Martti Mäkimattila

ORGANIZING FOR SYSTEMIC INNOVATIONS
– Research on Knowledge, Interaction and Organizational Interdependencies

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ABSTRACT

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Organizing for systemic innovations – research on knowledge, interaction and organizational interdependencies

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Systemic innovation has emerged as an important topic due to the interconnected technological and sociotechnical change of our current complex world. This study approaches the phenomenon from an organizing perspective, by analyzing the various actors, collaborative activities and resources available in innovation systems. It presents knowledge production for innovation and discusses the organizational challenges of shared innovation activities from a dynamic perspective. Knowledge, interaction, and organizational interdependencies are seen as the core elements of organizing for systemic innovations.

This dissertation is divided into two parts. The first part introduces the focus of the study and the relevant literature and summarizes conclusions. The second part includes seven publications, each reporting on an important aspect of the phenomenon studied. Each of the in-depth single-case studies takes a distinct and complementary systems approach to innovation activities – linking the refining of knowledge to the enabling of organizations to participate in shared innovation processes. These aspects are summarized as theoretical and practical implications for recognizing innovation opportunities and turning ideas into innovations by means of using information and organizing activities in an efficient manner.

Through its investigation of the existing literature and empirical case studies, this study makes three main contributions. First, it describes the challenges inherent in utilizing information and transforming it into innovation knowledge. Secondly, it presents the role of interaction and organizational interdependencies in innovation activities from various novel perspectives.
Third, it highlights the interconnection between innovations and organizations, and the related path dependency and anticipatory aspects in innovation activities. In general, the thesis adds to our knowledge of how different aspects of systems form innovations through interaction and organizational interdependencies. It highlights the continuous need to redefine information and adjust organizations and networks based on ongoing activities – stressing the emergent, systemic nature of innovation.

**Keywords**: innovation, system, systemic, knowledge, interaction, interdependencies, organization, dynamics, case study

UDC 65.011.8:165:65.01:001.891
FOREWORD

I have had the opportunity to work in mature and turbulent business environments, both of which require innovations to compete. Management experience has highlighted the importance of co-operation, collaboration and co-opetition between and within organizations and underscored the challenges posed by various organizational interdependencies. Focusing on market-based transactions, synchronizing parallel processes or managing intellectual property issues cannot guarantee success but are critical to inter-organizational activities. Successful interaction is essential to knowledge creation during shared innovation activities, from opportunity recognition to producing finalized products or services. Interdependencies emphasize the systemic nature of innovations – such as relationships with converging technologies and organizing under dynamic conditions – while business activities are based on actors and their resources in dynamic, changing environments. Due to my personal interests, this study observes organizing for systemic innovations from the perspective of small- and medium-size enterprises (SMEs) and their collaborative activities, while also taking aspects of public organizations into account. This study also tries to capture the origins of mature and turbulent business environments and how change impacts activities and organizations in various ways.

With the guidance of a supportive academic community, previous knowledge and recent research from 2009-2014 are summarized in the form of this doctoral dissertation. My hope is to deliver the things I have learned during this demanding academic process in a format that benefits other researchers and managers in the field of generating systemic innovations to gain a competitive edge in business and for the public good. I also hope that this literature synthesis can help clarify the phenomenon of systemic innovation, as the various ways in which the concept is used can cause confusion. At the same time, it should provide students with the latest references from literature in the field.
ACKNOWLEDGEMENTS

I would like to thank my supervisors Professor Vesa Harmaakorpi and Professor Tuomo Uotila, as well as Professor Timo Pihkala and Professor Helinä Melkas for their valuable support and constructive advice. I would also like to thank my colleagues for their collaboration and co-authoring during various research projects and for the many useful discussions along the journey of writing this thesis at the LUT-Lahti School of Innovation. I am grateful I had the opportunity to work in such creative atmosphere.

I would also like to express my gratitude to my pre-examiners, Professor Harri Haapasalo and PhD Katri Valkokari. Their thoughtful comments helped me finalize the dissertation.

I gratefully acknowledge the financial support granted to the work by the Finnish Cultural Foundation, Päijät-Häme Regional Fund and the Foundation for Economic Education.

Finally, I would like to thank my family for supporting my decision to continue pursuing time-consuming academic studies to complement my experience gained in the industry and previous university studies.

Life is a continuous learning process, dynamic and emergent like innovation.

Lahti, November 2014
Martti Mäkimattila
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PART II: PUBLICATIONS

**Publication 1:** *Combining Foresight and Innovation: Developing a Conceptual Model.*

Author’s contribution: Researching literature on foresight and innovation. Supporting role in the writing – second author.

**Publication 2:** *Issues in Absorbing Foresight Knowledge for Innovation in SMEs*

Author’s contribution: First author. Literature review, participation in observations and analysis.


Author’s contribution: First author. Literature review, participation in analysis of data accessed and delivered by the second and third authors.


Author’s contribution: First author. Literature review, collaboration on data acquisition with second and third authors, data analysis.
**Publication 5:** Systemic Innovation in Complex Business Portfolios – A Case Study


Author’s contribution: First author. Literature review, participation in analysis of innovation-related aspects of data. Data was accessed and delivered by the second author.

**Publication 6:** Developing Collaboration Structures for University-Industry Interaction and Innovations


Author’s contribution: First author. Literature review, collaboration on data acquisition with second author and other researchers, data analysis.

**Publication 7:** Redesign of Home Care Service Delivery – A Systemic Approach to IT Innovations


Author’s contribution: First author. Literature review, data acquisition and analysis.
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ABBREVIATIONS

AAE Acquisition, Assimilation, Exploitation
AC Absorptive Capacity
ARA Actors, Resources, Activities
ATE Acquisition, Transformation, Exploitation
CIM Cyclic Innovation Model
DUI Doing Using Interacting
IMP International Marketing and Purchasing
IS Innovation System
IT Information Technology
LUT Lappeenranta University of Technology
<table>
<thead>
<tr>
<th>MLP</th>
<th>Multi Level Perspective</th>
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<tr>
<td>MO</td>
<td>Matrix Organization</td>
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<tr>
<td>NIS</td>
<td>National Innovation System</td>
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<td>R&amp;D</td>
<td>Research &amp; Development</td>
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<td>RIS</td>
<td>Regional Innovation System</td>
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<td>SC</td>
<td>Social Capital</td>
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<td>SME</td>
<td>Small and Medium-Sized Enterprises</td>
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<td>ST</td>
<td>Sociotechnical</td>
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<td>STI</td>
<td>Science Technology Innovation</td>
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<td>UAS</td>
<td>Universities of Applied Sciences</td>
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PART I: OVERVIEW OF THE DISSERTATION
1 INTRODUCTION

“The only thing that is constant is change.”
- Heraclitus

1.1 Background of the study

Nowadays organizations and policy-makers are challenged by the large amount of information in their operational environment, e.g. regarding converging technological systems alongside changing human behavior and the complex relationships caused by globalization, economical dynamics, and increasing regulation. Actors sharing networked activities have become more reliant on knowledge and interaction than ever before (Bessant & Tidd, 2007; Bergman, 2005; Nonaka & Takeuchi, 1995). They are searching for opportunities and new solutions to answer the needs of rapidly changing business environments and technological development. These solutions can take the form of innovations – of product, process, market, material, or organizational innovations – as noted much earlier by Schumpeter (1934). Such innovations, created to solve problems and to adapt to changes, are more and more interlinked with each other and various actors. Along with their behavioral and normative logics, individuals, organizations and global systems form a sociotechnical system. This system creates a causal platform for innovation activities and requires better understanding than is currently offered by individual innovation studies. The present study aims at advancing discussions of systemic innovation, approaching it from the perspectives of knowledge and interaction. The purpose is to promote this critical and timely discussion, building on earlier theories by focusing on several in-depth case studies to further understand organizing for systemic innovation in an information rich environment.
1.2 Indicating the research gap in the literature

