transfer can still benefit from the dynamic management capabilities in both organisations. Both externalisation and offshoring display a set of challenges to both the delivering- and the receiving organisation. The procedure of addressing these challenges can be learned and incorporated into organisational change routines, i.e. dynamic management capabilities. If both parties have done so, then the direct and concurrent externalisation and offshoring route may prove most efficient.

> *P4. The externalisation and/or offshoring process is more efficient if dynamic management capabilities in the source firm and in the supplier of product development services exist and can be exploited.*

In all cases of external procurement of product development services, monitoring of efficiency, effectiveness and flexibility is important. By regular reassessment of the decision to procure the services externally, and even more importantly, to procure them from a specific supplier, the firm can ensure that it meets its requirements on this product development. Some firms do this evaluation regularly and jointly with the service supplier, thus ensuring that both parties share a common view of the degree to which the service supplier meets the agreed objectives. Should the monitoring and evaluation lead to unsatisfactory results, the firm can either move the task to another supplier (6) or reinternalise the task (reversing transitions 1-5).

Reinternalisation can vary in difficulty, depending on how much time has passed since it was last performed in-house, where the resources that performed the task prior to externalisation are, how much the task and the environment have changed, and the uniqueness of the task and competence required. Reversing the processes of externalisation and offshoring is not trivial. As the execution of tasks is removed from the firm, and replaced by merely ordering their execution, the depth of the knowledge of these tasks is reduced over time, gradually rendering reinternalisation more and more difficult. Even ordering the work in a professional way may become difficult.

If all specific operational product development capability has been lost from the firm, reinternalisation can be very difficult, or possibly even impossible. The reinternalisation process is more efficient if operational product development capabilities still exist in the source firm, thus supporting proposition P1 above.

Moving the task from one supplier to another one – re-sourcing (6) – implies that the existing supplier hands the task over to the new selected supplier. This reduces the burden on the original firm. However, in some cases, the motivation for the existing supplier to hand it over may be limited, possibly forcing the original firm to support the transfer with its own resources. This implies that even a transfer to a new supplier may be difficult for a firm who is no longer able to perform the task internally, for the same reasons that reinternalisation may not be an option.

> *P5. The re-sourcing process – the replacement of a supplier of product development services – is more efficient if operational product development capabilities and dynamic management capabilities in the source firm or in the current supplier, and in*

the new supplier of product development services, exist and can be exploited.

Capabilities for Efficiency in Organisational Transitions

The role of capabilities in supporting organisational transitions can thus be summarised as follows (see also Figure 4):

Operational product development capabilities (A) support efficiency in all transfers of product development. Efficient task transfer leverages the task capability of the source- as well as the target unit. Operational product development capabilities can be transferred with the task responsibility when externalising, re-internalising, and possibly also when re-sourcing.

Operational management capabilities (B), in the form of shared management procedures and routines between units within a firm for example, support efficiency in offshoring.

Dynamic product development capabilities (C) are critical for improving product development operations. In internal organising of product development, dynamic product development capabilities play a key role in continuously improving and keeping the operations competitive. The supplier needs to possess dynamic product development capabilities for the same reason. In external organising of product development, internal dynamic product development capabilities can be leveraged to help the supplier to improve its product development performance. However, dynamic product development capabilities do not play the same prominent role in creating efficiency in organisational transitions.

Dynamic management capabilities (D) per se deal with organisational dynamics, and play an instrumental role in supporting organising and all types of organisational transitions. Both firms that externalise and offshore, and suppliers that provide product development services, have the potential to learn from experiences and, over time, develop more efficient routines for managing product development transfers. In the case where one firm and one supplier have performed several transfers between them, the collective experience has the potential to develop into a shared, common dynamic capability, making further transfers even more efficient.

Preservation of Capabilities Supports Efficiency in …	**Task: Product Development**	**Management**
Operational	Externalization, Re-Internalization and Re-Sourcing Ⓐ	Offshoring Ⓑ
Dynamic	Ⓒ	Externalization, Offshoring and Re-Sourcing Ⓓ

Figure 4. Preservation of Capabilities that Support Organisational Dynamics

Summary and Conclusions

In this article, I have deployed a typology of modes of organising product development, based on the dichotomies of internal vs. external, and onshore vs. offshore. This typology is also used by Cronin (2004) and Rumyantseva (2005).

This typology of modes of organising is in line with other similar typologies (see e.g. Arnold 2000; Birkinshaw 2000; Sako 2003). It is however the first typology that focuses on location, both geographical and organisational, supporting the analysis of the dynamic processes of externalisation and offshoring. In their study of the ways in which multinational corporations serve various national markets, Buckley and Casson (1979) take a similar approach, separating the 'location effect' from the 'ownership effect'. The typology presented in this article can be combined with other contingency variables, such as modularisation (Sako 2003), internal organisation (Birkinshaw 2000) and task specificity, strategic importance, and contribution to competitive advantage (Arnold 2000). It can also be used for structuring existing research on the steady-state effects of externalisation and offshoring, as well as for further research in this area. In addition, it can, as in this article, form the basis for the study of dynamic effects.

Product development capabilities play an important role in sustaining and renewing the competitiveness of the firm. In the extant literature, the focus is primarily on the role of product development in renewing the product portfolio (e.g. Clark, Kim B.

& Fujimoto 1991; Wheelwright & Clark 1992), and secondarily on the role of product development as a vehicle for firm renewal (e.g. Bowen et al. 1994; Dougherty 1992). Shifting the focus from a static view of the organisation and its capabilities, to a dynamic structural view, this article aspires to illustrate a number of aspects of the role of capabilities in organisational transitions.

This article focuses on transitions between modes of organising. In the dynamic environment many firms face, and with the accompanying requests for flexibility and agility in organising (DeSanctis, Glass & Ensing 2002), efficiency in organisational transitions is critical, but has received little explicit attention in extant research. This article aims to make a contribution towards a dynamic organising framework or, as DeSanctis et al. propose, "an adaptive and progressive model of organising" product development. The only prior work in this area known to me is Sako's (2003) research on modularity and outsourcing, where she discusses the different paths from internal non-modular- to external modular product development. She thereby makes a groundbreaking contribution in highlighting the transitional paths. It can, however, be questioned whether some of the paths Sako identifies are realistic, e.g. the option of first externalising an integral product and later, when it is external, modularising it. Moreover, her article fails to distinguish between externalisation of development and externalisation of manufacturing.

With this typology, I propose six major organisational transitions: externalisation, offshoring, concurrent externalisation and offshoring, external offshoring, offshore externalisation and re-sourcing.

Operational product development capabilities are essential to successful product development, but their importance in supporting the transfer of task responsibility has not received adequate attention. When product development has been externalised, the ability to specify and order product development services may decrease with time, gradually rendering the firm unable even to procure that same development (Howells, James & Malik 2003). The findings in this paper are in line with Fine and Whitney's (1999) argument that externalising and managing external product development require the same competencies as those required to perform and manage product development internally.

Product development capabilities support all types of transitions between ways of organising product development. When combining externalization and divestiture, these capabilities can be transferred with development staff.

Management of external and offshore product development requires processes and routines that comply with the requirements of both the source firm and the supplier of product development services. In order to make the externalisation process efficient, the firms may choose – at least initially – to retain the existing management routines and procedures of the source firm, and simply transfer them across to the service supplier. When offshoring within the context of a corporation, company culture, processes and routines are often similar in both the onshore- and offshore locations, thus simplifying the transition.

The importance of routinised previous experience of the transition processes of externalisation and offshoring may seem trivial, but has not received adequate attention either. Compared to internal product development management of external and offshore product development requires additional and new or somewhat different management skills. Both source firms and suppliers of product development services can, over time, build routines and procedures that support efficient transfer of product development activities in- as well as out of the firm. These capabilities are dynamic management capabilities since they provide the ability to reorganise product development.

The proposed extension from a static to a dynamic, transactional perspective of product development organising calls for further research inquiring into how the type of development, as well as the relationship to other firm functions, e.g. manufacturing, affects these dynamics.

Tentative implications for management can be derived from the propositions presented in this article. However, the validity of the propositions in a broader context remains to be verified in future research.

Implications for Management

Externalisation and offshoring are tools available for finding efficient, effective and flexible modes of organising product development. These tools can enable firms to lower costs and to focus on their core competencies, capabilities and tasks. If used improperly, these tools can at the same time reduce the firm's product development capabilities for the future, and limit its strategic flexibility. Externalisation and offshoring are therefore tools that should be used with care.

When externalising, firms should consider the need to retain the staff and the existing product development capabilities. If possible, the externalisation process can be made more smooth and efficient by combining externalisation with a transfer of operational product development capabilities to the future supplier of product development services, e.g. through the transfer of some or all of the staff previously performing the development task being externalised.

When offshoring, firms should seek to retain operational management capabilities by retaining corporate and ownership structures as well as routines and procedures, thus making the transfer more smooth and efficient.

Through externalisation and offshoring, firms can develop dynamic management capabilities to reorganise product development. By continuously exploring and enhancing these capabilities based on the additional experience gained, and exploiting these capabilities in ongoing organising efforts, firms can increase the efficiency – as well as the effectiveness of the transitional processes.

Firms need not only to be efficient and effective in externalising and offshoring, but also to develop a flexibility to adapt to changes in the environment. Retaining the ability and option to replace a supplier or even to reinternalise product development is important. Therefore firms need to retain sufficient operational product development capabilities and dynamic management capabilities to support a transfer to another supplier or even 'back home' if necessary.

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EXTERNALIZING PRODUCT DEVELOPMENT FOR FLEXIBILITY: EXPERIENCES FROM THE TELECOM INDUSTRY

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ABSTRACT

Externalization can be used as a tool for restructuring, downsizing and focusing product development. In combination with divestiture of operations and creation of a contractual alliance with the externalized unit, externalization offers a way to manage downsizing of internal product development. The externalizing firm retains control over and access to the development capability, although the operation itself has been divested.

