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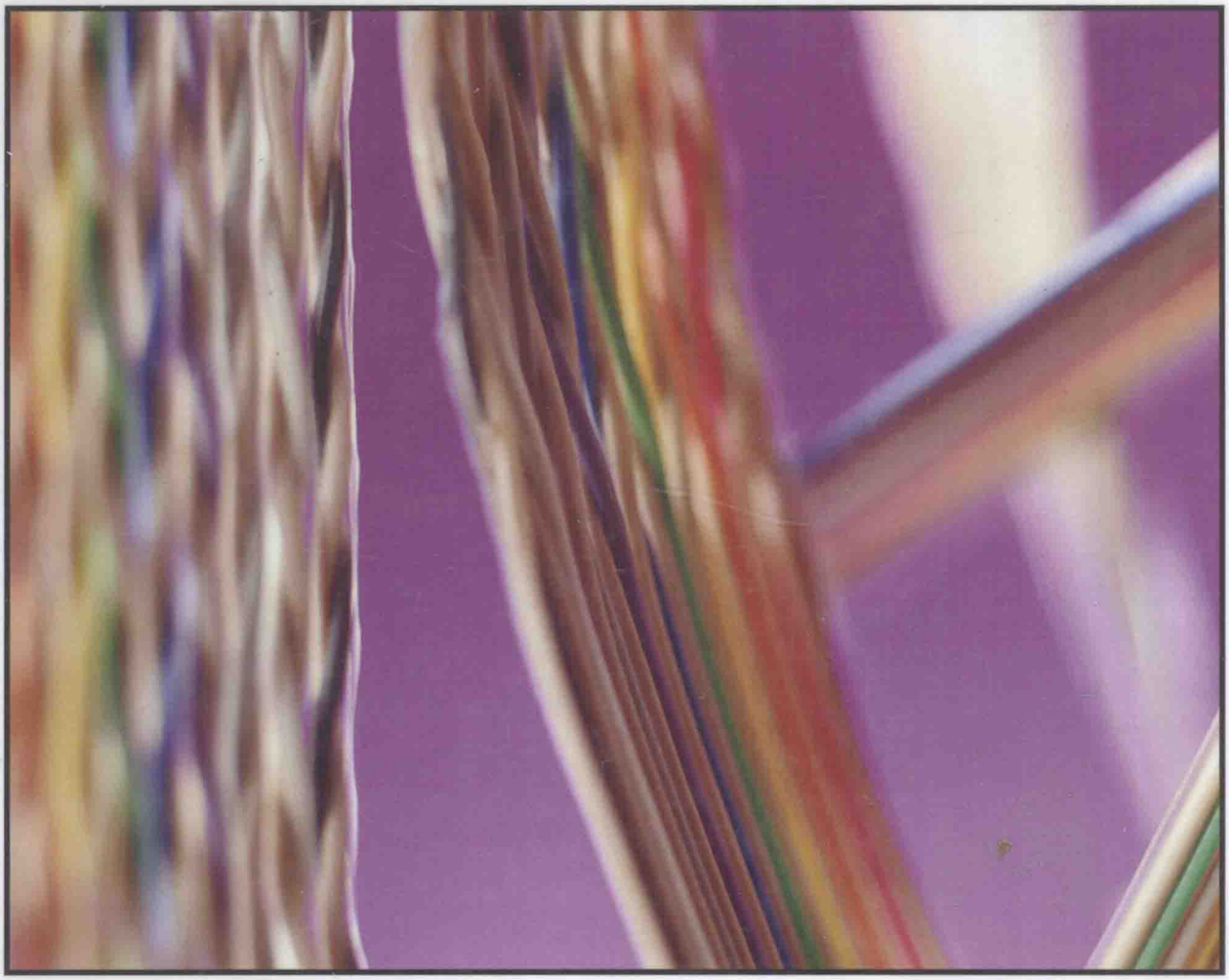
Using Activity Domain Theory for Managing Complex Systems



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Information Science REFERENCE

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Hershey · New York

Director of Editorial Content: Kristin Klinger
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Typesetter: Michael Brehm, Michael Killian
Cover Design: Lisa Tosheff
Printed at: Yurchak Printing Inc.

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com/reference

Library of Congress Cataloging-in-Publication Data

Taxen, Lars, 1944-
Using activity domain theory for managing complex systems / by Lars Taxen.
p. cm.
Includes bibliographical references and index.
Summary: "This book offers a new approach toward managing the coordination of complex system development tasks, combining a deep understanding of concrete, every-day conditions of the telecom industry with innovative theoretical development of the Activity Domain Theory"--Provided by publisher.
ISBN 978-1-60566-192-6 (hbk.) -- ISBN 978-1-60566-193-3 (ebook) 1. System theory. 2. Network analysis (Planning) 3. Management information systems. 4. Workflow--Management. 5. Industrial management. I. Title.