To comprehensively understand organizing for systemic innovations, this study draws on established innovation and organizational theories (e.g. classics written by Ansoff, Barnard, Kahn, Katz, Perrow, Schumpeter, Selznick, Simon, Thompson) supplemented with the later literature and recent studies presented in this thesis. This literature describes innovation (with its connection to economical and organizational dimensions), opportunities as well as inertial forces, and presents the interlinked challenges of renewal. A couple of central papers bridging technology development and the organizational aspects of systemic innovations have been written by Chesbrough and Teece (1996) focusing on the coordination and control of systemic innovations in a multi-actor environment, and Maula et al. (2006) focusing on proactively managing open innovations in systemic contexts. They create a fruitful theory ground but do not fully cover the dynamics of organizing with various actors in the systemic context. In addition, large amounts of literature on intra- and inter-organizational collaboration have been written from various perspectives of shared knowledge-based activities (e.g. Smedlund, 2009; Distantont et al., 2012; Valkokari, 2009; Valkokari et al., 2012; Lampela, 2009; 2012; Seppänen, 2008; Miettinen et al., 2006; Ritala, 2010). The notion of open context has been also widely discussed in the last decade, the discussion being based on the work of Chesbrough (2003; 2010), e.g. by Valkokari et al. (2009) and many others. This literature describes the role of knowledge in various types of development networks and collaborative activities, but without focusing specifically on systemic innovations. As pointed out, innovation and organizing for innovation is a topic that has been studied intently from various perspectives (e.g. Van der Panne et al., 2003; Bergman, 2005; Koivuniemi, 2008; Lam, 2006; Van de Ven & Poole, 1995; Burgelman et al., 2006; Galanakis, 2006; Teece, 1996; Zaltman et al., 1973 and other references listed in this dissertation’s publications), thus a clear research gap exists in synthesizing the different approaches to systemic innovation and understanding how organizing for systemic innovation takes place.

The first step in filling this gap was to explore the various interpretations given to the term systemic innovation and other terms describing the same phenomena and closely related concepts. During the period of study design and the research proper, 2009-2014, researchers recognized the need to clarify concepts used in the literature, such as systemic innovation.
(Nieminen et al., 2011; Valovirta et al., 2011; Miller, 2012; Mortati, 2013; Mulgan & Leadbeater, 2013) and innovation systems (Hekkert et al., 2007; 2011; Hekkert & Negro, 2011; Coenen & Díaz López, 2010; Markard & Truffer, 2006; 2008; Bergek et al., 2008). Supportive analyses of innovation in interaction (Håkansson & Olsen, 2011; Ford & Håkansson, 2006), collaboration architectures (e.g. Fjeldstad et al., 2012) and ecosystem architectures (e.g. Järvi, 2013; Adner, 2006) were also produced during this period. Concepts related to sociotechnical transitions were further developed, based primarily on Geels’ prior works (Geels, 2002; 2004; 2005; 2010; 2014; Geels & Schot, 2007; Loorbach, 2007; Rotmans & Loorbach, 2009; Loorbach & Rotmans, 2010; Loorbach & Wijsman, 2013; Raven et al., 2012; Papachristos et al., 2013; Steinhilber et al., 2013; Genus & Coles, 2008). Essential parts of the above-mentioned literature are explained in the theory section to create a solid ground for the present study. Some of these publications confirmed the research gap and addressed implications for future research, which were taken into consideration also when further focusing on case studies. For example, this dissertation narrows the gap identified by Fjellstadt et al. (2012) as to how actor-oriented mechanisms can enable problem identification and stimulate multi-party collaboration on a large scale, the nature of control in actor-oriented organization designs (goal determination and fulfillment, resource allocation, and the limits of actor-oriented control mechanisms), the transformation from hierarchical to actor-oriented organizations and collaborative value creation (Ibid). Opportunities for refocusing the study based on interesting issues arising from empirical cases were embraced, since analyzing actors and their collaborative activities in the systemic context can lead to discovering interdependencies and complementarities that were previously unknown, as was also noted by Jaspers (2009).

1.3 Objective of the study

This study focuses on organizing for systemic innovations, which is defined in this study as “an interconnected set of innovations, where each influences the others within the system and the ways in which they are interconnected with the actors and the environment”. The objective is to understand the phenomenon of organizing for systemic innovations by presenting the current literature and conducting several in-depth case studies that contribute as whole.
The research problem is presented in the form of a research question and defined as follows: 

*How can various actors organize for systemic innovations, and how do systemic innovations interact with the actors as part of the system itself?*

Systemic innovations are seldom controlled by one individual or one organization. The reason is that they involve complementary innovations – and, secondly, related system transformations often interact with several interconnected actors and their inbuilt interdependencies. As such, this study focuses on organizations and their collaborative parties involved in systemic innovation activities. The core interest of this study is attaching to knowledge flows and shared innovation activities based on actor-oriented schemes. Transforming knowledge into innovations will be discussed, and various systemic innovation aspects of organizing will be presented.

The focus of this study is not individual creativity, organizational innovativeness, strategic management of innovation networks, or the normative environment of intellectual property rights, even though they all play an important part in collaborative innovations. Nor is the purpose to present systematic innovation processes, or to approach technology development from a linear perspective of parallel activities, or to describe the political guidance of transition management. Instead, the aim is to better understand the complex systemic entity of innovation activities and the challenges of dynamic interaction under changing conditions.

### 1.4 Key concepts of the study

In this study, *organizing* means *forming a social entity that is structured and managed to pursue collective goals to access and use available resources.* The definition is drawn from organization literature (e.g. “… a system of consciously coordinated activities of two or more persons,” Barnard, 1938).

*Innovation* is defined as it is by Tidd et al. (2005, p. 66) “…*turning opportunity into new ideas and of putting these into widely used practice*”. 

Knowledge was described as “justified true belief” by the philosopher Plato. Bringing this closer to practice, knowledge is defined in this study as “information in context (Aune, 1970) coupled with an understanding of how to use it” (Davenport & Prusak, 1998). Knowledge is seen as the key resource in innovation activities.

Interaction\(^1\) is action that occurs when two or more objects have an effect upon one another. In a social context, interaction is seen as a dynamic, changing sequence of actions between individuals and groups who modify their reactions according to the actions of their interconnected partner(s). The focus of interaction in this study is at the meso-level of how actors and activities produce a system, such as organizations and innovations exhibiting a systemic interconnection.

Organizational interdependence describes relationships in which the members of a group are dependent on other actors. It exists whenever one actor does not wholly control all of the conditions necessary for accomplishment of an action or for obtaining the outcome desired from the action (Pfeffer & Salancik, 1978). An interdependent relationship can arise between two or more cooperative autonomous actors, e.g. due to ongoing interlinked activities. This definition takes a broad integrative outlook, covering the different theoretical perspectives of interdependence presented by Staudenmayer (1997) and rooted in Thompson (1967, p. 54), according to which internal interdependence as “the extent to which a task requires organizational units to engage in work-flow exchanges of products, information, and/or resources and where actions in one unit affect the actions and work outcomes in another unit”.

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1.5 Overview of the study

This study presents different approaches to systemic innovation and the essential literature related to organizing for systemic innovation. It also introduces the main topics related to knowledge, interaction and interdependencies in collaborative innovation activities from the organizational perspective. It discusses seven publications – qualitative case studies – along with their findings and contributions to the main research questions. Summaries of these publications are presented in Part 1 with short overviews, case descriptions and empirical findings. Part 2 includes original publications.