Externalization through divestiture and alliance creation creates flexibility. In this article, we analyze this type of externalization based on three cases from the telecommunications industry. An organizational preparation process is found to precede and prepare for the individual externalization processes. This process is found to be the primary enabler and creator of flexibility in both internal as well as external product development. Externalization of module development is found to leverage the results of the organizational preparatory phase, and contribute to structural flexibility. No such effect is seen for externalization of integration. A broad interorganizational interface, with many actors communicating, frequently, about various aspects of the interorganizational relationship, is found to contribute to all types of flexibility.

INTRODUCTION

Many technology-based companies have in the past, through various renewal programs, externalized non-core activities such as production and logistics. As a result of this, product development has become a more dominant part of the firm's activities and cost base, and now firms can no longer avoid including product development when considering restructuring and possibly downsizing in situations when the business environment changes significantly.

The importance of being able to adapt to changes in the market and in the environment is increasingly important. Organizing for flexibility, to enable such adaptation, is critical to being able to meet challenges as well as exploit market opportunities.

There is a need to understand how externalization of product development can contribute to the flexibility needed to adapt to changes and exploit opportunities in the marketplace.

Externalizing and Downsizing

Externalization of product development, i.e., replacing internal development with external development, can be driven by different objectives: exploration or exploitation, with a focus on innovation or efficiency. Externalization can be a way of accessing resources and knowledge not available inside the firm, or not available in requisite quantity. By contracting out product development, or replacing in-house development with procurement of modules, the firm is able to leverage resources and capabilities external to the firm and free up internal resources.

Externalization can also be used to downsize and reduce the cost of product development. External suppliers may be able to exploit economies of scale to reduce costs. By externalizing and divesting rather than closing a product development center, the firm can avoid redundancy costs, as well as eliminate yet continue to access and leverage the capabilities and resources of the former development center. In this article, we will focus on externalization driven by exploitation objectives that seek to increase efficiency and flexibility.

Between market and hierarchy: Alliance

Product development is in many ways seen as a critical capability and competence.[1] Product development is critical not only for the operations of the firm, but also for its renewal and capability development.[2] In order to gain the flexibility of external product development, yet retain control over and access to product development capability, firms increasingly choose hybrid forms of governance between market and hierarchy: networks or alliances.[3]

Product development capabilities encompass knowledge about both technology and product. Such capabilities are not traded on the market, and take time to develop. Firms seek methods to appropriate such capabilities. By combining externalization with divestiture and transfer of development staff to the acquirer of the product development unit, capabilities are transferred intact to the acquirer, and made available to the former employer, only now through a market mechanism rather than the employment contract mechanism.

The importance of retaining control may increase when externalization is combined with divestiture. The externalizing firm may become dependent on the supplier in order to continue to access the capability and to develop its products. At the same time, the supplier may in the short term become dependent on the continued sale of services to the former owner of the unit, at least until alternative and complementary business opportunities have been developed. For these reasons, some sort of hybrid relationship somewhere between market and hierarchy, e.g. an alliance, is often sought.

By creating an alliance with the acquirer, contractually stating mutual obligations of supplying and procuring product development services, the externalizing firm secures access to and supply of product development services, and the acquirer secures business volume for the unit at least for an initial period of time.

Scholars often assume, implicitly or explicitly, Tthat alliances are initiated between independent companies. [4] In the case of product development alliances created through divestiture and externalization, this is not the case. On the contrary, the alliance is created between two organizations with close ties from the start. It inherits business, historical and cultural ties as well as shared knowledge structures through the transfer of staff.

Product Modularity

Complex products are often divided into parts, called modules, to enable synergies and reuse, to allow decoupling, and thus distributed development and/or production, to enable specialization. The structural elements within a module are tightly coupled, whereas they are less tightly coupled to extra-modular elements.[5] Product modularity and structure are important enablers for externalization.[6]

Externalization of product development can be achieved in a number of different ways. Internal development can be replaced by procurement of components or subsystems (module procurement).[7] Entire products or systems can be procured externally (product procurement).[8] These components and products can be standard or firm-specific.[9] Standard modules are those used by several customers without further modification. Firm-specific modules are unique to or at least adapted to the specific requirements of the individual customer. The firm may contract out the development (contracting), possibly retaining specification and verification activities. This trend to externalize product development both contributes to and is made possible by the emerging markets for technology and product development services.[10] Procurement of all modules in a product, including the integration of modules, would be synonymous with withdrawing from product development, and possibly repositioning as a reseller of a system procured from a supplier.

Products can be modular in production or in design.[11] Modular production enables the firm to leverage specialized components procured externally as well as specialization of different production processes in different plants. Modularity in design supports design reuse as well as external procurement of components or design contracting. Modularity can also be extended to the market and to the customer. Market modularity,[12] where multiple firms and organizations provide complementary modules, enables each provider to focus on its own modules, and thus enables vertical as well as horizontal disintegration. Some firms may withdraw from module development and focus on systems integration and provisioning.[13]

Modularity in Organizing

A modular product structure supports distribution of the product development activities for different modules geographically or organizationally. Firms may choose to utilize a global network of product development centers, or to contract out product development of different modules to different subcontractors. A modular product structure requires well-defined *module interfaces*. If the interfaces cannot be clearly specified ahead of time, then development of architecture and modules must interact closely, and product development should therefore be centralized.

Product structure and organizational structure are interdependent.[14] Misfit between product structure and organizational structure can lead to an inability to compete. A modular organizational structure may be efficient in performing modular innovation, but may hamper architectural innovation.[15] A firm with an integrated organization and product that fails to identify and adapt to an emergent standardized and modular form, a dominant design, may be stuck in an integrality trap.[16] A firm with a modular organizational structure, lacking sufficient systems knowledge, that fails to identify or adapt to architectural change, may be stuck in a modularity trap.[17] As technology evolves, product architecture will in many cases cycle between integral and modular,[18] requiring firm organization to follow. The challenge for the firm is to avoid falling into the traps.

Interface

Externalization poses new challenges to organizational structure and to organizational interfaces within the firm as well as between the firm and its suppliers of product development services.

In this article, organizational interfaces will be classified based on the number and types of actors involved, as well as on the frequency and intensity in the communication. *Broad* interfaces are normally both wide and intense, meaning that many actors are involved and the communication is frequent and intense. *Narrow* interfaces, analogously, are narrow and non-intense, meaning that few actors are involved and communication is infrequent and non-intense.

Narrow informal interfaces may in some cases be very efficient, but may at the same time prevent externalization or at least make it very difficult. The ease or difficulty in transforming interfaces in order to support externalization may play a major role in decision-making on what should be kept internal and what should be externalized. Firms planning to externalize may begin by creating structures and interfaces in such a way as to create the option of externalization

Externalization of product development turns some previously intra-firm interfaces into inter-firm interfaces, possibly increasing the risk of falling into the modularity trap. On the other hand, the fact that existing product development is external may make it easier to replace this development effort with a new internal centralized effort better suited to addressing the challenge of architectural innovation.

The requirements on organizational- as well as module interfaces are related to the structure. In the case of design contracting, the requirements on the interface are to enable the externalizing firm not only to manage the relationship with the externalized unit, but also to enable an absorptive capacity[19] to be able to learn from the partner. A lack of absorptive capacity may increase the dependency of the externalizing firm on the divested unit.[20] Design contracting tends to put more focus on the organizational interface between the externalizing firm and the divested unit. Module procurement is to a larger extent built upon stable module interfaces, either standard or firm-specific, and therefore tends to reduce requirements on the organizational interface.

The ability to specify the module interfaces and the existence of a market for product development services are two important enablers for creating a flexibility option of switching suppliers for a specific module.

Flexibility

Flexibility increases the firm's ability to maneuver in situations with high uncertainty and low possibility for anticipating the future. Planning for flexibility has become an important ingredient in firm's strategies in turbulent environments.[21] The firm can achieve flexibility in organizing, in choice of technology, as well as in definition of product architecture.[22] The organization itself can become more agile by modifying its management and development processes. Product development can be based on flexible technologies, e.g. FPGAs and other programmable devices. By exploring a modular architecture, the firm can create flexibility for distributing product development geographically or externally as well as supporting supplier changes.

Volberda describes three types of *organizational flexibility*: operational, structural and strategic flexibility.[23] *Operational* *flexibility* consists of routines based on existing structures or goals, and relates primarily to the *volume of activities* rather than the kind of activities undertaken, and thus is sometimes also referred to as "volume flexibility". *Structural flexibility* is about adapting to changes in the environment, by *doing things differently*: introducing multifunctional teams, changing managerial roles, changing control systems, changing the supplier, or externalizing internal activities. *Strategic flexibility* is the ability to *do different things*, by changing strategies, applying new technologies, creating new product market combinations, or controlling and changing the market through market power.

Flexibility is a way of creating options for future decision-making. Flexibility can be seen as an investment, enabling the firm to adapt to and react to future changes in the environment. The more dynamic and volatile the environment, the greater the need for and the benefit from flexibility. Flexibility per se is not necessarily positive. Introducing a modular product structure with well-defined interfaces may result in a more expensive product to develop and manufacture. Requisite flexibility, enabling the firm to handle those situations that can occur in the future, is a valuable option. Therefore a major challenge for management is to assess which areas the firm needs flexibility in, how much flexibility, and at what price.

In this article, we inquire into the practice of concurrent divestiture and externalization of product development. In particular, we want to inquire into how divestiture and externalization of product development is implemented, and how flexibility is affected.

RESEARCH DESIGN AND METHODS

Cases of divestiture and externalization of product development in two firms in the telecom industry, during the years 2001 and 2002 when the industry was in a recessionary state, form the basis for this article. In both cases, externalization was used as a tool for downsizing and focusing on core business and capabilities. The focus of this article is both on the overall change process within the two firms and on three specific cases of externalization.

The article is based on the authors' personal experiences and participant observations, as well as interviews and studies of various internal as well as public documents. Both authors have decades of experience of product development organizing, and were employees of the respective firms while performing this study.