T57.6.T39 2010
384.01'15--dc22

2009038606

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Foreword

"Why make it simple when you can do it so beautifully complicated?" This answer to a student is attributed to one of the classical German philosophers of the 19th century. Some readers may think that the author of this book would reply in a similar way. The theoretical discourse of this book, which is partly inspired by some of these philosophers, is indeed a tough piece of cerebral aerobics. However, it results in the wonderful simplicity of understanding complex issues, which makes the reader feel amply rewarded.

Mastering the mindboggling complexity of creations such as modern telecom systems can not rely on shortcuts and silver bullets. On the basis of extensive professional experience and reflection the author convincingly demonstrates that coordinating the development of such systems needs to build on well-grounded theories and thoughtful application. The successful development and diffusion of the "anatomic-centric" approach to project coordination within the Ericsson telecommunications company, where the author was so deeply involved, testifies to the importance of this contribution.

In the area of complex systems development, thoughtful project management is a key factor for innovation, for bringing together system capabilities to actually working systems and for taking them to the customer. The critical question then is: How can managers and practitioners conceptualize and understand the central ingredients of successful project management in this and similar fields? In the extant literature there is a plethora of tools for advanced planning and scheduling, for system decomposition and modularization, for reducing interdependencies and avoiding errors. But there is also a growing criticism of these approaches. A number of these studies have criticized mainstream models of project management for an over-emphasis on the role of planning and scheduling and highlighted the need for developing models that take into account the need for flexibility and adaptability. These studies have singled out the importance of fitting project management to the situation and working out contingency formulae as critical for firm-level competitive advantage. This critique, however, tends to be overly general in character and lack grounded suggestions for effective managerial practices and coordination mechanisms which are needed to make complex system development at all possible.

This work pursues a different route, different both from the traditional planning road, and the alternative "flexibility" route, where everything is open for negotiation. By applying rigorous theoretical analysis it brings a new depth to the art and science of complex system development in general and to project management practices in particular. As the author forcefully argues, nothing is as practical as a good theory. The theories discussed and analyzed here do indeed lead to very practical results such as new forms of representing and expressing interdependencies, new means of creating shared understanding, new ways of communicating system characteristics and integrating complicated project activities into systems which function as predicted and can be delivered as promised.

The reader is invited to a rewarding ride through research and experimentation, ending up in highly useful new insights.

May 2009
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Christian Berggren *is Professor in Industrial management at the University of Linköping, Sweden and director for the KITE research program, Knowledge Integration and Innovation in Transnational Enterprise (http://www.liu.se/kite). Christian Berggren has published extensively on innovation and project management within the automotive, electro-technical and telecommunications industries. His recent papers include "The integrator's new advantage - reassessing outsourcing and production competence in the global telecom industry", European Management Journal, 2008, 26, 5, 314-324; "Technological capabilities and late shakeouts: Industrial dynamics in the advanced gas turbine industry", Industrial and Corporate Change, 2008,* **17, 335-392**; *"Lagomizing, Organic Integration, and Systems Emergency Wards: Innovative Practices in Managing Complex Systems Development Projects, Project Management Journal, 2008, 39, S111-S122 and "Rethinking Project Management Education: Socials twists and Knowledge Co-production", International Journal of Project Management, 2008, 26, 3, 286-296. Berggren's current research focuses on the role of knowledge integration capabilities for realizing innovative solutions by combining complex technologies.*

Preface

The sociologist Kurt Lewin once said that "there is nothing so practical as a good theory". As a general motto, this view is no doubt acknowledged among practitioners and academics. Industrial accomplishments should be informed by insightful theories that in turn may be further elaborated from practical experience.

However, when taking a closer look at how this motto is practiced in industry and academia, things become more intricate. My experience, as someone who has spent many years in both camps, is that theories are still by and large the concern of academia, and practice the concern of industry. When academia approaches practice, it is usually after something interesting has taken place in industry. For example, the emergence of Enterprise Resource Planning (ERP) systems took place several years before academia began researching this major upheaval in organizations. Moreover, the main knowledge interest is to *explain* the ERP phenomenon using various informing theories. Accounts for the use of theories to *influence* the trajectory of ERP systems are rare in academia.

From the other vantage point, industry shows limited interest in theories unless they give immediate pay-back in ongoing development tasks. As early as 1995, David Parnas expressed concerns about software engineering conferences:

The sad fact is that most Engineers actually writing code do not come to these conferences. They also do not read IEEE Transactions on Software Engineering. However, if we want to influence the way that software is written, we have to admit that we are doing something wrong. (Parnas, 1995, p. 30)

Unfortunately, we still seem to be doing something wrong. Industry feels that academic research is irrelevant since – so it is believed – academia has no real understanding of the magnitude and complexity of the practical challenges industry is facing. Practical applications emanating from theories used in academia are mostly seen as vehicles for advancing theory development and thus of little relevance to practitioners.

In contrast, the message of this book is that theories can indeed make a difference in demanding practical settings. The book communicates a story where theory and practice mutually have influenced each other. The theory is what I have coined the Activity Domain Theory (ADT), and the practice is the development of telecommunication systems at Ericsson, a major supplier of telecommunication equipments all over the world.