Figure 1. Composition of the study

The two first publications (1&2) focus on transforming future-oriented information into innovation knowledge and discuss the required interaction from an organizing perspective. This is followed by cases (publications 3&4) that bring the discussion to the intra-organizational aspects of interaction and interdependencies related to collaboration while
responding to changing conditions. Publication 3 presents a rather mature context, while publication 4 focuses on the turbulent environment of converging technologies and user habits. Both cases direct us to discover more about the inter-organizational dimensions of innovation (publications 5, 6 and 7). Publication 5 challenges us to consider how to draw the boundaries of an organization and presents multifaceted aspects of organizing within overlapping systems. It also presents an alternative systemic context, a sort of active platform that impacts interrelated innovation activities. Publication 6 then presents complementary aspects of various knowledge-production modes for innovation in a “larger” innovation system and discusses network structures in greater detail. Publication 7 develops the discussion in the context of public-private collaboration, while reflecting aspects of sociotechnical transitions in a system context. This leads us back to recognizing the importance of anticipatory activities, not only due to the strategic and operational choices of proactively adapting and organizing for upcoming changes, but also to highlight the interconnection between innovation and change, closing the loop back to the shared foresight and innovation where it all began. Figure 1 illustrates the composition of the case studies in context of main research problem and presented in the form of the central research questions. The dimensions of exploration and exploitation as well as division in intra- and inter-organizational aspects (see Figure 1) are illustrative, offering only a general description of the overall scope for reader.
2 INNOVATION AND ITS SYSTEMIC NATURE

2.1 Definitions of innovation and paradigm change

In public discussions, the term innovation is often misconstrued as an idea or invention, and is often also positioned purely as a product or process related to front-end activities, but Tidd et al. (2005, p. 66) define it as a “…process of turning opportunity into new ideas and of putting these into widely used practice”. Tidd et al. (2005, p. 66) also cite Drucker (1985), noting that “innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service” and Porter (1990): “Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things”. Innovation is generally seen as successful exploitation of new ideas.

As early as 1994, Rothwell described a paradigm change in innovation towards more shared and interconnected processes. Since that time, the conversation has been steered towards the interactive and systemic nature of innovation (Johanessen, 2009; Berkhout et al., 2006; 2010), stressing the importance of knowledge as a key asset (Jensen et al., 2007; Nonaka & Teece, 2001). Much attention has been paid to Chesbrough (2003) and his later contributions (Chesbrough et al., 2006; Chesbrough, 2010), in terms of his description of open innovation. The use of external knowledge in internal development activities, the utilization of networks in commercializing outcomes, and using all forms of intellectual property rights are at the core of the open innovation paradigm (Chesbrough, 2003; Chesbrough et al., 2006). Critics such as Trott and Hartmann (2009) have also steered towards open innovation as a new paradigm. Their main concerns are that knowledge and interaction have always been at the core of innovation, and the prevailing descriptions of the innovation process are overly linear. As Trott and Hartmann (2009, p. 729) note in their call for modern innovation models, “There is no fixed point of origin like those demarcating the beginning of the outdated (but still widely used) ‘technology-push’ and ‘market-pull’ models”. Berkhout et al. (2010) also criticized the linear pipeline descriptions that dominate current literature on innovation, and
they suggest that the system of dynamic processes could be seen as a circle of change, presented as a cyclic innovation model (CIM): “Innovation may start anywhere on the circle and previous innovations will inspire new ones: innovations build on innovations” (Berkhout et al., 2010, p. 487). Prior research has partly neglected the dynamism and systemic interplay of innovations, although interaction and firms facing the challenge of working beyond their boundaries have been widely acknowledged in innovation studies (Johannessen, 2009; Trott & Hartmann, 2009; Chesbrough, 2003; Huston & Sakkab, 2006; Rothwell, 1994; Brusoni et al., 2001; Pisano, 1990).

2.2 Innovation categories

The literature often classifies innovations based on their characteristics, and classifications like product, process, service and organizational innovations are used to describe forms of innovation (e.g Tidd et al., 2005; Apilo & Taskinen, 2006; Apilo, 2010; Grant, 1996; Lam, 2006; Schumpeter, 1934). A quite natural outcome of this is, that despite the fact that these different forms are often interlinked, sometimes studies make the over-simplification of researching one without taking the others into account.

Another approach is the “novelty” of the innovation and the size of the leap forward. Incremental innovations are small improvements to an existing product, process or service that usually helps maintain or improve its competitive position. Radical innovation is entirely new, significant improvement in performance or a complex solution that existing ones cannot offer through improvements. Henderson and Clark (1990) state that this traditional categorization is incomplete and sometimes even misleading, and introduce the term architectural innovation. It is defined as innovation that changes the architecture of a product without changing its components. Tidd et al. (2005) extend this concept to innovations other than product innovations and point to, for instance, technology fusions, in which different technologies converge. The essence of an architectural innovation is the reconfiguration of an established system to link together existing components in a new way. Henderson and Clark (1990) show that architectural knowledge is often embedded in the
structures of established firms and information-processing procedures and might become useless during architectural change.

Most of the time, innovation takes place according the known rules and spaces, but sometimes the primary rules are modified and the framework dislocated. When one or more of the basic conditions, like technologies, markets or regulations, shifts dramatically, then the space, rules and boundary conditions have to be redefined (Tidd et al., 2005). This was also a central theme in Schumpeter’s *creative destruction*, related to his theory of innovation (Schumpeter, 1934; 1950; 1971). Such renewal is often discussed using the terms *radical, discontinuous* or *disruptive innovation*; for instance, Augsdörfer et al. (2013, p. 17-27) have presented researchers’ varying definitions of these terms. Abernathy and Utterback (1978) developed a model explaining the dynamics through *fluid, transitional* and *specific phases* (see also Utterback, 1994). These phases help to explain why organizations experience challenges dealing with discontinuous changes. Although technology is often seen as changing the rules of the game, Christensen (1997, 2003) draws attention to markets as a trigger of change. He introduces the term *disruptive innovation*, an innovation that helps create a new market and value network and eventually goes on to disrupt an existing business and ultimately (and often unexpectedly) overtake an existing market.

When exploring the innovation literature, one is struck by the impression that a large amount of research deals with innovations as autonomous outcomes of linear processes, often within legally defined organizations. The concept of systemic innovation was introduced to innovation management literature as a category of innovation requiring specialized, complementary assets for successful commercialization of the innovation in question (Teece, 1986) and extended to innovations whose “benefits can be realized only in conjunction with related, complementary innovations” (Chesbrough & Teece, 1996, p. 6; Maula et al., 2006, p. 243). This discussion also stresses the challenges of managing interconnected innovations and organizations. Technology-oriented studies focus more on parallel engineering challenges, as noted by Jaspers (2009, p. 193): “Systemic innovation refers to product development activities that involve the change of multiple interdependent components.” In the social innovation context of the European Union, systemic innovation has been defined as “A set of interconnected innovations, where each is dependent on the other, with innovation both in the
parts of the system and in the ways that they interact” (Davies et al., 2013, p. 4). Some scholars coming from political and societal perspectives and the research traditions of public structures instead of private-organization innovation management link the term systemic innovation to sociotechnical change (ST) or relate it to innovation systems (IS) literature (Kivisaari et al., 2009; Nieminen et al., 2011; Valovirta et al., 2011). This first research genre, ST, is based on earlier work by Geels (2002; 2004; 2005; 2006; 2010) focusing on a multi-level perspective of transitions, and the latter, IS, is based on a wide range of national and regional innovation system research (e.g. Edquist, 1997; Hekkert et al., 2011; Braczyk et al., 1998; Cooke, 2001; Harmaakorpi & Melkas, 2005).

As can be seen here, scholars coming from different fields use terms slightly differently in discussions of innovation. In his exploratory work, Miller (2012, p. 6-7) has summarized eight different interpretations of the concept “systemic innovation” along with their sub-categories: 1) a solution/catalyst/initiative designed and implemented to create systemic change, 2) social technology built around systems phenomena, 3) innovation created by a system, 4) a solution that is itself a system, 5) a multi-stage innovation process actively involving a whole system, 6) an organizational, systems-thinking problem-solving process applied to broader social systems, 7) an innovation process designed according to systems principles 8) systemic innovation as a process that results in the transformation of a system.