The cases studied were chosen to exploit the presence of the authors, as well as their networks and experience. The study was to a large extent concurrent with the unfolding of events in the divestiture and externalization. In order to understand the process, the authors retrospectively studied the events and processes leading up to the divestiture and externalization, as well as longitudinally followed critical events in the development of the alliances between the divesting and externalizing firm and the new supplier of product development services.

The authors conducted 66 interviews with managers at different levels and with different responsibilities and roles, within the two divesting and externalizing firms as well as at the divested units. Some informants were primarily involved in the divestitures; others were managers for the units divested; yet others were dependent on the results of the development work externalized. The interviews ranged from 40 to 120 minutes in duration and were recorded and transcribed. Some informants were interviewed multiple times, in one case twelve times, in order to follow the development of the alliances. Additional information was sought from internal- as well as public written material. The interviews and data collection took place during the years 2002 and 2003.

Prior to this study, each of the authors had an extensive existing network in- and knowledge of one of the two externalizing firms. This enabled extensive, broad and deep access to information and informants. In order to guarantee a critical review of tentative findings, both authors have reviewed and critically discussed the findings from the interviews performed by the other, and later also critically reviewed the results and interpretations with an independent researcher.

For the purpose of confidentiality, the names of the organizations studied have been changed.

EXTERNALIZATION IN TWO TELECOMMUNICATIONS FIRMS

TeleHard and TeleSoft are two multinational telecommunication firms. TeleHard is a leading supplier of telecommunication infrastructure products and services. TeleSoft is a regional telecommunications network operator. Both firms were hit hard by the almost recessionary situation in the telecommunications industry in the years following 2000, and reacted by downsizing and concentrating on their core business. During this period, product development was one of the areas subject to strategic and radical change. To begin with, both firms had more than 20 000 employees. TeleHard had a larger share of its operations distributed worldwide, whereas TeleSoft had the dominant part of its operations in its country of origin.

Three cases of product development externalization have been studied (see Figure 1). TeleComponent and TeleModule were module developers, whereas TeleIntegration integrated modules into a complete system. TeleComponent was a subsidiary of TeleHard. TeleModule and TeleIntegration were subsidiaries of TeleSoft. All three units have between 500 and 2000 employees.

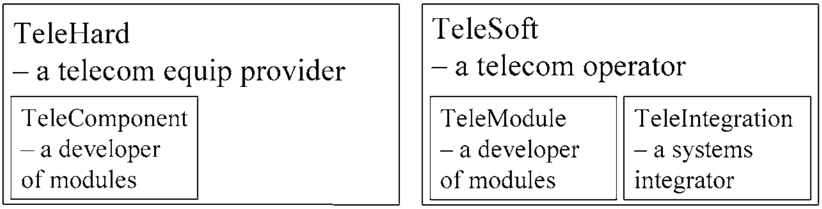

Figure 1. Three cases in two firms

TeleHard: Renewing product development – concentration and downsizing

TeleHard had extensive and geographically distributed product development. The products were modular in structure, supporting reuse as well as market adaptation. The modular structure also served the global geographical distribution of product development. The organization had evolved over time, resulting in many products and modules being developed in multiple locations, as well as many development sites working on many different products and modules. This resulted in a web of interdependencies between different product development units, all of which were necessary to develop a product.

Several years earlier, a strategy to make product development more efficient had been proposed. The strategy proposed fewer but larger product development sites that focused on one or a limited number of products or modules. Each product or module should be developed primarily in one location, with each location focusing primarily on one product or module. This concentration strategy was expected to create clear accountability in the product development organization. However, during the boom years of the telecom industry, the strategy was not implemented. The strategy was not implemented until the market turned down and the need for radical change became obvious throughout the organization. A new structure was established, starting with executive management, with organizational structures mapping the product structure, which supported clear lines of command and thereto related accountability.

Decisions on concentrating and downsizing internal product development were taken in a small group of executives who met each week in what was called the “Helsinki Meetings”. These meetings resulted in concentration of responsibility, alignment between product and organizational structure, closure of some units, externalization of some units, and volume reduction in some units.

By divesting and externalizing product development, TeleHard wanted to contribute to creating a market for design services related to the development of telecommunication products. The existence of such a market, and the contracting out of product development to such suppliers, was perceived as a way of creating a product development organization that could more easily scale up and down to adjust to changing market and business needs.

TeleComponent

Early on in the restructuring process, TeleComponent, a wholly owned subsidiary of TeleHard, was given the full responsibility for a certain class of telecommunications software, developing and supplying this software module for integration into the infrastructure products from TeleHard.

After a decision was taken in the Helsinki meetings to externalize TeleComponent, the task of managing the divestiture was given to a senior staff member. During negotiations with potential investors, there were little or no contacts between this dealmaker and the operational units. This later led to frustration and surprises for the operational units when they realized the structure and contents of the agreement, and of the volume purchase agreement in particular, in which TeleHard committed to buying certain volumes of services each month for several years. The contracted volumes exceeded the volumes that the operational units had planned to order from TeleComponent and had budgeted for. The operational units were also faced with the need to implement operational interfaces to the externalized unit as specified in the contract. Roles and responsibilities for the relationship with TeleComponent were assigned within TeleHard, and interfaces and meeting forums were defined.

The contract included a significant cash payment to TeleHard by the acquirer, which was an established northern European technical consultancy company. After the signing of the divestiture agreement, the locus of externalization activities shifted from the central staff functions out to the operational product development organization.

After the externalization was completed, there was an increased demand for the services from TeleComponent, over and above the volumes specified in the contract, and exceeding the capacity of TeleComponent. TeleHard was forced to both ask TeleComponent to subcontract to other suppliers, and to contract out some design directly to other suppliers.

A number of issues arose, including the task of managing daily ongoing business while at the same time trying to interpret the agreement and put mechanisms in place to manage accordingly. Some of these incidents were of a nature such that several actors began to have doubts about the correctness and value of the externalization.

TeleSoft externalization: focusing on core business

TeleSoft had for several years had an ambition to take an active role in the anticipated consolidation among telecom operators. To enable the option of additional financing, TeleSoft had to be seen as efficient and able to show that they were at least on par with the competition with respect to turnover per employee and similar key indicators. For these reasons, TeleSoft quickly and aggressively restructured and downsized operations, including product development, by externalizing all non-core activities. The divestiture strategy was to sell larger packages of units since this was assumed to be faster than selling unit by unit.

The first public signs of the plans to divest and externalize were that some activities, i.e. some subsidiaries, were organized into a separate business unit that became known internally as "Business Unit Miscellaneous". Two cases of divestiture and externalization from this unit are described here, TeleIntegration and TeleModule.

TeleIntegration

TeleIntegration was a wholly owned subsidiary of TeleSoft, serving as a systems integrator, integrating modules into the telecommunication network.

TeleIntegration was bundled with a handful of other subsidiaries, including TeleModule, into a holding company where a majority stake was sold to a venture capital company. The contracts governing the divestiture included a right and a commitment for TeleSoft to continue to procure product development services from TeleIntegration and TeleModule, but lacked any further elaboration about interfaces between TeleSoft and the divested units following the divestiture.

The intention was to contribute to the creation of a market for systems integration services, enabling TeleSoft to procure these services from multiple suppliers on the market and TeleIntegration to market these services to multiple customers. The downturn and emerging recession in the telecommunications industry seems to have made this very difficult though. Even two years after the divestiture, TeleSoft was still procuring a larger volume of services than contractually committed from TeleIntegration, although the volume had decreased slightly. TeleIntegration's sales to other new customers were dismal.

Immediately following the divestiture, both TeleSoft and TeleIntegration recognized a need for a more formalized relationship with specified dialogue arenas. For this reason, a more formalized alliance was developed later on between the two firms.

TeleModule

TeleModule was also a wholly owned subsidiary of TeleSoft, and developed new service modules and systems for administration and management of the telecom network. This could be described as a number of important modules in the telecommunications network.

TeleSoft had for several years concentrated their product development activities for these special modules to TeleModule but retained the responsibility and a limited development capability and absorptive capacity in-house. TeleSoft paid TeleModule based on the tariffs of what TeleSoft paid for contracting for product development of other modules from external firms. This established a virtual commercial relationship between TeleSoft and TeleModule even prior to the divestiture.

As described above, TeleModule was bundled with TeleIntegration and a handful of other subsidiaries and divested as a package. The divestiture contract did not specify the procedures for management of the relationship between TeleModule and TeleSoft, nor did it elaborate on communication and coordination. Operational-level contacts about specific projects and specific modules were plentiful between individuals in TeleSoft and TeleModule. At the corporate level, however, there were no formal contacts between TeleSoft and TeleModule.

At TeleModule, the divestiture was received positively, since the market was still strong, bureaucracy was perceived as being reduced by the divestiture and, for the foreseeable future, TeleModule was guaranteed a substantial portion of existing revenues from TeleSoft. During that time, the plan was to build a complementary new customer base. The decline in the IT- and telecom markets later drastically changed the possibilities of building that complementary customer base. TeleSoft ordered only the contractually committed amount of services, and at the now lower market prices, resulting in a severe financial crisis for TeleModule, resulting in significant downsizing. One division within TeleModule decided to close down their entire operation at one site. As a consequence, another division working with another module, which was strategically important to TeleSoft, closed down their activities at the same site. This took TeleSoft by surprise. There was no communication about the overall relationship between the two partners, and thus no communication about the effects of downsizing some parts of the business on other parts of the business. The situation, and the lack of strategic communication between the two firms, had created a structural inflexibility.

Immediately following the divestiture, TeleModule perceived that an improved strategic dialogue with TeleSoft would enable them to find win-win solutions. They were, however, unable to establish any strategic or corporate dialogue, since TeleSoft chose to keep communication distributed and limited to each individual assignment. Eventually TeleSoft did realize the effects - such as the site closure - of isolated communication without coordination, and initiated a group that could maintain a strategic dialogue with TeleModule to mutually address difficult situations and problems in the inter-organizational relationship.