The subject area of the book is, as the title indicates, the interplay between coordination, complex projects and ADT. The motivation for focusing on this arena is as follows. Our technological capabilities to develop products have increased dramatically. This enables us to produce ever more complex systems like telecom networks, airframes, cars, weapons systems, and so on. The complexity is augmented by the many different types of technologies used; in particular the increasing utilization of embedded control software.

However, our ability to cope with the complexities that these technological developments raise has not increased at the same pace. There is a gap between the possibilities that technology offers us and our capability to take advantage of this development. This is perhaps most evident in, for example, the poor track record of developing large software systems. The Standish Group classifies such projects as successful, challenged and failed. Although there has been some increase in the rate of successful projects, still in 2001 about half of the projects were considered challenged, i.e. completed with overrun budget, over the time estimated, and with fewer functions than specified (Standish Group, 2001). 23% of the projects were outright failures and only 28% were considered successful. Thus, there is an urgent need to improve the track record of complex projects.

Coordination is at the heart of complex system development since such endeavors are possible only by the purposeful coordination of socially organized work. There is a pressing need to understand the nature of coordination in order to improve the way coordination is carried out. However, theoretical efforts to define coordination (e.g. Kraut & Streeter, 1995; Malone & Crowston, 1994) seldom reach into the unruly domains of industrial practice. When things become concrete and detailed, esoteric and abstract theories will come off badly. Thus, the focus on coordination is motivated by the need to operationalize this concept, i.e., to make it useful in practice.

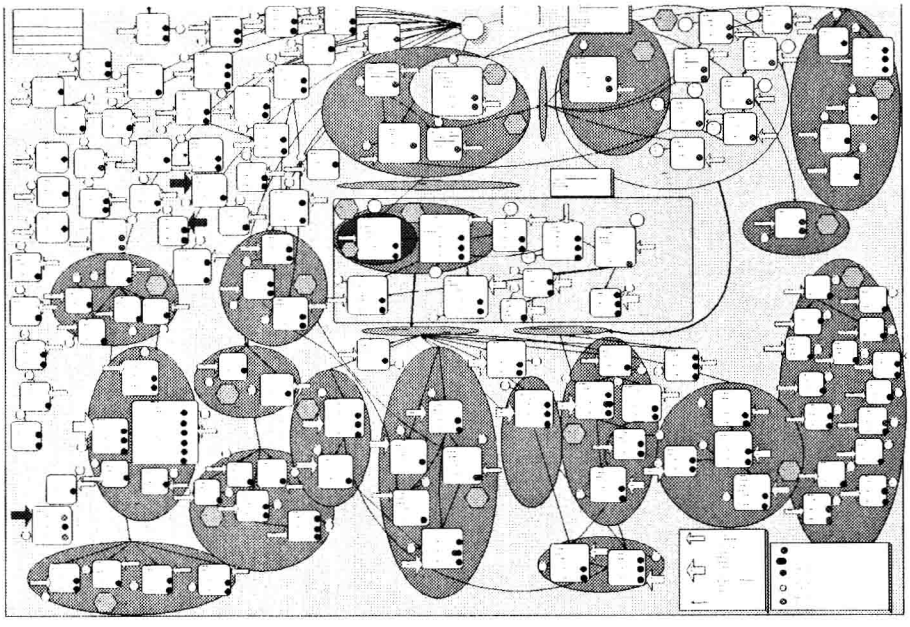
Why do we need to theorize about coordination? After all, well-working and efficient products appear on the market at an ever increasing pace. It seems that industry is doing pretty well without dwelling into intricate theories. However, the story of failed and target overrun projects shows that things are not all that well. Either we take the position that such failures are inevitable, considering the magnitude and complexity of these projects, or we seek to improve the way we run our projects guided by, hopefully, well-informed theories.

As many other scholars, I am convinced that the root cause of failed projects are to be found, not primarily in the complexity of the technology, but in our social and cognitive capabilities to manage the complexity of such projects. Social and cognitive aspects are inherent features of ADT, which implies that this theory should be well armed to guide the coordination of complex development tasks. The reason why I dare to state this rather bold claim is that I worked for more than 30 years in different roles at Ericsson. This provided me with a down-to-earth appreciation of the concrete problems the development of a telecom system poses. Rather late in my professional life I spent ten years at the university, first as a Ph.D. student and later as an associate professor. This enabled me to reflect and theorize about my experiences from Ericsson. In this sense, the book is a synthesis of a personal meandering between practical and theoretical camps, something that should provide a good basis for practical theory development. It is up to the reader to judge whether I have succeeded.

THE REALITY OF THE TELECOM INDUSTRY

The telecommunication industry in general and Ericsson in particular can be seen as a paradigmatic example of the complexity many product development organizations face today. The ensemble of telecommunication systems has been called the world's largest machine; an immense network of interacting nodes, each performing some kind of utility like setting up calls, keeping track of the position of a mobile, providing charging functions, etc. The network is constantly evolving. New types of services such as live TV directly in the mobile are implemented as the capacity of the network increases. In addition, there is a legacy of existing equipments and networks that must be considered when making changes in the network. Another source of complexity is the many different technologies used such as radio, software, hardware, mechanical, and optical ones.