The main approaches presented above and leading to the definition used in this dissertation, are later introduced in greater detail. This study taps them as complementary sources of theory triangulation (see the section Methodology). The range of literature is one reason why aspects of systems are synthesized under the framework of knowledge, interaction and organizational interdependencies presented in this study.
2.3 Knowledge in the context of systemic innovation

“The purpose of active knowledge creation and sharing in innovation processes is to ensure that the most potential innovation opportunities are recognized and exploited in practice fully and quickly” (Bergman, 2005, p. 1)

Information related to autonomous innovations is often well understood within existing technologies, sometimes even embedded in industry standards and codified in norms. Systemic innovations, on the other hand, pose a unique set of challenges regarding information exchange, knowledge-refining processes and organizational adjustments (Chesbrough & Teece, 1996). Jensen et al. (2007) offer two supplementary modes of knowledge production: the Science Technology and Innovation (STI) mode is based on codified scientific and technical knowledge, while the Doing, Using and Interacting (DUI) mode relies on informal processes of learning and experience-based know-how and know-who, which are often tacit. Henderson and Clark (1990) state that innovation rarely involves dealing with a single technology or market, but rather a bundle of knowledge that is put together into the new configuration. Tidd et al. (2005, p. 15) also conclude: “Innovation is about knowledge – creating new possibilities through combining different knowledge sets.” Berkhout et al. (2006) see that, in the future, innovations will combine technical capabilities and customer needs across sectors. Bessant and Tidd (2007) describes this challenge as knowledge spaghetti – innovation is more than knowledge creation; it is about connections with complex knowledge flows thorough structures, networks, technological infrastructures and, above all, through people in a knowledge-rich environment. Nonaka et al. (2000) outline the organizational levels of knowledge creation, noting their tacit and explicit dimensions. The organization is an entity that creates knowledge by virtue of its actions and interactions with its environment and new syntheses of existing, firm-specific capabilities. The researchers argue that the traditional “information-processing machine view” of organizations is static and passive and fails to capture the dynamic process of knowledge creation. The most important aspect of understanding a firm’s ability to harness knowledge is its dynamism in continuously creating new knowledge out of existing firm-specific abilities (Nonaka & Teece, 2001; Nonaka et al., 2006). According to Lam (2006), organizations with different structural forms vary in their patterns of learning and knowledge creation, engendering different types of
innovative capabilities – which leads to the discussion of organizational adaptation and change, focusing on whether and how organizations can overcome inertia in the face of discontinuous technological changes and radical shifts in environmental conditions. The notion presented Sorenson et al. (2006, p. 994) is that “complex knowledge resists diffusion, even within the social circles in which it originated”, and Uotila (2008) notes the importance of intermediaries in facilitating knowledge transfer and increasing the absorptive capacity of actors in innovation systems.

An organization’s ability to value, assimilate and apply new knowledge is often characterized on Cohen and Levinthal’s (1990) notion of absorptive capacity (AC). Zahra and George (2002) developed this concept further by distinguishing between two different types of AC: potential absorptive capacity, which is critical to acquiring and assimilating external knowledge, and realized absorptive capacity, which refers to the functions of transformation and exploitation of the knowledge. They also suggest that there is a need for special social interaction mechanism between assimilation and transformation processes. AC is dependent on links across a mosaic of individual capabilities (Cohen & Levinthal, 1990) and formal and informal networks linked and strongly influenced by cognitive processes at the managerial level (Volberda et al., 2010). As Cohen and Levinthal (1990) have argued, firms can understand, absorb and implement external knowledge only when it is close to their own knowledge base. Re-ordering knowledge opens up new possibilities for transformation by challenging what is known and what is not (Kuusi & Hiltunen, 2011). Godkin (2010) discusses inertia in the context of AC; insight inertia appears when management does not observe and interpret cues from the external environment on time, and action inertia arises when the response to environmental activity is too slow or the information gathered is not adequate for generating actions and results beneficial to the organization. AC is used in this study, because it manifests the same principles as the other theories used in this study: a dynamic nature, certain path dependency with accumulation, personal and organizational levels embedded in formal and informal structures, and knowledge and interaction given a crucial role in networked innovation activities.

From a system perspective, a central issue in studies on knowledge and adaptive organizational processes is the relationship between the concepts of exploration and exploitation. March (1991) argues that processes focusing more on exploitation than
exploration are likely to be effective in the short run but self-destructive in the long run. The returns from exploration are less certain, more remote in time and organizationally more distant from the locus of action and adaption than the returns from exploitation. Adaptive systems that engage in exploration to the exclusion of exploitation are likely to find that they suffer the costs of experimentation without gaining many of its benefits. They exhibit too many undeveloped new ideas and too little distinctive competence. Conversely, systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in suboptimal stable equilibriums. As a result, maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival. It is noted that both exploration and exploitation are essential functions for organizations to prosper in the long run, but problems arise from the fact that they compete for the same scarce organizational resources. Finding the appropriate balance is also difficult because of system aspects. Exogenous changes make learning from experience difficult but essential for adaption. Learning is also challenged due the fact that individuals become more homogenous with their knowledge within organizations as time elapses. The individuals and the code share the same (but not necessarily accurate) beliefs, while each of the “equilibrium” adjustments aims to serve elimination of differences between individuals and the organizational code. These aspects of knowledge lead us to consider the roles of interaction and interdependencies in organizing. (March, 1991)

2.4 Interaction in the context of systemic innovation

Characterizing innovation as a social, non-linear and interactive process highlights the role of social capital in bridging and bonding actors. Tura and Harmakorpi (2005) present the often-used dimensions found in literature: 1) the structural dimension: the configuration of linkages between actors, like how to reach who, 2) the relational dimension: the personal relationships between the members of the network, e.g. reputation, respect and friendship, and 3) the cognitive dimension: social assets, such as systems of meanings, shared representations, values, and interpretations. Social networks affect the flow and quality of information and resources available through actors for activities (Granovetter, 1973; Burt, 2004; Smedlund, 2008; 2009; Dougherty, 2008; Håkansson & Snehota, 1995; Fjeldstad et al., 2012; Landry et
Granovetter (1973) introduced the concept of strong and weak ties in social networks. Burt (2004; 2005) has developed the “strength of weak ties” concept further by arguing that innovations are most likely to be found in structural holes between dense network structures. Actors who are able to benefit from structural holes are likely to create innovations, while new ideas emerge from selection and synthesis across the structural holes between different groups (Burt, 2004; Zaheer & Bell, 2005; Powell & Grodal, 2005). To utilize the systemic innovation potential in these structural holes, information should be transferred between partners who usually have different knowledge interests. However, this information transfer is sometimes hampered due to an organization’s “internal beliefs” and distances in an innovation network (publication 1, Table 3.1: Types of distance in innovation networks, Harmaakorpi et al., 2006; Parjanen et al., 2011). The partners participating in networked innovation processes on the opposite sides of structural holes have different knowledge interests and information bases accumulated for their own purposes (Melkas & Harmaakorpi, 2008). The difference is often so great that a special interpretative function is needed. Burt (1997) calls this special function information brokerage. Actors who have suitable connections can act as brokers and establish the necessary ties for activities between otherwise disconnected groups and knowledge clusters (Burt, 2004; Parjanen et al., 2010; Parjanen et al., 2011).

Networks and collaboration can be defined in various ways, for example based on how they share information, risks and benefits, or aspects of maturity or integration. Camarinha-Matos et al. (2009) and Pekkola (2013) use the categories 1) networking (exchange of information without a common goal), 2) coordinated networking (aligning activities), 3) cooperation (information exchange and adjustment of activities with resource sharing towards common goals), 4) collaboration (entities jointly plan, implement and evaluate activities to achieve value-generating goals). Powell and Grodal (2005) state that the better developed multiple multifaceted ties between organizations are, the better commitment and capabilities are able to handle complex knowledge with its tacit\(^2\) and explicit components. Håkansson and Snehota (1995) highlight that network development is not “change from one state to another”; it is

\(^2\) Seidler-de Alwis and Hartmann (2008) state that transfer of tacit knowledge requires personal and informal interaction, and Scharmer (2001) notes that self-transcending knowledge, aside tacit and explicit knowledge, requires an interplay of shared action, shared reflection and formation of shared will.
dynamic flux with the bonds, ties and links with actors, resources and activities, at times leading to conflicts and rearrangements of collaboration in networks.