THE EXTERNALIZATION THROUGH DIVESTITURE PROCESSES

Seeking to make sense of our three cases inside two firms, we started to inquire into the process that led up to the decision to divest and externalize the units. Only then, serendipitously, did it become clear to us how important the firm-level organizing process was in setting the context for the individual cases of divestiture and externalization. The firm's overall business strategy and organizing principles played an important role in the initiation as well as decision-making on externalization. Emergent organizational taken-for-granted routines and procedures were carried by a small number of actors in the respective firms.

The concentration and externalization strategy evolved within a small group of executives, and later emerged into the open, piece by piece. It gradually became known to the employees, was met by resistance as well as support, and evolved further based on the interactions and experience being developed. In order to make divestitures possible, a process of reorganizing the firm tended to precede the actual unit-level divestiture and formation of alliances (see Figure 2).

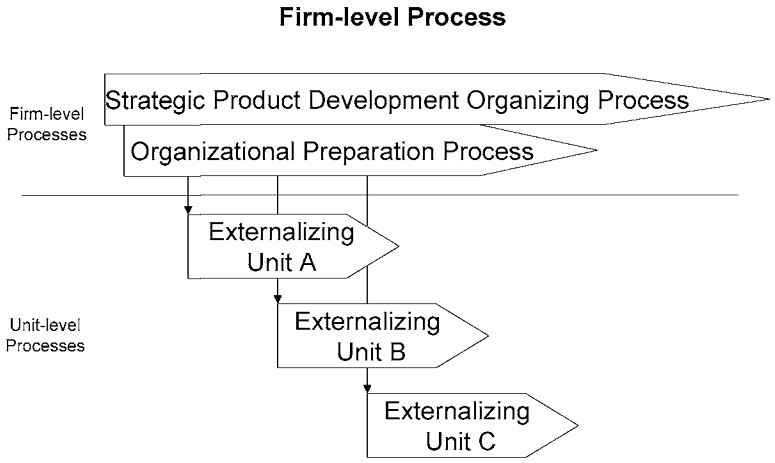
Firm-level Process
Firm-level Processes
Strategic Product Development Organizing Process
Organizational Preparation Process
Unit-level Processes
Externalizing Unit A
Externalizing Unit B
Externalizing Unit C

Figure 2. Two process levels in divestiture and externalization

Firm-level processes

In both TeleHard and TeleSoft, the product development strategy is developed as part of the overall firm-level strategy, and is clearly linked with other firm-level strategies such as product, market and technology strategies. Together with the current product development capability, the decisions on business and organizational structure form the framework for an organizational preparation process, as well as for the individual cases of externalizing product development units.

In TeleHard, the product development concentration strategy had been developed several years earlier, but only when hard times hit could it be implemented. In TeleSoft, the firm strategy was based around and driven by the need to downsize and streamline the organization to be better prepared for possible mergers and acquisitions. In both firms, this initiated firm-level processes, changing the size and scope of the firm. The strategy process and the organizational preparation processes run in parallel, the latter creating options for divestiture. When a decision is made to divest a unit, a new process takes over, and another set of actors become involved and focus on making the decided externalization and divestiture happen.

There are two process levels in divestiture and externalization: firm level and unit level. At the firm level, the strategy of the firm evolves, and initiates an organizational preparation process. Through this process, the organization is fitted to the task and product architecture. As a result of this fitting, the organization can either become more efficient internally, or can be packaged for externalization. The process in itself creates structural flexibility, and forms a basis for creating operational flexibility.

Unit-level processes

The externalization and divestiture process is initiated by the decision to externalize a unit. In order to make the process fast and smooth, units to be divested are bundled into packages. Often these packages later have to be modified, during the negotiations with prospective buyers. In all three cases studied here, the divestiture contracts include volume purchase agreements, detailing the commitments and rights of the externalizing firm to purchase a specified volume of product development services from the divested units. In the TeleHard case, the contract also elaborates on interface structure and establishment of dialogue arenas for coordination and management of the relationship.

The implementation of a product development alliance implies setting up, managing and reevaluating the relationship to the divested unit, now an external supplier rather than a part of the internal hierarchy (see Figure 3). Reevaluation can lead to re-commitment to the alliance, or to termination. If the alliance is terminated, the firm might seek another supplier of product development services, or may opt to re-internalize product development.

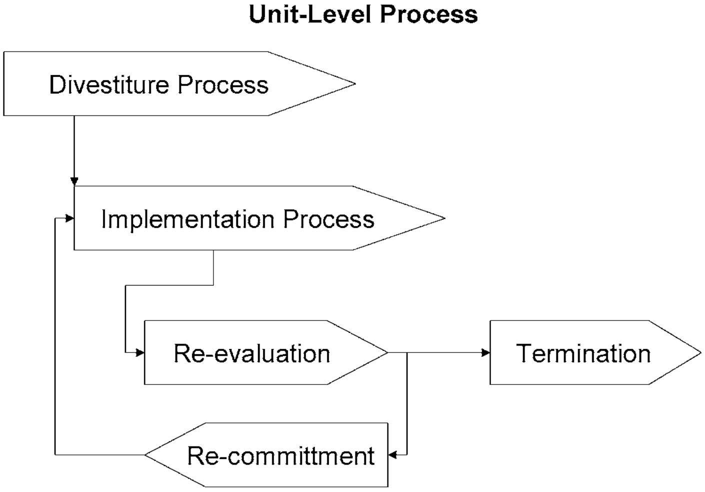

Figure 3. Unit-level processes

In the case of TeleComponent, both formal and informal reevaluations are done, leading to at least informal resolution of problems. In the TeleSoft cases (TeleModule and TeleIntegration), reevaluation is part of ad hoc meetings. The existence of more structure as well as dialogue forums in the case of TeleComponent supports joint problem solving, while the absence of pre-defined arenas impede joint problem solving in the cases of TeleModule and TeleIntegration.

For each externalization through divestiture case, there is first a divestiture process, followed by the implementation of the alliance with the former internal unit and new supplier of product development services. Reevaluation of this supplier relationship is a more or less continuous process, leading through renegotiations to recommitment to revised conditions or to possible termination of the alliance.

The strategic product development organizing process

Flexibility is one important objective for externalization. In TeleHard's strategic re-organizing of product development, the main drivers are efficiency and accountability. Units and geographical sites are as far as possible focused on development of one module or integration of one product; each module is allocated to one unit: and the integration of a particular product is allocated to one unit. Although justified by the strive for efficiency and accountability, this creates an option to increase structural flexibility by divesting units and future potential for switching to new suppliers. TeleHard also needs to be able to adapt product development to changes in demand with respect to volume and direction.

TeleSoft needs to downsize as well as be prepared to restructure the organization to re-align with another organization, in order to prepare for future consolidation in the industry. TeleSoft therefore needs both operational and structural flexibility. In addition to this, due to the turbulence in the industry and the difficulty in anticipating the future, calling for an ability to change direction in product development, they need structural flexibility.

The organizational preparation process

The organizational preparation process starts long before the individual decisions to divest and externalize different product development units, with a concentration of responsibilities and reduction of interdependencies between product development units. When the decision to divest is taken, the organizational preparation continues for the externalizing firm, both in order to accommodate the new situation with externalized product development and to support further structural changes.

In TeleModule, virtual commercial interfaces are created several years prior to divestiture. Module design activities are transferred from TeleSoft to TeleModule, but a significant absorptive capacity is still maintained at TeleSoft. There is a complex mapping between TeleModule's modules and organizations responsible for different products in TeleSoft. TeleIntegration's organizational structure is mapped more simply and directly to the structure of TeleSoft.

The divestiture process

In the divestiture process, the object to be divested is defined as a collection of units that are to be externalized. After deciding on what to include and what to exclude, the divesting firm identifies potential acquirers, attracts their interest, selects a candidate acquirer and initiates negotiations. This process defines the initial conditions for the relationship between the externalizing firm and the divested unit.

In all three of our cases, the divestiture contracts contain volume purchasing commitments. What to buy is less well specified than how much to buy. In the case of TeleHard, an elaborate post-divestiture interface is specified in the contract, creating arenas for strategic, structural as well as operational dialogue. In the cases of TeleModule and TeleIntegration, nothing is stipulated in the divestiture contract about the interface between the partners.

The implementation process

The implementation of the relationship with the divested unit is handled differently by TeleHard and TeleSoft.

In the case of TeleComponent, soon after the signing of the contract, the operational organization in TeleHard attempts to make sense of the contract and understand the explicit and implicit implications. Interfaces and dialogue arenas are established. Quite quickly, it becomes apparent that the contracted volume matches neither the capacity of TeleComponent nor the needs of TeleHard. The dialogue arenas provide a forum for resolving these problems and other potential sources of conflict.

TeleModule identifies a mismatch in structure as well as in the interface with TeleSoft, and therefore creates an internal divisional structure to better map its own business structure. The new structure did not, however, match the geographical distribution of TeleModule. The communication between TeleSoft and TeleModule is always about specific modules and therefore with specific divisions of TeleSoft and TeleModule. There is no communication about the overall relationship between the two firms, and thus no communication about the ripple effects of changes in one area on other areas and divisions, nor about long-term strategic development. The situation creates a structural inflexibility, and conflicts. This is eventually addressed through the creation of a dialogue forum to jointly discuss general issues between the partners.

The implementation process for TeleIntegration takes an entirely different path. The relationship between the TeleSoft telecom network unit and TeleIntegration integration activities was much closer than that with the module development at TeleModule. Despite the absence of an interface description in the contract, both partners soon identify a need for closer cooperation and a more elaborate alliance is established. One small unit within

TeleIntegration works with non-integration related activities. They have difficulty establishing relations with TeleSoft, resulting in low utilization and eventually the closure of that unit. The lack of a dialogue arena disables communication with TeleSoft about the value of these services.

THE EFFECTS ON FLEXIBILITY

In our analysis of the three cases of divestiture and externalization, in search of flexibility contingencies, we find that flexibility does in fact increase, but not directly and not primarily attributable to externalization. Flexibility increases primarily due to the concentration and organizational streamlining in the organizational preparation phase. To a large extent, it can be assumed that flexibility would have been achieved independently of externalization. The alignment between product structure and organizational structure enables and supports externalization, as well as many other potential restructuring methods.