Figure 1. An integration plan of one node in the 3rd generation of mobile systems (Taxén & Svensson, 2005. Used with permission)



In the telecommunications market there is a fierce competition among systems providers like Ericsson, Nokia™ and others. This competition has been heightened by the deregulation, leading to volatile requirement specifications of systems and pressure to shorten lead-times and costs. In addition, frequent reorganizations are carried out such as outsourcing, acquisitions, and the establishment of partnerships.

As an example of the complexity underlying a mobile phone call we may take a look at the image in Figure 1. The image, which should be read from top to bottom, is called an "integration plan". It is used as an instrument for coordinating development tasks (square white boxes) in one of the nodes in the network. Each task, which is called a "work package", provides a specific functionality to the node. The thin lines mark dependencies between the packages, indicating which packages must be ready in order for other packages to function properly. Thick arrows show the datum for integration and verification of the packages. Small dots indicate the status of a package such as "in design", "in test", "delayed", "ready", etc. The ovals signify basic services like registering the location of the mobile, calling the mobile, answering a mobile call, etc. In most cases the functionality is provided by software, where the total number of source code lines may be in the order of millions. In other cases, complex integrated hardware chips are used. The project may take more than a year to execute and can involve several thousand persons at development sites all over the world.

It is beyond doubt that the coordination of projects like the one in Figure 1 is a challenging task that needs to be supported by information systems (ISs). In order to implement such systems, there must be a sufficient consensus of how coordination should be conceived. At a general level, it is fairly easy to agree about what coordination items like, for example, a requirement is. However, as the level of detail increases, disagreements begin to surface. How should a requirement be identified? What kind of status values does a requirement have? What attributes characterize a requirement? How should requirements be related to other things such as customers, products, test cases, etc? In fact, the experience from Ericsson testifies that attaining common understanding about coordination is an overwhelming endeavor that takes precedence over other tasks. How to accomplish this endeavor is the recurrent theme of this book.

THE DEVELOPMENT OF THE ACTIVITY DOMAIN THEORY

The emergence of ADT can be seen as a result of two "trails" that met around 1998: a practical and a theoretical one. The practical trail provided me with a thorough understanding of the immense problems of coordinating huge, globally distributed development projects. The theoretical trail rendered me with theoretical instruments by which the practical experiences could be understood and subsequently be reflected back into guidelines for improving practice.

The Practical Trail

The molding of the practical trail occurred roughly between the late 1990s and 2003 when Ericsson was involved in the transition from the 2nd to the 3rd generation of mobile systems. This was a major challenge for Ericsson. In order to meet these challenges, Ericsson worked out a development method, which I will refer to as the *anatomy-centric approach* throughout this book. The origin of this approach dates back to the early 1990s, when Ericsson was involved in delivering the 2nd generation mobile systems to the Japanese market. The method wandered back and forth over many years in the company, sometimes heavily used, and sometimes more or less forgotten until it became compulsory for it to be used in all subprojects in the 3G development.

The anatomy-centric approach put quite new demands on the management and coordination of the 3G projects. One of the most critical tasks was to make sure that work packages implementing various functionalities were designed, tested and delivered to system integration according to the project plan. Typically, between 5,000 to 10,000 items needed to be managed with respect to revision, status, dependencies, etc.

In 1996 I was taking part in a work aiming at supporting the coordination of anatomy-centric projects. Early on, it was clear that specific IS support had to be developed for such projects. I became responsible for the pre-studies and subsequent implementation of such a system at a site in Stockholm. In early 1996 I happened to meet a lonely looking salesman at a construction fair. It turned out that the salesman was the retailer for Matrix, a Product Data Management system that was then fairly new on the market (MatrixOne, 2008). He showed in a couple of minutes the ease by which a particularly demanding data model construct could be implemented in Matrix. I became impressed with this demonstration, and managed to persuade Ericsson to take a closer look at this system. The system turned out to have the qualities we wanted, above all ease of changing the implementation.

During 1997, Matrix was prototyped in some pilot projects and 1 May 1999, the first usage of Matrix in the 3G projects was a fact. This was the start of an astonishing development. Between 1999 and 2003 other projects followed, both at Stockholm and other Ericsson sites. At its peak, around 140 projects and subprojects were using similar, albeit distinct, applications built on the same Matrix IS platform.

A striking feature of the coordination support developed was the establishment of separate applications built on Matrix at different sites. Although each application turned out to provide highly efficient coordination support, they were completely differently constructed, both in terms of information managed and functionality offered. There was no apparent reason why they should differ, since all sites were engaged in the same 3G development enterprise. However, any attempts to consolidate the applications more or less failed. This and other equally perplexing experiences make up the substance of the practical trail.