The “Swedish IMP scholars” see that the key elements of any network are actors, activities and resources, and have developed the ARA model for studies (Håkansson, 1982; Håkansson & Johanson, 1992; Håkansson & Snehota, 1995; Johnsen & Johnsen, 1999; Figure 2). The ARA model describes the in-built dynamics of a network, its actors and resources, which makes it a suitable concept for use in this study. Due to the ever-evolving, network-based nature of the ARA model, it is a good fit for studies of systemic innovation activities. Many other network models also exist, but the ARA model was selected because its network aspects are theoretically closely related to the concept of interaction and knowledge as dynamic resource, while some other network models spring from theoretical bases closer to static perspectives, e.g. transactions within predefined resource alliances and value chains. The ARA model can also be easily linked to the dynamic capability (Teece et al., 1997; Eisenhardt & Martin, 2000; Galunic & Eisenhardt, 2001) extension of resource-based theory (see e.g. Barney, 1991; Foss, 1998) and includes both internal and external aspects of development related to its actors. The ARA model also reflects the path dependency in networks, and accepts the social dimensions related to interaction and shared activities participated in by different type of actors.

![Diagram of the ARA model](image)

Figure 2. The network model of actors, resources and activities (Håkansson, 1982; Håkansson & Snehota, 1995; Axelsson, 2010 – figure adopted from Johnsen & Johnsen, 1999)
The ARA framework builds on the three elements in networks: actors, activities and resources. Actors could be organizations, such as companies, governmental bodies or other stakeholders, units within an organization, or individuals. Actors carry out various activities (communication, development, production, distribution) to create value. In doing so, they need to have access to resources, such as knowledge. Ongoing activities lead to increasing connections between actors, which means larger networks emerge. Developing networks makes it possible to create new activities. Ongoing activities mobilize resources, causing resource networks to emerge and networks to change (Axelsson, 2010; Håkansson, 1982; Håkansson & Snehota, 1995; Håkansson & Olsen, 2011).

Recent organization design literature and discussions feature rather similar elements originating from different theoretical roots. Fjeldstad et al. (2012, p. 739) state that the development and delivery of complex products and services requires dynamic mechanisms that allow actors to become aware of problems and opportunities, identify and form relationships with suitable collaborators, self-organize\(^3\) and collectively manage their goals and resources. Fjeldstad et al. (2012) propose that new organization designs are based on an actor-oriented architectural scheme composed of three main elements: 1) actors who have the capabilities and values to self-organize, 2) commons where the actors accumulate and share resources, and 3) protocols, processes, and infrastructures that enable multi-actor collaboration.

Chesbrough and Teece (1996) have previously highlighted that the distinction between autonomous and systemic innovation is fundamental to the selection of organizational design. When innovation is autonomous, a decentralized organization can manage the entailed challenges quite well, but when innovation is systemic, organizations are often dependent on other organizations and their members with very limited or no control at all. Such organizations can be firms or public actors related to shared innovation activities that require complementary assets and institutional changes. According to Ståhle et al. (2003), four main

\(^3\) A note on the term self-organization: due various theoretical origins, it is used in the literature references slightly differently. In system literature, it can be generally described as the ability of a dynamic system to spontaneously arrange its components or elements in a purposeful (non-random) manner, under appropriate conditions but without the help of external agency. Some organization literature uses the concept without a clear connection to system theories, describing a rather similar phenomenon, but referring more to the management practices of an organization.
factors that constitute an organization and define it as a system are its relationships, information flows, know-how and power structures.

2.5 System approaches to organizational interdependencies

*Systems thinking* and *systems theory* are rather common terms used to describe the complex interaction between different elements – a seeking to understand phenomena as a whole (Stacey, 2011; Gharajedaghi, 2011). The concept of *innovation systems*, however, does not come from general systems theory; according to Hekkert and Negro (2011), it was developed as an answer to the suboptimal view of innovation in neoclassical economics (cf. the linear model of innovation). Models have also been presented for analyzing multi-level dynamics and interdependencies with specific aspects of subsystems, such as Pieper’s and Klein’s (2007) open system-based approach for family firms and the systems theory-based reflections on “familiness” of Frank et al. (2010). While “systems” are often discussed without a proper historical connection to sociological paradigms, some of the main concepts are presented from systemic innovation and organizational aspects. A short summary based on work of Burrel and Morgan (1979), Kast and Rosenzweig (1972), Thompson (1968), Levy (1994), Anderson (1999), Ståhle et al. (2003), Ståhle (2008), Stacey (2011) is provided below to support the construction of the theoretical backdrop and analysis.

2.5.1 Systems theories and thinking in organizing context

Barnard (1938) defines a formal organization as a system of consciously coordinated activities of two or more persons when 1) there are persons able to communicate with each other, 2) who are willing to contribute action, 3) to accomplish a common purpose. His theory is concerned with relationships between people, and not so focused on management structures (Burrel & Morgan, 1979). Simon (1947) integrates motivational and structural approaches to organization within the context of the theory of equilibrium, with the central issue of administrative theory forming the boundary between the rational and non-rational aspects of human social behavior. Selznick (1948) also focuses on both human and structural factors with a goal-oriented approach from a structural-functionalist perspective, while Simon focuses on organizations as decision-making entities. Selznick argues that although
organizations are formally rational, in practice they are heavily influenced by the organization’s informal and social structures. Perrow (1972) note that Selznick’s analysis covers many important topics, such as formal and informal organization, mechanistic and organic management, individual and organizational goals as well as the ways in which changes in organizational structure come. Following on the heels of closed models, the open systems approach of the 1950s gained attention, especially from the structural functionalists adopting equilibrium models. The concept of sociotechnical systems was formulated and further extended discussions on the open context. The argument is that, in an industrial system, there are technological, social and economic imperatives that must be satisfied. The technological, social and economic dimensions of an organization are seen as interdependent but each as having value of its own (Trist & Bamforth, 1951). Another open systems approach to the study of organizations is presented by Katz and Kahn (1966); their analysis is based on the assumption that social systems are homeostatic, processing the characteristics of negative entropy, feedback, differentiation and equifinality. The contingency theory presented by Lawrence and Lorsch (1967) is seen as loose framework for synthesizing the principal notions of open systems theory with several levels of organizational analysis in a variety of environmental conditions. The following subsystems are often identified: the strategic control subsystem, the operational subsystem, the human subsystem and the managerial subsystem. Contingency theory assumes that each of the subsystems is open to a range of variation reflecting the organization. (Burrel & Morgan, 1979)

Pfeffer and Salancik (1978) wrote that interdependence is a consequence of the open-systems nature of organizations obtaining resources for survival. Aiken and Hage (1968) use the concept of organizational interdependence to explore internal organizational behavior in joint activities with other organizations and their environmental effects. They also include aspects of conflict and cooperation when using the concept to focus on inter-organizational exchange. Thompson (1967) defined three types of interdependence to describe the intensity of interactions and behaviors within an organizational structure: pooled, sequential and reciprocal interdependence. Christensen (2007, p. 40) summarized these in a knowledge-sharing context as follows: “Pooled interdependence refers to processes where each part in the process renders a discrete contribution to the whole. Under serial interdependence one process must be performed before others, while under reciprocal interdependence the output of each
process becomes input for the others, and the distinguishing aspect is the reciprocity of the interdependence, with each unit being contingent on the other.” Under reciprocal knowledge sharing, both the receiver and sender of knowledge are in a variable and unpredictable situation, and they constantly need to adapt to each other (Christensen, 2007). Staudenmayer (1997) summarizes a wide range of prior interdependency literature from the perspective of information processing, resource-based theories and sense-making theories, and she comes to the conclusion that we should broaden our view of interdependence beyond that of simply a structured pattern of task relationships.