From an external perspective, when observing the increase in flexibility, it is easy to somewhat incorrectly attribute this to the externalization. To understand the sources of flexibility correctly, it is necessary to go beyond the individual externalization cases, and observe and analyze the organizational preparation phase. How the externalization is implemented, with respect to establishment of interfaces, routines and procedures for managing the externalized product development, also has an impact on flexibility.

Strategic flexibility

Strategic flexibility, i.e. the ability to do other things by changing strategies, applying new technologies or creating new product market combinations, is not seen to change significantly as a result of externalization. One could argue that externalizing integration should decrease the strategic flexibility due to its interconnectedness to all modules, but this is not observed in this study. However, the strategic flexibility seems to increase as a result of the organizational preparation process. The reduction of interdependencies between different units and the creation of an organization that is more modular and more in line with the product architecture creates opportunities for developing new product and market combinations via new combinations of internal and external modules.

Structural flexibility

Structural flexibility, i.e. dealing with changes in the environment by doing things differently, increases as a result of the ability to externalize. In the cases of both TeleComponent and TeleModule, the externalizing firm introduces alternative suppliers.

In all three cases, structural flexibility is increased by the organizational preparation process. By concentrating most product development activities for each module to one site, and by introducing clear interfaces, the firm creates options for divestiture and externalization. This alignment between organizational structure and product architecture creates structural flexibility. As can be seen from the cases, the divestiture occurs along the lines of the existing organizational structure, using the existing structural flexibility rather than creating new structural options.

In the TeleModule case, the internal organizational structure is not modularized prior to divestiture and externalization. Creating internal modularity increases transaction costs, increases rigidity and reduces operational flexibility, while increasing structural flexibility.

Comparing the cases of TeleModule and TeleIntegration, externalization of module design contributes to increase structural flexibility, whereas externalization of integration does not.

Operational flexibility

Operational flexibility, i.e. the ability to increase and decrease volumes, also increases as a result of externalization, but with clear limitations. In both TeleModule and TeleComponent, small changes in volume can be accommodated. The dialogue arenas in the TeleComponent case seem to support the mutual adjustment, while the lack of dialogue forums may be an explanation for TeleSoft being surprised when TeleModule announces that a critical service will disappear as a result of downsizing. This incident also illustrates the need to align organizational and product structure in order to maintain and develop operational flexibility.

Externalization of product development can increase operational flexibility, primarily with respect to volume of activity. Compared to large established firms, suppliers of product development services can be expected to have developed more flexibility, through a larger focus on and therefore greater capability in resource reallocation and ramp-up and ramp-down of operations.

In both TeleModule and TeleIntegration, interfaces were observed to evolve over time, although from an initially unformalized and undeveloped situation. In TeleIntegration, the interfaces evolve rather rapidly, from initially narrow to gradually broader and more extensive. In TeleModule, interfaces remain narrow until the site closure incident, when vital TeleSoft services are hurt. Interface structure depends on perceived need, and can be developed quickly when needed.

In concluding, we compare the cases and the impact on flexibility from interface broadness and type of development (see Figure 4).

Initial Interface	*Type of Product Development*	
	Systems Integration	*Module Development*
Thick Interface	⇧	**TeleComponent** Structural flexibility increased Operational flexibility increased
Thin Interface	**TeleIntegration** Structural flexibility unchanged Operational flexibility increased	**TeleModule** Structural flexibility increased Operational flexibility increased to some limited extent

Figure 4. Interface and type of development impact on flexibility

CONCLUSIONS AND IMPLICATIONS

Externalization of product development, through divestiture with transfer of product development resources, and alliance formation, has been described based on three cases from the telecommunications industry. This type of externalization is a tool for organizational renewal and downsizing, yet offers the requisite control over resources still needed. Alliances created through divestiture and externalization differ in several ways from traditional alliances. This type of externalization enables capability retention through instant capability transfer with staff. Complete conceptualization of divestiture and externalization alliances warrants further research.

Searching for how externalization contributed to flexibility, we serendipitously found that firm-level strategic organizing processes enable, support, and form the basis for efficiency as well as flexibility. These organizational preparation processes change the organization, enabling a choice of higher internal efficiency or higher flexibility in external organizing. New interfaces and structures are created, supporting divestiture and externalization and creating flexibility. Aligning the organizational structure with the product architecture creates flexibility and supports efficiency and flexibility in both internal and external product development. In order to understand individual cases of externalization, the organizational context has to be known and understood.

In this study, externalization of product development related to development of product modules was seen to enable structural flexibility for the externalizing firm. The structural flexibility implies an ability to change suppliers if needed. Externalization of integration activities did not lead to an observable increase in structural flexibility.

A broad interface and a forum for dialogue between the externalizing firm and the divested unit were seen to increase the flexibility in all dimensions. Such an interface can help to resolve the operational issues, can reduce the risk for structural negative surprises and support joint strategy development to support a continuously evolving inter-organizational relationship.

This article attempts to contribute to understanding externalization of product development through divesting internal development operations, and in doing so proposes some tentative conclusions. Further research is required to examine the applicability of these results. Specifically, we propose comparisons with other industries such as the automotive industry, to identify commonalities and differences. Following externalization cases over a longer period of time would allow going beyond the identification of the generated flexibility options to actually seeing them exercised. Did they make good on their promises? Finally, this study was performed during a recessionary period of the telecom industry. What long-term effects did the downsizing and externalization have on the industry and the firms involved? Further research on the long-term effects is needed.

These findings have a number of implications for practical management of product development organizations. It is imperative to clarify where in the organization there is a need for structural flexibility, as well as why. Aligning the organization with the product architecture creates options for externalization and divestiture that may be exercised in the future, but also increases efficiency and flexibility in internal organizing.

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Models in action: how management models are interpreted in new product development

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This paper studies the *use* of product development management models. Through an interpretive research approach based on in-depth interviews with 22 middle managers in two product development organizations, five ways of conceiving projects, project management and the role of models are identified – administrative, organizing, sense giving, team building and engineering – all representing different perspectives on – and ways of using models. The findings question essentialist views of models, common in the literature, as either normative guides for action or symbolic tools decoupled from action. Instead, the study indicates a large variety in the use of models mediated by the user's conception of the situation and the model. The study highlights the communicative role of models as boundary objects, enabling coordination of and communication about different conceptions of the development task. Rather than contributing to behavioral standardization (an implicit assumption that underlies most formal models), this study suggests that models support cognitive standardization by providing a common set of concepts and a framework that may be drawn upon in making sense of complex product development projects.

1. Introduction

Over the past decades, rules, guidelines and procedures for managing product development have been increasingly packaged into formalized management models aimed at prescribing project execution (Cooper, 1994; Ulrich and Eppinger, 1995; Mulder, 1997; Beskow, 2000; Morris, 2001). In their simplest form, such models consist of a rough outline of the principal workflow during the product development process. However, more sophisticated versions constitute comprehensive management systems, including definitions of managerial roles, regulated procedures for budgeting, scheduling, decision-making, reporting, controlling and documentation, as well as different administrative techniques (Mulder, 1997; Eskeröd and Östergren, 2000).

In the normatively oriented literature presenting these models, their advantages are usually taken for granted. By enacting one common, formalized model, so that all projects have to pass through the same principal process from idea generation to product launch, an organization accomplishes more accurate project planning (Cooper, 1993), easier coordination (Karlson, 1994), shorter lead times (Mulder, 1997), more efficient knowledge transfer (Beskow, 2000), and more effective quality assurance (Ulrich and Eppinger, 1995). The models are seen as manifestations of best practice product development. Even though the detailed design and content of the models are sometimes disputed (Eisenhardt and Tabrizi, 1995), there is a broad consensus in this literature that adherence to a common model makes the product development process more efficient.

These taken-for-granted advantages of models are based on an assumed coherence between the procedures articulated in the formalized model and the practical actions actually performed by people engaged in projects. However, this assumption may be questioned; detailed studies of how people actually perform work tasks in other fields in which sequential, formal models are prevalent (e.g. systems development, management consulting) have demonstrated large discrepancies between the formal models and observed actions. For example, studies of the use of formal models for software development have repeatedly shown that the models are not rigidly followed (Leonard-Barton, 1987; Hardy et al., 1995; Fitzgerald, 1996, 1997, 1998; Sauer and Lau, 1997). In fact, several studies in the context of systems development even suggest that a rigid use of models may lead to less efficient development work (Hardy et al., 1995; Wastell, 1996). Instead, successful systems development is dependent on the project managers' experience of adapting the model to the specific problem in question (Stolterman, 1991; Fristedt, 1995; Hardy et al., 1995). Similar results have also been found for the use of formal models in management consulting (Werr, 1999).

The link between formal models and observed practice has also been questioned from a more critical perspective by scholars who suggest that models serve mainly as 'window dressing,' and thus have little to do with providing a common procedure for executing a technical task. Instead, it is claimed by these scholars that models have a primarily political function, creating legitimacy and attracting support to the project from its organizational environment (Sapolsky, 1972; Meyer and Rowan, 1977; Brunsson, 1980), or disciplining and controlling the workforce in times when traditional hierarchical/bureaucratic mechanisms may no longer be acceptable (Hodgson, 2002). The role of formal models as symbols of rationality and control has also been studied from a more socio-psychological understanding of managers' situation being expected to control a reality, which is highly complex and unpredictable (Huczynski, 1993). Formal models have, in this context, been emphasized as an important contribution to a manager's sense of control and thereby his/her self-esteem (Huczynski, 1993; Watson, 1994).

Consequently, there is reason to questions the central assumption made in the normative literature that formal models could and should be followed. At the same time, there is a lack of studies on the *use* of models in the specific context of new product development. In this paper, we approach the question of model use in product development from an interpretive perspective. We will analyze how a product development management model is used and conceptualized in product development practices, as well as how this conceptualization relates to the user's personal understanding of his/her work and context. By taking an interpretive approach, we acknowledge the different perspectives in the literature on the use of formal models as complementary. Rather than searching for the *one* way in which models are used, we focus on the users' different conceptions of these models and their contributions, thus allowing for a variety of model uses in practice.