The Theoretical Trail

The origin of the theoretical trail can be traced back to a long personal interest in philosophy in general and in dialectical thinking, the Marxian concept of praxis, semiotics, and meaning in particular. With such a backpack it was near at hand to reflect on the daily practice where I spend most of my working hours. The philosophical "spectacles" enabled me to see taken-for-granted values and conceptions from other perspectives. For example, an outspoken value at Ericsson was to "develop what the customer requires", or – expressed differently – "The customer is always right". The problem, however, was that the customer seldom knew precisely what he wanted and often changed his mind in the midst of the development of a particular system. It appeared to me that the real process was much more interactive and dynamic than expressed by prevailing tenets. Customer and supplier together worked out a common view of the system, sometimes in conflict but more often in cooperation.

So, the theoretical trail had to some extent been cleared alongside with my practical, daily work. However, this trail would have remained dormant if it hadn't been for a company controversy over the choice of the Matrix system. The Corporate IT organization at Ericsson stipulated the use of another system, which however did not have the necessary capabilities – above all flexibility to change the implementation in an easy and straightforward way.

The controversy over the platform intensified during 1998, and at a certain point in time, Matrix was on the brink of being thrown out in favor of the corporate system. Along with that my ideas and the promising results we had achieved so far would disappear. In order to save this work I turned, more or less in despair, to Linköping University with a research proposal. After some initial hesitation, the proposal was accepted, and so my academic career started, rather late in life – I was 54 years old then. At that point I was quite convinced that a promising initiative to improve coordination support was for ever gone. However, in May 1998, the project manager for one 3G project got interested in our prototype and decided to use this in his project. From that moment on, the tide changed and Matrix became a key component in the 3G development endeavor.

Thus, I could elaborate the theoretical trail alongside my work at Ericsson until 2003 when I was required to leave the company together with many others as a result of the telecom crisis. So, from that moment the practical trail faded away while I could continue to refine the theoretical trail in my research. In retrospect, the constellation of idiosyncratic circumstances that gravitated around 1998 seems almost inconceivable. The transition from 2G to 3G at Ericsson, my position as responsible for the IS support in one project, the encounter with the Matrix platform, the conviction and support of a single project manager, my interest in philosophy – all these elements coincided in time and space to form the backbone of the ADT-approach and consequently the material for this book.

THE MAIN FEATURES OF THE ACTIVITY DOMAIN THEORY

There is no lack of theories that address social and technological issues. This is perhaps most evident in researching ISs. For example, the Association for Information Systems provides a list of more than 50 theories used in IS research (IS theories, 2008). So, why bother about yet another theory? The main reason, I believe, is that ADT differs in some crucial aspects from most other theories proposed.

- ADT originated and evolved within the telecom industry. Thus, it has been sculptured from and scrutinized by concrete industrial needs. Most other theories originate from outside the industry, and are appropriated or adjusted to fit the particular circumstances of that industry. For example,

the Actor Network Theory (e.g. Latour, 1992) originated in social sciences and has been used by a number of researchers to analyze the impact of ERP-systems.

- ADT is operational in industrial settings. By operationalization, I mean that the theory can be expressed in elements that can be manipulated, measured or observed in a particular situation in order to influence this situation. This means that the theory is indeed "practical" in the sense that Kurt Lewin meant.
- A common thread in ADT is the concept of *meaning*. Meaning is considered intrinsically related human action, and only meaningful sensory impressions can be informative and acted upon. Consequently, a key issue in coordinating human actions is the construction of common understanding about how coordination should be conceived.
- The focus on meaning implies that human cognition plays an important role in ADT. A key tenet in ADT is that the properties of human cognition constitute the way we apprehend our socially constructed reality.
- ADT states that common understanding is constructed in the social *practices* (e.g. Schatzki, Knorr Cetina, & von Savigny, 2001). A practice has been defined as a coherent set of human actions characterized by a commonly understood object towards which coordinated actions are directed (Wartofsky, 1987).
- The inclusion of both human cognition and social practices means that ADT integrates individual cognition, social organization and technological-material aspects of human action into a coherent whole.

These features are reflected in the structure of ADT. Its key construct is the *activity domain*, which can be seen as a particular form of social practice where coordinating aspects are at the fore. The motivation for the existence of the activity domain is that it supplies products or services that meet some social need. In order to do so, the actors in the domain work on some work object, the outcome of which fulfills the need.

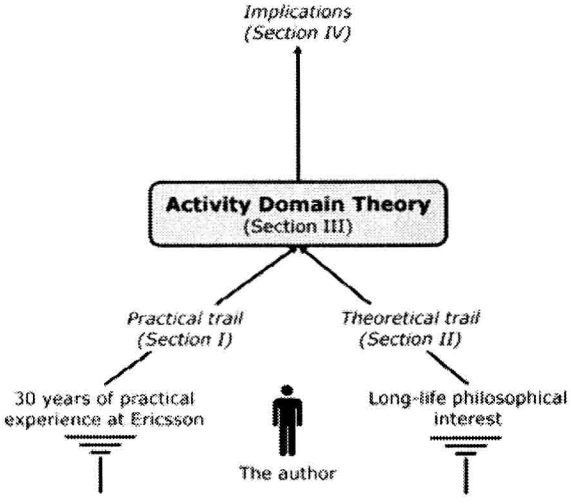
The work object molds the inner structure of the activity domain, including the meaning actors associate with the object and other related items needed in order to produce the outcome. For example, the activity domain of flying an airplane will differ quite radically from that of building a house in terms of what the work object is, what things are important, what methods work or don't work, what rules and norms are valid, what tools or instruments are used, etc.