Cybernetics has been identified as one basis for exploring systems via communication and feedback (Wiener, 1948; 1950). Current views tend to depict organizations as complex, dynamic systems, whereas earlier views emphasized internal regulation and feedback processes. According to Ståhle et al. (2003), a dynamic systems paradigm focuses on the non-linear and unpredictable behavior of systems, rather than on controlled growth, and on internal dynamics and self-induced change instead of adaptation to the environment via feedback processes. According to their view, systems take advantage of sensitive non-linear interactions and co-working resonances between the system as a whole and its sub-systems. It emphasizes the capacity of systems for spontaneous renewal and ability for self-induced change – instead of the organic paradigm, with its open and constant interaction with the environment allowing change through evolution and internal regulation (Ståhle et al., 2003; Ståhle, 2008).

The diversity of perspectives on change and systems can be understood when considered from the premise that a single actor only focuses in its own part of system. Its perspective depends on its own aims, history, roles, knowledge and interests in its activity context within a certain, often operative, time frame. As Håkansson and Olsen (2011, p. 8) state, “nobody will have complete picture or anything close to it”, and views are relative; interpretations vary based on the viewer in the landscape. Drazin and Sandelands (1992) point out that systems consisting of independent actors whose interactions are governed by a system of recursively applied rules naturally generate stable structures. They self-organize; pattern and regularity emerge without central control. Self-organization, “autogenesis”, is the natural result of nonlinear interaction, not any tendency of individual agents to seek order (Fontana & Ballati, 1999).
complex adaptive systems, agents only act on the information available in their immediate environments, from those few agents connected to them in a feedback loop. As highlighted by Anderson (1999) and Ståhle et al. (2003), Brown and Eisenhardt (1997; 1998) and Weick (1979) see that organizations continue to exist only if they maintain a balance between flexibility and stability. Another important notion is presented by Anderson (1999), based on Bak’s (1996) observations, that a system replaces the weakest agent based on fitness; the least efficient is replaced by new entrant from better fitting pool of candidates. Both of these – co-evolutionary adaptation through flexibility and replacements – are important aspects of innovation activities; they impact networks and as well as organizations (Anderson, 1999). The key element is the network of actors – knowledge, as other resources, is valued constantly based on its evolutionary position and the network connections related to actors in feedback loops. Replacements in particular will change the tacit knowledge structures and conceptions of power embedded in organizations and networks (Howells, 2002). Doz (1996) has pointed to the role of strategic and operational interdependencies between what an alliance encompassed and what the actors accomplished separately – interaction led to adaptation and successful evolutionary projects. Valkokari (2009, p. 113) summarizes the key concepts of complex system theory into aspects of business networks by linking openness, emergence, self-reference, connectivity, interdependency, diversity, dimensionality, nonlinearity, co-evolution and aggregation in practical, organizing aspects of networks and vision formation based on shared aims. She comes to the conclusion that interdependency and diversity play important roles in self-organization and network-level renewal, due to interpretations of the environment and the activities required, especially in radical collaborative innovations (ibid.).

As the literature reveals, general systems theory (Von Bertalanffy, 1968) introduces large numbers of concepts to dissect the dynamics of so-called complex adaptive systems, whereby co-evolution, self-organization and emergence are seen as core concepts. Co-evolution refers to the interaction process between different systems through those adapted to each other; this interaction is reciprocal. The system as whole also adapts to changes in its environment because of the capacity of individual components to respond to changes in their environment. Self-organization means the emergence of order without external control. When a complex system is at the edge of chaos, these radical changes may occur suddenly. The occurrence of crises is seen as one characteristic of complex adaptive systems. Emergence refers to the birth
of new patterns. In complex systems, there is an interaction between fast and slow dynamics at different scales, but change is always present and continuous. A dynamic equilibrium means a constant process of minor incremental adjustments; the term attractor is used to describe this certain state in which system drives itself with no easy access out. Relatively long periods of such adaption alternate with short periods of radical change. The transition dynamics of societal systems are seen as a particular case of such complex system dynamics. Transitions occur when the system and its environment somehow grow apart. (Loorbach, 2007; Rotmans & Loorbach, 2009; Anderson, 1999; Laszlo & Kipper, 1998)

2.5.2 Innovation systems and sociotechnical transitions

Innovation systems and sociotechnical transitions with a multi-level framework are closely related concepts for the study of environmental change in technology and business. They draw from common theoretical roots and share phenomena but follow mostly independent research strands related to radical innovation processes and fundamental transformations of entire economic sectors (Markard & Truffer, 2008). The concept of innovation system stresses knowledge flows between different actors as being key to innovation (Hekkert et al., 2011). Actors can be individuals, enterprises and institutions. A formal definition of an innovation system based on the Freeman’s (1987) definition is “the networks of organizations and institutions in the public and private sectors whose activities and interactions initiate, import and diffuse new technologies.” Another even broader definition by Edquist (1997) is “all important economic, social, political, organizational, institutional factors that influence the development, diffusion and use of innovations”. Hekkert and Negro (2011) see such broad definitions as problematic but expressive of the notion that innovating firms are embedded in a wider socio-economic environment where political and cultural influences in addition to economic policies impact innovation activities. According to Hekkert et al. (2007), analyzing the social and institutional structures of different innovation systems is challenging due to the dynamic nature of technological change and its interconnection to systems transformation. Coenen and Díaz López (2010) distinguished the following dimensions of system approaches: system boundaries, actors and networks, institutions, knowledge, and dynamics. Hekkert et al. (2007; 2011) and Hekkert and Negro (2011) synthesize seven main functions: entrepreneurial activities, knowledge development, knowledge exchange, guidance to search, formation of
markets, mobilization of resources and counteracting resistance to change. A dynamic framework seems to be part of a wider tendency in the innovation system literature to focus not only on changes in the system, but changes of the system as well (Bergek et al., 2008; Coenen & Díaz López, 2010). The notions presented above are often discussed in a policy context; they confirm the premise that firms do not innovate in isolation, and such dimensions should be considered in systemic innovation studies approaching challenges from an organization perspective.

The frameworks of technological innovation systems, sectorial systems of innovation and sociotechnical systems are commonly used approaches to examining innovations (Coenen & Diaz López, 2010; Nieminen et al., 2011). The purpose of technological innovation systems studies has been to show how technological innovation gives rise to economic growth (Coenen & Diaz López, 2010). In the sectorial systems literature, innovation is primarily seen as a means for firms and industries to achieve competitiveness (Coenen & Diaz López, 2010). The national innovation system (NIS) approach places a major emphasis on country-specific factors influencing innovation. Actors sharing a common culture, history, language, social and political institutions are identified using national boundaries (Edquist, 1997). The focus of the NIS is to identify the importance of interactions among the many agents within a single country and the way in which they support learning that promotes innovation (Hekkert & Negro, 2011; Lundvall, 1992). In the regional innovation systems (RIS) approach, the basic idea is similar to that of NIS but the unit of analysis is a region (Hekkert & Negro, 2011; Braczyk et al., 1998). Prior discussions have also widely covered aspects of RIS (Braczyk et al., 1998; Cooke, 2001; Harmaakorpi, 2004; Harmaakorpi & Melkas, 2005; Pihkala et al., 2007; Kallio et al., 2010), such as knowledge flows among intermediates and firms and also the use of future-oriented knowledge in regional innovation processes (Uotila, 2008). The ST system literature is first and foremost interested in how new configurations around large sociotechnical systems emerge and are retained in society, interlinking innovations, transitions and system changes (Geels, 2002; 2004; 2005; Geels & Schot, 2007). Niche innovations, sociotechnical regimes, and the sociotechnical landscape (Figure 3) are used to describe the interplay of various levels related to transitions (Geels, 2002; 2004; 2005; Geels & Schot, 2007; Loorbach, 2007).
Recent studies have also pointed out the difference between innovation and transition policy in complex innovation environments (Alkemade et al., 2011). Loorbach (2007) discusses transition management and the role of innovations in transitions, including complex adaptive systems as a background theory for multi-level frameworks. Loorbach (2007) presents a cyclical process model as a basis for operational management of actors with multi-level governance. It consists the following components: 1) problem structuring, establishment of the transition arena and envisioning; 2) developing coalitions and transition agendas (transition images and related transition paths); 3) establishing and carrying out transition experiments and mobilizing the resulting transition networks; 4) monitoring, evaluating and learning lessons from the transition experiments and, based on these, adjusting the vision, agenda and coalitions. In reality there is no fixed sequence of the steps in transition management, and in practice, transition management activities are carried out in parallel and a random sequence (Loorbach, 2007).
The multi-level perspective of ST also has its critics, as the theory reflects the past instead of future-orientation aspects (e.g. Genus & Coles, 2008). There have been attempts to link innovation systems and systemic innovations to a futures perspective, such as the frameworks of Kaivo-oja (2011), and strategic aspects of path dependency within organizations that interpret future-oriented information as a part of innovation systems, such as Ahlqvist et al. (2012), which construct organisational capacities for future orientations based on systemic transformation, anticipatory culture, and knowledge spaces.