The following section will introduce the interpretive perspective applied in this study. Thereafter, the methodology used is outlined, followed by the presentation of empirical data. Five conceptions of managing product development projects are identified, and the roles of models within each of these conceptions discussed. Finally, the observed use of models and implications of the interpretative perspective in research on product development are discussed.

2. An interpretive view of models in use

Understanding the roles of product development models in practice requires an understanding of human action and what encompasses competence in human action. Two approaches are often proposed in the literature: a rationalistic approach and an interpretive approach (see e.g. Sandberg, 2000).

The rationalistic approach is based on two significant assumptions (Schön, 1983). The first is a separation of knowledge from action, implying that the knowledge needed for competent action can be unambiguously established and stipulated by experts and then transferred to practitioners for implementation (Schön, 1983). Here, handbooks, directives, working models and methods are seen as important vehicles for documenting and transferring knowledge from experts to practitioners.

The second assumption is that of a separation of means from ends (cf. March and Simon, 1958), which implies that a specific situation can be unambiguously identified as a specific problem (end), requiring a specific solution by the application of a specific knowledge (means). This knowledge is often articulated in the form of a specific

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documented method, model or procedure. Thus, from a rationalistic perspective, competent action is about choosing and applying the right method to a specific, well-defined situation.

Although the rationalistic approach dominates among current approaches to competence in most organizations (see e.g. Easterby-Smith, 1997; Easterby-Smith et al., 1998; Empson, 2001, for a review), it has been criticized on the basis of detailed studies of actual work practice (see e.g. Schön, 1983; Brown and Duguid, 1991; Sandberg, 2000). Abstract models and methods, it is argued, may not be helpful to the practitioner when it comes to dealing with complex situations. As stated by Brown and Duguid (1991), 'as a journey becomes more complex, the map increasingly conceals what is actually needed to make the journey' (p. 42). Schön (1983) further questions the possibility of unambiguously identifying a certain problem as representing a specific category of problems to be solved by a specific method. Rather, he argues that most real-life situations are 'confusing messes.' These messes have to be understood and the problem to be solved has to be defined (or 'set') according to the practitioner's personal, tacit experience, rather than according to any abstract, articulated expert knowledge (see also Polanyi, 1962, 1967).

An alternative to the rationalistic approach is the interpretive approach, which builds on different ontological and epistemological bases. The interpretive approach questions the dualistic ontology assumption of a distinct separation of person and world, and the objectivistic epistemology assumption of the existence of a reality beyond the human mind. Instead, it is assumed that person and world are intimately related through a person's lived experiences (Berger and Luckman, 1966; Marton, 1981; Richardson, 1999). According to Sandberg (2000: 11), this implies that the worker and his/her work 'form one entity through the lived experience of work.' Competence is thus viewed as being constituted by 'the meaning the work takes on for the worker in his or her experience of it.' Studies of competence based on an interpretive approach have highlighted the situated and tacit character of skillful action. An architect, for instance, does not just solve stipulated problems. On the contrary, a significant part of his or her competence involves interpreting the situation and, based on experience, framing and setting the problem to be solved (Schön, 1983). Similarly, Blomberg (2004) shows how stockbrokers experience their work in very different ways and thus act and relate to formal knowledge in different ways. In the same vane, Dubinskas (1993) identifies two ways of making sense of a complex engineering project among representatives of two collaborating companies, where the two different conceptions of the project led to very different actions and caused different problems.

The interpretive perspective thus highlights the importance of how the skillful practitioner conceives his work as a key aspect of skillful action. In the following, we thus seek an understanding of the use of development models in the practitioners' lived experience of product development practices. The empirical section focuses on identifying and describing patterns in how engineers conceive their work in product development projects, as well as how they conceive the formal models meant to guide their actions.

3. Method

Given the explorative aim of this study, it uses an inductive research approach. Through qualitative interviews with model users, the study addresses the use of one of the most well known and sophisticated models for project management in product development.

3.1. *Empirical setting*

The study was conducted in two product development units of a large telecom manufacturer. The two units specialized in different technical areas, but had significant similarities nevertheless (see Table 1).

3.2. *The models in use*

Both development units had embraced the same project management model for product development, supported and complemented by numerous other administrative and technical tools and techniques. This was a typical example of a sophisticated development model and constituted a comprehensive management system. As far as development models go, it was considered state of the art in Europe at the time. Originally developed in the late 1980s for the management of large and complex development projects in the company, at the time of the study, the model was in general use for different kinds of projects in a variety of industries. It was securely anchored in the units studied, well known and widely spread

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Table 1. Summary of the two development units studied

	Development unit 1	Development unit 2
Task	Development of processor platform for telecom products	Development of radio base station platform
Size of unit	330 employees	400 employees
Organization	Matrix: project functional	Matrix: project functional
Size of projects	250 300 employees 50–100 MUSD	100 300 employees 10–100 MUSD
Technology	Software and hardware, mostly digital	Software and hardware, digital and analog
Primary management focus	Performance	Cost

among the staff. It was promoted by corporate management and manifested in handbooks, in print as well as Internet-based documentation, training programs, seminars, conferences and professional networks.

The model depicted a new product development project as starting with an idea, passing through a sequence of five phases, and resulting in a complete product to be launched onto the market. The project workflow was described as a linear, stage-gate process (Cooper, 1993), subdivided into a predetermined set of sequential phases (stages), with stipulated formal managerial decisions as boundaries (gates). Each stage consisted of a set of prescribed, multifunctional, and parallel activities. At each gate, a set of deliverables was specified as criteria to be met before proceeding to the next stage. Prior to starting the next phase, the project progress and the plan forward was typically reviewed by a committee of senior managers (for further description of stage-gate models, see Cooper, 1993; Mulder, 1997).

3.3. Data collection and analysis

The fieldwork was conducted using an insider/outsider approach (Bartunek and Louis, 1996). Two researchers, part-time employees in different units of the telecom manufacturer, conducted interviews in units other than those where they normally worked. An external researcher was used to gain an outsider perspective. In total, 22 semi-structured interviews with project and functional managers at the middle management level were conducted. The interviewees worked in various roles managing new product development in the two units. The projects were of a technical nature and the interviewees predominately had an engineering backgrounds. The interviews lasted 1 2 h and were taped and transcribed. The interviewees described the management models used in their work, their purpose, and the benefits they attributed to them. They also described possible shortcomings of the models, as well as any additional tools used to guide them through the product development process.

The analysis of the interviews was inspired by a phenomenographic method (Marton, 1981, 1986; Sandberg, 1994, 2000). The main aim of the analysis was to understand the life world, i.e. the lived experience, of the interviewees, and to identify similarities and differences in lived experiences of project management and method use. In a first step of the analysis, each interview was read through with a focus on the interviewee's conception of the task of managing product development projects. Attention was given to how they described the task as well as what aspects of the task they emphasized. Based on these readings, clusters of interviewees expressing similar conceptions emerged. Unlike in many content-analysis approaches, in identifying these clusters, the focus was not on single statements but rather on combinations of statements and the way in which they related to other statements in the interview. During this interpretive process, the classification of individual interviewees was repeatedly questioned and discussed by the researchers. Although each interview was used to contribute to one conception only, this does not mean that each interviewee holds only one conception, or that one conception completely describes an individual's perception of models in product development. The identified conceptions should rather be seen as qualitatively different categories – ideal types – of understanding management models in product development. In practice, individuals often combine these different perspectives in various ways.

In order to verify the classifications, in a second step of the analysis, the interviews were again compared with the other interviews in their respective clusters and to those of other clusters. In

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this process, a small number of interviews were reclassified to another cluster and some of the clusters from the first round of analysis were merged. Through this step, the number of clusters stabilized at five. The third step involved reading through the interviews in these clusters once again, focusing now on how the models were conceived – how they were described, the roles they were attributed, and their conceived contributions and limitations. Finally, a detailed description of the five clusters, in terms of conceptions of product development, the management of product development and the role of models in this context, was produced. Strongly condensed versions of these conceptions are presented below. The cluster descriptions and the classification of interviewees into clusters were fed back to the interviewees and accepted as reasonable descriptions.

We acknowledge that researcher bias could have an influence on the conceptions identified through this process. Here, the three authors had different backgrounds and different preconceptions of product development: one through a long career in practical management of product development, one as a researcher on project management, and one as a researcher on management consulting. The different backgrounds, combined with an awareness of the risk for bias and testing the validity of the identified conceptions with practitioners and scholars not engaged in the study, represent an attempt to limit bias as much as possible (Sandberg, 2005). As in all qualitative research, however, the concepts and categories presented should be seen as plausible but tentative: in need of further development, refinement and augmentation in future research.

4. Conceptions of model use

Formal development models were an important aspect of project managers' reality in the two units studied. The interviewees claimed to have a good understanding of the models, and had access to web pages on the company intranet where guidelines, checklists and techniques of the model were provided. Most of them had also participated in company training programs explaining the content of the model in detail. Most interviewees described the product development model as deeply ingrained in their way of working. Consequently, the model was very much a taken-for-granted feature of the everyday life of project managers in the two product development groups. Concepts and terminology originating from the model were frequently used at meetings, in administrative documents, and in technical communication.

4.1. Shared conceptions

Analysis of the interviews indicated the existence of four aspects of model use that were shared among the interviewees. The first was that everybody agreed that structured development models in general could contribute to the management of new product development. As one interviewee put it: '[models] are very important. I definitely think they are one reason for the firm's success.' Even though some interviewees criticized the design of the specific model in use as being too bureaucratic, there was a strong consensus that formalized development models are important for successful product development.