In spite of the different realities constructed in activity domains, ADT claims that certain deep structures coined *activity modalities*, can be found in every domain. These modalities denote cardinal dimensions along which meaning is constructed, and they can ultimately be traced back to the way our cognitive system works. Stated differently, ADT claims that the social reality constructed in activity domains reflects the way we as humans apprehend the world. For example, since our minds discern a temporal dimension, we create "temporal" artifacts like calendars and clocks that help us to coordinate our actions.

ORGANIZATION OF THE BOOK

From the background sketched in the previous sections, it is relatively straightforward to organize the book in four parts, each consisting of a number of chapters (see Figure 2). The practical and theoretical trails leading up to the ADT are described in Section 1 and Section 2 respectively. These parts should be

Figure 2. Organization of the book



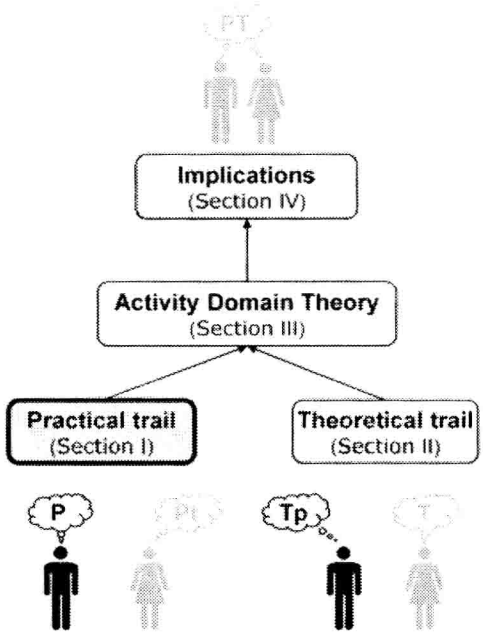
read as paving the way for the ADT, which is presented in Section 3. Section 4 discusses implications of the theory in a number of areas, with a focus on the coordination of complex systems. With that a full circle is closed and we may approach practice and theory with, hopefully, some new insights.

Stakeholders

Since the book aims at a balanced approach between theory and practice, the following main stakeholder groups can be identified:

- **The P-type:** *"Just do it."* This group consists of action oriented practitioners, people that consider theories as irrelevant for achieving results. Research carried out at universities is regarded with great suspicion by the P-type person: nothing practical ever comes out of the ivory towers in academia.
- **The Pt-type:** *"What's happening here?"* This group includes practitioners that reflect on what they are doing and try to find ways to improve practice. Innovative new products and methods often emerge from this group. Still, these innovations occur outside academia; there is no or little interaction with research.
- **The Tp-type:** *"Can my theory make an impact in practice?"* Here we find theoreticians with a practical inclination; persons in academia active in applied sciences such as IS development, computer science, software engineering, etc. These persons want theories to be relevant for practice. However, practical applications developed are mostly used as means for theory development, and these applications are in general less complex compared to ones found in product-developing industries.
- **The T-type:** *"I think, therefore I am."* In this group we find theoreticians without any practical application in mind. Practice is regarded as dirty business that should not ever be let inside the academic fortress. This group corresponds to the P-type group in industry; no interaction whatsoever between academia and industry is the basic attitude.
- **The PT-type:** *"Practice and theory are two sides of the same coin."* Persons in this group are, I dare say, quite rare today. They combine the interests of the Pt and Tp person types.

Figure 3. The stakeholder focus Section 1



I foresee that people from these, admittedly caricatured, groups will be interested in different parts of the book as follows.

Section 1: The Practical Trail

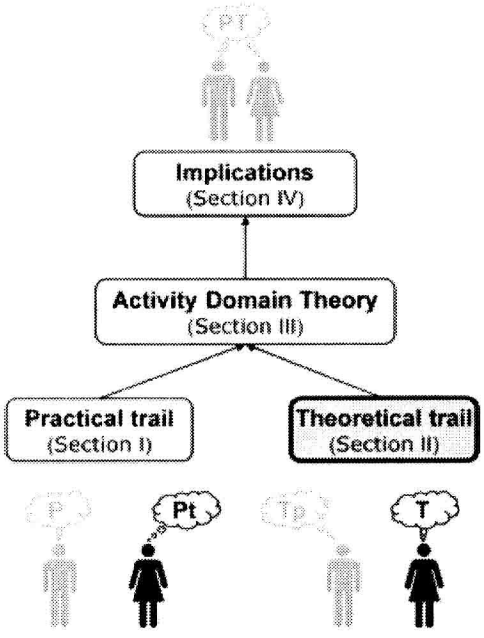
Relates the empirical background of the ADT. The stakeholder focus for Section 1 is on the P and Tp type of stakeholders (see Figure 3). Practitioners may be interested in how the coordination of the 3rd generation of telecom systems occurred at Ericsson; what kinds of obstacles had to be overcome and what results were obtained. This part should also be of interest to theoreticians who are interested in how a theoretical understanding might grow out of practical experiences rather than from appropriation of other theories for practical purposes[1].