2.6 Theory synthesis

This section summarizes the literature review to capture the essentials for the empirical part of this dissertation. Traditionally most innovation models are rather linear. They often describe the processes along the innovation path as a causal sequence: investments in scientific research leading to application-oriented development, resulting in successful market introductions (Berkhout et al., 2006; 2010). Rather often innovation is viewed primarily from a technological orientation, causing insufficient attention to be paid to the social and behavioral sciences. Recent studies increasingly focus on the systemic aspects of interconnected innovation processes and complex collaboration with various types of human and technological interaction (Nieminen et al., 2011; Berkhout et al., 2010). This study follows the latter author in viewing co-evolving innovations and actors, and using system theory to support the analysis of organizing for systemic innovations (Figures 4 and 6). In most systems, feedback is seen as a natural phenomenon. This means that a path exists that carries part of the output back to the inputs, as in systemic innovations. This makes innovation very complex and, therefore, interaction often has unexpected consequences which we do not fully understand beforehand. This challenges future orientation and foresight activities, while the impacts create changes in innovation space, requiring further adaptation and causing new innovations to follow innovations. This highlights looped interconnections and explains why many innovations cannot be approached with linear closed models.

Despite living in an interconnected world, the barriers to creating new innovations remain. Often actors are on, and activities take place in, different vertical levels and horizontal slots,
causing friction due to conflicting interests and timing challenges. Issues are often described as economical, technological, normative, or organizational – and sometimes characterized, e.g. as intra- and inter-organizational issues, viewed as multi-level perspectives on transitions, or analyzed on micro-/macro-levels. Based on these different views, it seems that particularly for systemic innovations an environment must be created where a large diversity of actors with a broad range of backgrounds can freely interact and exchange information. Brokering knowledge and actors are seen important due to the different distances in innovation activities (Parjanen et al., 2010). Loorbach (2007) has used the term transition arena when describing one form of such an entity, aiming to integrate the actors and activities. This type of approach requires a significant change in the current institutional cultures and social structures as disciplinary boundaries are deeply rooted in our organizations and the offered solutions are often a collection of segmented optimizations instead of a total answer (Berkhout et al., 2010).

![Organizing multiple actors in an innovation system](image_url)

Figure 4. Systemic innovations in a dynamic environment

Figure 4 illustrates how an idea transforms into an innovation. In systemic innovation various actors are needed to join, co-develop, and control innovation; in contrast to autonomous innovation. Actors have their own continuously developing knowledge bases complementing each other in their shared aims but they also have unique interests, causing friction and
challenging openness. Collaboration requires adaptation in organizations but also development of the environment where actions take place. This can be seen, e.g. in the forms of normative regulation driven by policy makers or in changing customer habits, and such changes are reciprocal – they also guide and form innovation. This challenges us to think how an organization developing a systemic innovation can be defined. Organization does not follow the juridical dimension of one organization (e.g. one company’s boundaries) while innovation takes place in a cross-section of sectors and is conducted by multiple actors (Figure 6) – this also often causes internal tension for the participating organizations. Further, the customers and environment are seen to be at the core of reciprocal organizing for innovation. This whole entity is often also referred to as an “ecosystem”, e.g. in the telecom business.

The common thread bringing these above presented approaches together for this research is that all of them discuss the interaction and reciprocal interdependencies of actors and levels in dynamic knowledge processing that leads to renewal. Therefore, the literature and analysis are synthesized under the main concepts of knowledge, interaction, and organizational interdependencies – and analyzed on a meso-level. This guides us to consider the phenomenon’s characteristics from a dynamic perspective while organizing in and between collaborative parties under the challenges of a multi-level structure. As Fontana and Ballati (1999, p. 15-16) summarize, “The history of an organized system is not merely the series of events in which the system had been involved. It is the series of transformations by which the system was progressively formed. This means path dependence and frozen accidents. Early architectural decisions cannot be reversed if the functioning of many components depends on them… however, by the very process of adaptation, organizations participate in the construction and active maintenance of the world to which they are adapting.”

In this study innovation systems literature emphasizes that actors are embedded in a wider socio-economic environment, where policies and norms impact activities through various channels and levels. This can also be viewed as one form of feedback. The multi-level perspective on socio-technical transitions is used to illustrate the regime and landscape changes related to innovation diffusion. System theory is used to understand the system dynamics and adaptation required from organizations. Organizational theories help to
understand human behavior when organizing for systemic innovations during changes in a networked environment. Knowledge is seen as a key ingredient for innovation and is approached from a dynamic perspective, including the tacit and codified elements challenging organizing for refining information into useful knowledge. Absorptive capacity is used to understand the challenges in knowledge transfer and creation in and between organizations during innovation activities. All these theoretical perspectives share a view of the system’s dynamism with a certain path dependency in the chosen context.
3 RESEARCH STRATEGY AND METHODOLOGY

3.1 Research method

Burrell and Morgan (1979) state that all organizational theories are based upon a philosophy of science and a theory of society. They suggest that social science can be conceptualized in terms of four sets of assumptions: 1) assumptions of an ontological nature that concern the phenomenon studied, 2) assumptions of an epistemological nature that concern the basis of knowledge, 3) assumptions concerning human nature and, in particular, the relationship between human beings and their environment, and 4) assumptions of a methodological nature. These four assumptions determine the way we investigate and obtain “knowledge” about the social world, with subjective and objective dimensions related to those assumptions (Ibid).

Subjective means that perceptions and experiences that may be different from person to person and change over time and with context. Instead of subjectivism, the term constructionism is often used to describe the social nature of reality. In a constructionist perspective, social actors produce social reality through social interaction. Objectivism assumes that social reality has an independent existence outside the knower, i.e., the researcher. (Eriksson & Kovalainen, 2008)

There are two basic models by which scientific knowledge can be achieved: deduction and induction. Deduction rests on the idea that theory is the first source of knowledge, and the subsequent research process leading to the empirical study is rather linear. Deductive reasoning is concerned with the formulation of hypotheses and theories based on which particular phenomena can then be explained. Inductive research, on the other hand, starts from empirical material towards theoretical results. Inductive reasoning draws on observed cases to generate general statements or general claims about most cases of the same kind. These two models seldom exist in pure form; most social research involves both inductive and deductive reasoning processes. Some research literature offer abduction\(^4\) as a way of combining

\(^4\) The literature often mentions Charles S. Peirce as the original developer of the concept of abduction, citing his works *How to Make Our Ideas Clear*, *The fixation of belief*, and *Deduction, induction, and hypothesis*. Dubois
deduction and induction. Abduction refers to the process of moving from everyday
descriptions and meanings given by people to concepts that create the basis of an
understanding or explanation of the phenomenon described. In practice, abduction is difficult
to separate from iterative work related to empirical research. Dubois and Gadde call an
abductive approach in case-study research “systematic combining” and describe it as a
nonlinear, path-dependent process of combining efforts with the ultimate objective of
matching theory and reality. (Eriksson & Kovalainen, 2008; Dubois & Gadde, 2002)

Research methodologies are often classified into two main categories: quantitative and
qualitative approaches. They originate from different scientific paradigms. Quantitative
research is often seen to have its roots in positivism, assuming that only knowledge gained
through measurements and objective identification can be seen as the truth (Gummesson,
1991; Eriksson & Kovalainen, 2008). Qualitative research is often labeled as interpretative (or
hermeneutic, as by Gummesson, 2000, p. 176). The strength of qualitative data is seen in
lying in its richness and holism, with a strong potential for revealing complexity and the
nature of “real life” (Miles & Huberman, 1994).