Secondly, however, the above did not mean that models were seen as guides for action to be followed in detail. Rather, all interviewees emphasized that the use of formal models should be pragmatic, i.e. adapted to the needs of each specific situation. None of the interviewees claimed complete adherence to the model in all its details. On the contrary, even the interviewees with the most formalized approach to product development emphasized that the model had to be applied with common sense. Several of the interviewees also pointed out the risks of a fundamentalist approach to models: 'The risk is that you do what the model tells you, instead of thinking for yourself.'

Thirdly, the advocated pragmatic use of models was manifested in models being deeply ingrained in everyday action. Different individuals applied central concepts of the model in different ways, and the interviewees did not see, or seem to care about, the distinctions between the development model and the company's other administrative guidelines. During the interviews, interviewees frequently attributed features (e.g. specific procedures) to the model that could not be found in the formal documents describing it. However, most interviewees did not conceive this conceptual fuzziness as a problem. In order to execute their tasks, they used the tools they had available.

And finally, all of the interviewees agreed on one aspect of the common development model – the fact that it provided a common language. That is, it was commonly agreed that the creation of a shared terminology and framework for product development within the organizations was one of the basic contributions of the model. As all simultaneous and successive projects in the organizations were described within the same conceptual framework of phases, decision-making, understanding of roles and routines, communication was facilitated. The model's common framework and language also supported the creation of a common focus for all of the engineers engaged in the usually large and complex projects of the two organizations.

4.2. Five conceptions of project management and the usefulness of models

Beyond these generally shared views on models, the interviewees in our study expressed numerous differences in their views of models and how they contributed to or hindered their work as managers in product development. The communication feature is a typical example. Even if all agreed that the model facilitated effective communication, the described content and purpose of this communication varied distinctively between the interviewees. Some appreciated the model for enabling formal communication in terms of schedules, reviews and progress reports, as exemplified by the following quotes: 'Models provide us a shared way of planning and monitoring the project.' 'Models provide us a standardized way of measuring progress, milestones and toll-gates.' Others saw the model primarily as something that enabled informal communication, related to team processes and organizational issues, during project execution: 'Models create a common way of working, communicating and making sense of the situation.' 'Models provide us with a common language.'

These differences in conceptions of formal models were related to fundamental differences in how the interviewees viewed the nature of project management and the project manager's role. In spite of applying the same formal development model, being employees of the same company, being engaged in relatively similar kinds of projects, and having been trained at the same project management courses, the interviewees expressed fundamentally different conceptions of the task of project management in product development. Five different conceptions of the nature of project management and the role of models in product development were identified among the interviewees. These conceptions were labeled (1) administrating, (2) organizing, (3) sense giving, (4) team building, and (5) engineering. They are summarized in Table 2 and will be outlined in greater detail below.

4.2.1. Conception 1: administrating

> 'We need models to ensure that we work in the same way.'
> 'The best part of the model is the document templates.'

Table 2. Five conceptions of projects, project management and formal models in product development

	Administrating	Organizing	Sense giving	Team building	Engineering
Conception of projects	A set of well-defined activities to be planned and coordinated	A set of competencies that explore a mission	A complex and confusing web of activities and relations	A group of interacting individuals (human beings)	A set of technical challenges
Conception of project management	Plan and monitor formal project progress	Facilitate and lead the enactment of the project mission	Make and communicate sense of a confusing world	Manage the individual- and social well-being of project members	Solve technical problems
Conception of models	Procedures and documents that standardize projects and make it possible to control them	A common language that facilitates collective action; Documented best practice that frees energy for exploration	A common language for making sense of 'chaos'	Documented best practice that provides focus and prevents energy drain; A common language that enables communication	Documented best practice that supports work efficiency; An administrative burden

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Quotes like the above, identifying models as a common framework standardizing the work in projects and providing templates and guidelines for action were recurring in the group of interviewees that shared an 'administrating' conception of the management of product development projects. A central point in this conception was the view of projects as a set of rather well-defined activities to be planned and managed largely through written directives and reports. Development models were seen as supportive in providing structure and a timeline for the project as well as providing a means for following up progress.

Interviewees who shared an administrating conception of project management saw their role as implementing a rather well-defined assignment within budget and on time. They emphasized planning, monitoring and managing the project by written documents, which were presented both inside and outside the organization. As one interviewed project manager described it: 'It is quite clear how you should work [as a project manager]. There are document plans, describing the things that should be available at different decision points . . .'

In the case of the administrating conception, reports specified by the development model were a central element of product development practice: 'All project [managers] write a monthly report. The project office manager then consolidates them into one report. I then write my report to my manager based on this consolidated report.' Thus, in this context, the models enabled control by supporting project structuring and providing uniformity and familiarity, as one of the interviewees clearly articulated it: 'Models make projects more uniform.'

4.2.2. Conception 2: organizing

> 'You start by building a project organization. Then you work to find out exactly what to do.'

While interviewees representing an administrating conception viewed the task of product development as a rather well-defined one, interviewees representing an 'organizing' conception saw projects as continuously emerging out of a mission to be accomplished. For them, project management was about continuously organizing the project to meet unforeseen challenges. In this context, models were viewed as tools that supported organizing, communication and action, and as a point of departure from which to deviate as the challenges of a specific project so demanded. One of the interviewees commented that '[models] provide us with a common language. Repetitive tasks are done in the same way all the time. We don't have to reinvent the wheel.' Models thus supported the management of standard issues, freeing cognitive capacity to solve non-standard problems. In this problem solving, models were viewed as important in providing a common language that enabled communication between different actors and different groups. Models were seen as supporting effective cooperation and communication between projects and the line organization, and as enabling actors to establish and discuss a shared view of projects, their plans, deliverables and status.

Interviewees who concentrated on organizing rather than administrating placed more focus on action, talk and organizing in order to explore the project development task, and less on formal documentation and requirements. 'As a project manager, what you call an activity isn't so important. You just do it,' one manager explained. The project managers who shared an organizing conception viewed projects as something to be done, as a way of organizing in order to understand what to do, and then do it. According to this conception, a project manager should actively organize and acquire resources for his/her project. Models could be a point of departure for planning and action, but were secondary to the specific challenges of reality: 'It is good to have instructions, but not always be forced to abide by them.'

4.2.3. Conception 3: sense giving

> 'Models structure chaos. We need a shared understanding, a common philosophy.'
> '[Models] create a common way of working, of communicating, and of understanding where we are. . . . [Models] define what things are.'

The central task for interviewees representing a 'sense giving' conception was that of creating and communicating a shared understanding of the project and its role in its context. Against a conception of engineering as a highly complex and 'chaotic' practice, the main task of the project manager was seen to be the creation of a shared understanding of the project and its environment. 'I see my mission [as a project manager] to try to show the bigger picture' as one of the interviewees described her role. As another interviewee depicted it: 'it is the role of the . . . project manager to tell us how it all fits together.' The sense giving project manager thus viewed his/her role as

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providing project members with a vision of the project, its role and meaning, within which they could act.

In this context, models were conceived as supportive in that they provided a common work practice and enabled communication about work practices. Models thereby created the foundation for creating a shared understanding of both the individual project and its context with respect to other projects, suppliers and customers. Models provided a common language and framework upon which an understanding of the project in its environment could be created and communicated. This role of the model included both providing an overarching philosophy of how to conceive of product development projects and a concrete toolbox that could support day-to-day work.

In their continuous effort to relate a project to its environment, the sense giving interviewees emphasized the importance of staying up-to-date on the development, not only in his/her own project but also within the environment. This required substantial communication supported by 'a common view, a shared philosophy,' provided in part by the shared model.

4.2.4. Conception 4: team building. For the interviewees representing a 'team building' conception, the creation and maintenance of an effective product development team was conceived as the central task. For them, project management was as much about managing human motivation and interaction as about technical planning and problem solving. In this endeavor, models were conceived as of limited immediate help. The following quote from one of the interviewees was typical:

> '[Models] do not give me any support for how I, as a project manager, should handle people and situations, which is the most important part of my role as a project manager. A much more important question is how a human being feels, than whether he has finished writing a document. If you help people, enable them to do their job, then the documents get done and a sense of completeness [is created] as well.'

Although models were conceived as giving limited direct support to managing the human aspects of product development projects, they were conceived as helpful on a secondary level, by supporting the creation of a positive work situation. By providing a framework and a roadmap, models helped the project team to focus on the most important and necessary tasks and documents at any given time, and thereby avoided unnecessary work and stress. Models were seen as providing a basic structure, which enabled the reuse of earlier experience:

> '[Models] prevent fuzz. It is simpler [with models]. Just creating a simple plan what steps do we need, when do we need different information, which information needs to be synchronized and such things. Just to make it more efficient.'

Models were also seen as enabling communication within the project team as well as with external stakeholders and other projects. As in the sense giving conception, the management of the project's relation to its environment was an important task for the team building manager in order to protect his team from disruptive and demotivating influences from the environment. The common model within the development organization was here again seen as an important enabler of communication across project boundaries.

4.2.5. Conception 5: engineering. A fifth and final group of interviewees conceived of their task mainly as one of coordinating and supporting technical problem solving. These actors saw product development projects as manifestations of a product concept. They applied an operationally centered logic in designing and controlling actions. 'It is [the technical] reality that is in control, quite simply,' as one of the interviewees described the management of product development projects.

The 'engineering' project managers viewed the organization and planning of projects as subordinate to the technical structures and the technical reality. The product and the technical vision should, according to this group, be the guiding principle, for organizing projects as well as designing models and work procedures. As one manager put it: 'I think that you should focus on products and delivering products to customers. And define projects based on this.'

While these interviewees were generally sympathetic to the phenomenon of common models as a way of formulating and disseminating 'best practice,' they were skeptical towards the specific development models in use, as they were viewed as inaccurate descriptions of development practice: '... we have a model. But it describes a waterfall model that we can seldom follow fully.' Consequently, models for the engineering man-

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agers were often conceived of as an administrative burden rather than a support. Development was described as happening despite models rather than thanks to them. Models were thus viewed as supportive only if they truly reflected the way technical development work was actually performed. The interviewees focused on technology and expected models to provide a common language and standardized work procedures. In many cases, however, interviewees felt that the models were too far from their product development reality.