The chapters in Section 1 are as follows.

The Dawn of the Activity Domain Theory
An historical account of events, observations and experiences from the Ericsson 3G development projects between 1997 and 2003 that gradually shaped the ADT.

Reflections
Attempts to make sense of the events reported in the previous chapter. Reports on other observations collected over many years at Ericsson that contributed to the formation of ADT. These observations concern the dilution of the business process concept; the difficulties of establishing common vocabulary in information modeling projects; the chaotic IS/IT architecture in the organization; and the fragmented responsibilities of processes, information architectures, IS/IT and business rules, resulting in glitches between these areas. Summarizes the insights and needs from the practical trail:

Figure 4. The stakeholder focus Section 2



- **Common understanding:** The 3G development experience made it painstakingly clear that achieving common understanding is a difficult task that is easily overlooked. Thus, a methodical way of addressing this issue should be up front on the agenda.
- **Integrating construct:** Many observations pointed to the need of some organizational construct that could integrate elements like IS/IT, business processes, information structures, and corporate business rules. Taking one of these elements, for example, business processes, as the basis for organizational analysis and change initiatives appeared to be insufficient since all elements obviously were interdependent and, consequently, could not be sensibly treated one at a time. Gradually, an insight grew that some kind of *practice* construct (e.g. Schatzki, Knorr Cetina, & von Savigny, 2001) was a viable candidate for this purpose. The practice idea was later elaborated into the *activity domain,* which subsequently became the integrating construct in ADT.
- **Contextualization:** Other observations indicated that situational and contextual aspects must be given more attention in the organizational discourse. This was most conspicuous during the 3G development, where different sites developed site-specific coordination support applications; each of which provided previously unmatched IS support. Thus, by delimiting the scope of commonality, it seemed that the efficiency of IS application development tasks increased dramatically.
- **Recurrent patterns:** A closer look at the most frequent organizational artifacts indicated that these were manifestations of more basic, underlying patterns that appeared over and over again. These patterns came across as being of separate kinds but nevertheless interdependent and mutually constituting each other. Subsequently, these patterns were elaborated into the *activity modalities* in ADT.
- **Enactment:** Organizational artifacts must be what Orlikowski (2000) calls *enacted* in order to become useful in a particular organization. The enactment view "starts with human action and

examines how it enacts emergent structures through recurrent interaction with the technology at hand" (Orlikowski, 2000, p. 407). Some experiences made me aware of the fact that the historical development of organizational artifacts like information models, process models, etc., must be taken into account. Not until these artifacts are regarded in a historical perspective, is it possible to appreciate the enactment efforts behind their particular appearance at a certain moment in time.

Section 2: The Theoretical Trail

Describes the theoretical roots of the ADT. The focus of Section 2 is on the Pt and T type of stakeholders with a focus on the T-type (see Figure 4). Obviously, theoreticians will have an interest in the theoretical background of ADT. However, I also want to address practitioners with a reflective mind, primarily through examples from everyday life and industrial settings.

The chapters in Section 2 are as follows.

The Philosophical Roots
Provides an account of the Marxian philosophical cornerstones that have influenced the ADT: the concept of *praxis*, the *dialectical relation*, the *epistemology of praxis*, and the *dialectical method*. In the concept of praxis, the Marxian tradition tries to capture the fundamental nature of human activity. The dialectical relation conceives related phenomena as mutually constituting each other. The epistemology of praxis concerns the nature of trustworthy and actionable knowledge. The dialectical method is the Marxian approach towards investigating the underlying essence of phenomena that we experience as immediately given in everyday life. Together, these cornerstones provide an alternative conceptualizing of organizational phenomena.

Activity Theory
Reviews three additional cornerstones for ADT from the Russian theory of Activity (AT) (e.g. Kaptelinin & Nardi, 2006): the concept of *activity* (frames the context in which individual actions are meaningful), the concept of *mediation* (humans always put something between themselves and their object of action), and the AT view on *meaning* (how we make sense of reality).