5. Discussion

This inquiry offers a multifaceted and complex picture of the roles of formal management models in product development projects. Most current literature emphasizes the model's content and design, and treats its usage as unproblematic. The model is assumed to constitute an articulated best practice that provides an efficient structure of prescribed activities for product development work (cf. Ulrich and Eppinger, 1995; Mulder, 1997; Adler, 1999; Beskow, 2000). However, this study challenges that view. Even with its limited empirical basis, it indicates that different aspects of the model will be acknowledged, and will furthermore be put into use in different ways, depending on a specific individual's conception of product development.

This in turn challenges the traditionally assumed rather direct link between the formalized model and product development practice underlying most formalized models. The study suggests an important mediating variable in terms of the user's conception of the product development task. Depending on this conception, the model will be enacted in very different ways. The pragmatic use of models pointed out in the literature (Fitzgerald, 1997, 1998; Orlikowski, 1988) thus receives a new meaning. Whereas existing discussions of a pragmatic use of models have highlighted the adaptation of the model to a specific situation (where users use the parts of the model that fit the specific situation), this study suggests that the model user's conception of the development task may be another important variable for understanding the enactment of a general model in a specific situation. This suggests that models are not only enacted to fit a specific situation but also on the basis of the model user's conception of the development task.

In the following, three aspects of our findings will be discussed: how the identified conceptions relate to previous research; the implications of management models on product development practice; and suggested areas for further research.

5.1. The conceptions in perspective

The five conceptions identified in this study (i.e. administrating, organizing, sense giving, team building, and engineering) were generated strictly from the empirical data of the interviews. However, in following with the applied methodology, we view these conceptions as rather general 'forms of thought' that should have meaning beyond the local setting of the studied organizations (Marton, 1981, p. 180). Thus, we include a brief discussion of them in relation to more general discussions of approaches and perspectives on product development and project management.

In most of the literature, technical development is viewed as a linear, rational, one-way process from identified need to product launch on the market (Kline and Rosenberg, 1986). This view is also well represented in our interviews as the administrative conception. However, considering the rational focus in a great number of the textbooks, it is not as dominant as may be expected. Instead, our study identifies a number of different ways of understanding product development.

Dubinskas (1993) has contrasted the mainstream, rationalistic notion of product development management (which he calls the 'funnel model') against what he labels a 'fermentation vat model,' which emphasizes the building of new knowledge as the object being developed emerges during project execution. With its focus on continuous idea generation, tolerance for ambiguity, and emergent specification of details during the process, this model entails important aspects of the identified organizing and sense giving conceptions.

Based on a review of the product development literature, Brown and Eisenhardt (1995) construct a categorization of product development perspectives that partly overlap this. Rather than two perspectives, however, they suggest three: 'rational plan,' 'communication web,' and 'disciplined problem solving.' The three perspectives, which represent major streams in the literature, resonate rather well with the conceptions identified above, although the conceptions presented here are more fine grained. The administrative conception identified in our study shows a resem-

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blance to Brown and Eisenhardt's 'rational plan' perspective, our sense giving and team building – to their 'communication web' perspective, and our organizing and engineering conceptions – to their 'disciplined problem solving' perspective. Some overlap between academic approaches to product development and practitioners' interpretation of their organizational and professional practice is thus indicated.

Several of the current conceptions, most notably organizing, sense giving, and team building, however, neither fit entirely with Dubinskas (1993) nor with Brown and Eisenhardt's (1995) categorizations. As they put a strong emphasis on the significance of sociological and psychological factors in their understanding of projects and project management, the organizing, sense giving, and team building conceptions go beyond most product development literature. They do, however, resonate well with modern leadership approaches emphasizing participative and relationship-oriented aspects of work (Yukl, 2002).

Although alluded to in the 'disciplined problem solving' perspective, the engineering conception also appears to be less well represented in the traditional literature on product development. In order to find similar views, we must turn to descriptive studies of skills and knowledge formation on the level of the individual engineer (Schön, 1983). The engineering conception aligns well with observations made, by Zuissman (1985) or Whalley (1986) for example, that professional engineers tend to claim that formal, certified, and theoretical knowledge play only a limited role in the day-to-day performance of their tasks. Instead, professional engineers emphasize practical knowledge and learning by doing, based on the experiences of 'tinkering' with the intended product (Karlson, 1994; Bragd, 2002).

Our findings may also be discussed in relation to Dougherty's (1992) study of different thought worlds in product development, i.e. in her terms 'technical people,' 'field people,' 'manufacturing people,' and 'planning people.' Our study addresses what Dougherty calls the 'technical people.' However, rather than finding a homogeneous conception among these people, we found considerable variation. This may indicate a need for being more attentive to variations in conceptions, even among individuals within groups perceived as rather homogeneous in terms of their work roles.

Finally, a note on the status of the conceptions is warranted. The literature on teams and leadership often identifies different roles or styles, and argues for a contingency approach to the composition of teams (e.g. Belbin, 1993) or application of leadership styles (Hersey, 1984). The five conceptions identified above, however, are neither roles nor styles, but rather constitute general patterns of thought that individuals may draw from in constructing their perception of the product development reality (Marton, 1981).

5.2. Models, conceptions and normative control

Based on the above study, we may also question the assumption made in much of the literature, that the key contribution of models is behavioral standardization, i.e. standardization of development activities (Cooper, 1994; Ulrich and Eppinger, 1995; Eskeröd and Östergren, 2000). This study, however emphasizes the importance of a more cognitive standardization (cf. Hodgson, 2002). The main contribution of models emphasized across conceptions (although for different reasons) was that of a common language and framework, enabling communication both within and between projects. Models were important not so much as guides for action, but rather as providers of a common framework and a set of concepts that enable communication about project progress (administrating), project meaning (sense giving), etc. Consequently, the development models studied can be understood as 'boundary objects' (Starr and Griesemer, 1989; Bowker and Starr, 1999), enabling coordination between individuals with different conceptions of the product development task. The models thus supported communication between different actors, although they interpreted and used it differently. The models provided a basic structure for the projects (focus, common language, etc.), but also some room for improvising within this structure (Brown and Duguid, 1998).

The overall concepts and general logic of the model thus served primarily as building blocks in creating a shared reality among team members of each and every project (cf. Räisänen and Linde, 2004). While many scholars have disputed whether a formal model functions as a codified best practice that creates efficiency (cf. Ulrich and Eppinger, 1995; Beskow, 2000), or merely as a rhetorical tool that creates legitimacy (Sapolsky, 1972; Brunsson, 1980), our findings suggest the importance of a common model *per se*, regardless of whether it represents best practice or not. As product development projects are to a large extent

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collective and temporary undertakings, routines and roles that are standardized and shared among the personnel make actions predictable (Brunsson and Jacobsson, 1998). Formal development models thus become a vehicle that facilitates the joint formulation of collective procedures for action. By providing a common terminology for participants in a specific project, as well as across different simultaneous and successive projects, the model was instrumental in supporting collective sense making processes with respect to the project assignment and its environment.

Scholars using a more critical approach have argued that the reality created on the basis of normative project management models is one of oppression and management control – a reality constructed by stages, gate decisions, specifications, templates, milestones, schedules, and stipulated deadlines that discipline the participants to act within a specific sphere in time and space (Hodgson, 2002). Consequently, models enable actions and communication patterns, in line with prescribed behaviors and underlying norms, while at the same time restricting action and communications that violate these norms. Hence, formal development models have been argued to be effective instruments in gaining managerial control in a post-bureaucratic context of product development projects conducted by 'empowered' professional engineers (Räisänen and Linde, 2004). Our findings, however, question the direct and detailed disciplining proposed by the above studies and highlight the considerable freedom of interpretation that exists when it comes to the practical use of formal models. In spite of the existence and institutional enforcement of shared models in the organizations studied, the conceptions of projects and project management were varied.

5.3. *Suggestions for further research*

By applying an interpretive perspective to the use of product development management models, this paper has contributed to a more fine-grained understanding of the links between formal models and product development practice. Many questions for further research emerge in the wake of this study. While the study has highlighted differences between how different individuals conceive of their task, it remains to be studied how these conceptions are linked to different aspects of project success. Interesting questions for further research include: Can differences in conception be linked to differences in performance, or is there a need for a contingency approach to project management (cf. Engwall, 2003)? Furthermore, our findings call for an elaborate analysis of the antecedents of the different conceptions, as these remain unclear from this study. Other important questions for further research address the origins and stability of the conceptions. Are they the result of certain experiences from earlier projects, of organizational culture, of personal traits, or of a specific situation in specific projects? In order to answer these questions, a broadening of the empirical basis is needed with respect to both time and scope.

6. Conclusions

The findings of this study give reason to redirect the traditional emphasis found in the product development literature, from model *design* to model *use*. As models are *interpreted* by their users and applied within the framework of each user's conception of his or her work, there are several different ways to use one and the same model. Different users emphasize different model features, and use these features in their work in different ways.

Viewing the use of models as mediated by the conception of projects and the project management task, questions the notion that the practice of product development can be improved by the implementation of new (and better) models (e.g. Takeuchi and Nonaka, 1986; Iansiti and MacCormack, 1997; Cooper et al., 2002). In the organizations studied, the ingrained characteristics of the models and their pragmatic use might actually have disarmed the model's prescriptive potential. Users of the model seldom noted that they consulted the model before acting, thus reducing the value of models in implementing changes to specific procedures.

While questioning models' direct guiding influence on product development practice, the study has highlighted the role of models as an enabler of communication within and between projects, by providing common models and concepts. Changing models may thus still have an effect on practice, although indirectly, by providing new concepts upon which members can construct a joint reality (see e.g. Cole, 1994; Boland and Tenkasi, 1995). However, based on this study it may be concluded that, when it comes to changing practice, a focus on new models alone is insufficient. In addition to models, how organiza-

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tional members conceive of the task must be considered and, if deemed necessary, changed. This will demand a different approach than the mere implementation of a new methodology.

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