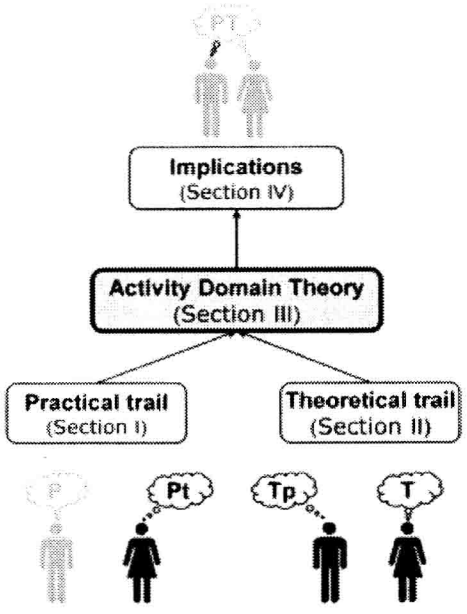
Section 3: The Activity Domain Theory

Provides an account of the ADT as a synthesis of the empirical and theoretical trails, and conceptualizes ADT as an elaboration of AT where coordination is in focus. Describes the *activity domain* as a work setting (team, group, business unit, etc.) whose existence is *motivated* by its capability to produce some *outcome*. The outcome is achieved through the actions of socially organized *actors*, who transform a *work object* into the outcome. The outcome of one domain may be the *prerequisite* for another domain, which means that the activity domain construct is *recursive* and *scalable*.

In order to transform the work object, actors *enact resources* consisting of means and skills. Enactment in the context of ADT refers to the fact that the potential capabilities of means become resources only when actors have drawn these into the social fabric of the activity domain, and collectively learnt how to use them. Thus, capabilities of means and actors must always be related to the work object and motive in order to become useful resources in the domain.

A key tenet in ADT is that society as constructed in human activity reflects or is congruent with the structure of the human cognitive system. A corollary of this tenet is that humans have innate capabilities to coordinate their actions. These capabilities are characterized by the *activity modalities contextual-*

Figure 5. The stakeholder focus Section 3



ization, spatialization, temporalization, stabilization, and *transition*. Modalities are manifested both as societal imprints in the form of artifacts, institutions, norms, etc., and as individual, cognitive imprints in the human mind and body. For example, a coordinative means like a calendar is a manifestation of the temporalization modality. In order to become a coordinative resource, however, actors must learn to use it and interpret it in a common way.

An important consequence of the ADT perspective is that sense making is inherently related to the activity domain. In other words, different activity domains enact by necessity different communal meanings[2] or taken-for-granted ideologies about what is meaningful.

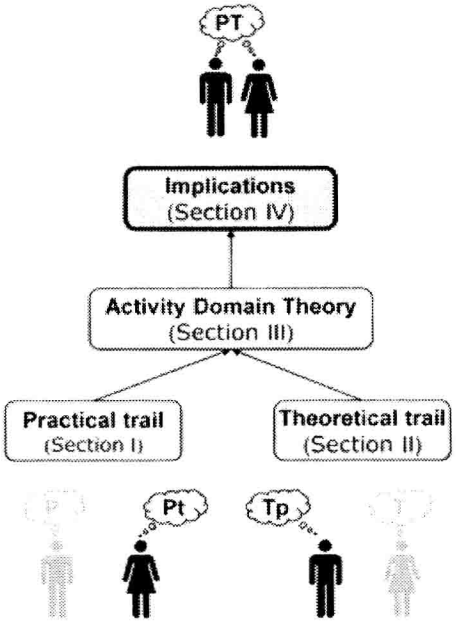
The stakeholder focus of Section 3 is similar as for Section 2; however with more emphasis on the Pt type since an important part of ADT is the operationalization of the theory (Figure 5).

The chapters in Section 3 are as follows.

Cognitive Grounding
Reviews indications from cognitive neuropsychology and linguistic sciences that support the claim of activity modalities as basic features of the human cognitive system.

Operationalizing the Theory
Describes how the ADT is operationalized by modality specific models and IS support. These models are deliberately chosen to facilitate common understanding. Suggests a method, the *domain construction strategy,* for constructing the models and common understanding of them.

Figure 6. The stakeholder focus Section 4



Positioning Against Other Theories
Positions the ADT against complexity theory and other akin, practice-based theories such as to Structuration Theory, Actor Network Theory, Organisational Semiotics, Work System Framework, and the Cultural-Historical Activity Theory.

The Practical and Theoretical Trails in Hindsight
Recapitulates the practical and theoretical trails from the ADT perspective; how are practical experience and theoretical roots reflected in ADT?

Section 4: Implications

Reflects on implications of the ADT in various areas. Since Section 4 represents a synthesis of practical and theoretical insights, stakeholders of the Pt and Tp types would be interested in this part. Moreover, it is my intention that Section 4 will provide arguments for the need of true border spanners; PT actors that combine deep practical and theoretical knowledge.

The chapters in Section 4 are as follows.

The Anatomy-Centric Approach for Coordinating Complex Projects
Reviews the anatomy-centric approach for coordinating complex projects. Elaborates the *anatomy* as a means to manage dependencies between capabilities in a system. Describes the anatomy-centric approach and discusses its implications. Suggests how the anatomy may be seen as an architecture, supporting agile development of software. Analyses the approach from the perspective of activity modalities. Demonstrates that the three images used – the anatomy, the increment plan and the integration plan –