This study is a qualitative case study that follows abductive logic, and can be seen to be
hermeneutic in its general approach of connecting theories and cases within this umbrella
study, instead of using the strict circular methodology in case research. This study aims to
create a holistic understanding of a phenomenon using primarily qualitative data within
empirical case studies, while simultaneously exploring complementary theories to explain the
phenomenon (Figure 5). Following Gummesson (2000, p. 93), validity is seen as continuous
process that is integrated with theory and that requires the researcher to continuously asses his
assumptions, revise his results, retest his theories and models and reappraise the given
limitations that have been set for the study. According to Brinbergh and McGrath (1985, p.
17), validity network schema research is the study of relations between elements. As they
note, “The research process is the identification, selection, combination and use of elements
and relation from the conceptual, methodological and substantive domains,” referring to the
properties, patterns and relations of phenomena and the methods and strategies used to study

and Gadde present the abductive approach in a case research context in their article “Systematic combining: an
abductive approach to case research”, and Mantere and Ketokivi present abduction as the successful basis for
how scientific discoveries are made in their article “Reasoning in Organization Science”.

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them. As Rautianen (2012) notes, a good research question alone is not enough; researchers should develop rich insights into the phenomenon. This study approached the phenomenon from various perspectives based on theories and complementary cases, creating rich insights to the topic, including elements and relationships previously familiar to the researcher in a practical context, which gave a supportive pre-understanding for planning and conducting the study.

3.2 The case study approach

“The case study approach is the preferred method when 1) “how” or “why” questions are being posed, 2) the investigator has little control over events, and 3) the focus is on a contemporary phenomenon within a real-life context.” (Yin, 2009, p.2)

Methodologically classic case studies are linked to interpretative, ethnographic and field-research traditions and diverge distinctly from experimental, quantitative and deductive research traditions aiming at producing statistical generalizations (Dyer & Wilkins, 1991; Eriksson & Kovalainen, 2008). Despite the qualitative spirit of case study research, they can also entail quantitative data. This means that case study research is a research approach or strategy rather than a method (Eriksson & Kovalainen, 2008). A common feature of various definitions of case study research is the emphasis of the production of detailed and holistic knowledge based on the analysis of multiple empirical sources rich in context (Tellis, 1997; Eriksson & Kovalainen, 2008). Case studies often combine various data collection methods, such as archives, interviews, questionnaires, and observations. Using quantitative and qualitative research methods in combination produces the best results (Yin, 2009; Flyvbjerg, 2006; Voss et al., 2002; Eisenhardt, 1989). Many case studies follow the processes outlined by Eisenhardt (1989, p. 533) and well-known processes presented by Yin (2009, p. 57), which describe the conducting of multiple case studies. This study also applied these generally accepted frames (e.g. Table 1). It defines the research questions suitable for case studies, selects theoretically useful cases (Table 2), uses multiple data collection methods when entering the field (Table 3), analyses data through multiple lenses and theories (Table 4), and reflects the literature in its outcomes.
Case-study research is often used to contribute to our knowledge of individual, group, organizational, social, economic, and political phenomena. Voss et al. (2002, p. 197), summarize the strengths of case research based on the work of Meredith (1998) and Benbasat et al. (1987): “The phenomenon can be studied in its natural setting and meaningful, relevant theory generated from the understanding gained through observing actual practice. The case method allows the questions of why, what and how to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon.” Dubois and Gadde (2002) highlight the challenges of the case study method when the research object is

Table 1. The process of building theories from case study research (Eisenhardt, 1989, p. 533)

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting started</td>
<td>Definition of research question</td>
<td>Focuses efforts</td>
</tr>
<tr>
<td>Selecting cases</td>
<td>Possibly a priori constructs</td>
<td>Provides better grounding of construct measures</td>
</tr>
<tr>
<td></td>
<td>Neither theory nor hypotheses</td>
<td>Retains theoretical flexibility</td>
</tr>
<tr>
<td>Selecting cases</td>
<td>Specified population</td>
<td>Constrains extraneous variation and sharpens external validity</td>
</tr>
<tr>
<td></td>
<td>Theoretical, not random, sampling</td>
<td>Focuses efforts on theoretically useful cases, i.e. those that replicate or extend theory by filling conceptual categories</td>
</tr>
<tr>
<td>Crafting instruments and protocols</td>
<td>Multiple data collection methods</td>
<td>Strengthens grounding of theory by triangulation of evidence</td>
</tr>
<tr>
<td></td>
<td>Qualitative and quantitative data combined</td>
<td>Synergistic view of evidence</td>
</tr>
<tr>
<td></td>
<td>Multiple investigators</td>
<td>Fosters divergent perspectives and strengthens grounding</td>
</tr>
<tr>
<td>Entering the field</td>
<td>Overlapping data collection and analysis, including field notes</td>
<td>Speeds analysis and reveals helpful adjustments to data collection</td>
</tr>
<tr>
<td></td>
<td>Flexible and opportunistic data collection methods</td>
<td>Allows investigators to take advantage of emergent themes and unique case features</td>
</tr>
<tr>
<td>Analyzing data</td>
<td>Within-case analysis</td>
<td>Gains familiarity with data and preliminary theory generation</td>
</tr>
<tr>
<td></td>
<td>Cross-case pattern search using divergent techniques</td>
<td>Forces investigators to look beyond initial impressions and see evidence through multiple lenses</td>
</tr>
<tr>
<td>Shaping hypotheses</td>
<td>Iterative tabulation of evidence for each construct</td>
<td>Sharpens construct definition, validity, and measurability</td>
</tr>
<tr>
<td></td>
<td>Replication, not sampling, logic across cases</td>
<td>Confirms, extends, and sharpens theory</td>
</tr>
<tr>
<td></td>
<td>Searching evidence for “why” behind relationships</td>
<td>Builds internal validity</td>
</tr>
<tr>
<td>Enfolding literature</td>
<td>Comparison with conflicting literature</td>
<td>Builds internal validity, raises theoretical level, and sharpens construct definitions</td>
</tr>
<tr>
<td></td>
<td>Comparison with similar literature</td>
<td>Sharpens generalizability, improves construct definition, and raises the theoretical level</td>
</tr>
<tr>
<td>Reaching closure</td>
<td>Theoretical saturation when possible</td>
<td>Ends the process when the marginal improvement becomes small</td>
</tr>
</tbody>
</table>
undergoing changes during the period of observation, but with a proper approach, such unexpected changes can be turned into strengths, as in this study. It has been claimed that the interaction between a phenomenon and its context is best understood through in-depth case studies, and learning from a particular case conditioned by the environmental context should be considered a strength rather than a weakness. Qualitative methods and case study research are often misunderstood and criticized, but nowadays they are better accepted as delivering important knowledge that quantitative research cannot achieve with its own variables in social and cultural constructions (Silverman, 2001; Eriksson & Kovalainen, 2008; Denzin & Lincoln, 2008; Flyvbjerg, 2006). According to Yin (2009), rigor has been one of the greatest concerns in terms of elements that could bias the direction of a case study’s findings and conclusions. Several authors in book edited by Gomm et al. (2000) discuss the challenges of the case study method, especially when it comes to generalization; Lincoln and Guba (2000) stress the point that generalizations and categories are active creations of the mind instead of existing in real nature. Yin (2009) contrast the value of analytic generalization in qualitative case studies to statistical generalizations often based on quantitative studies. Pålshaugen (2009) highlights the value of action-oriented case studies in an organization and innovation research context and offers general validity and practical concerns to make judgments outside of scientific aspects. Case studies can create useful knowledge for other organizations struggling with similar challenges, as well as for various national programs supporting innovation systems.

Case studies can be classified as single-case and multiple-case/collective case studies (Eisenhardt, 1989; 1991; Leonard-Barton, 1990; Eriksson & Kovalainen, 2008; Yin, 2009). An intensive case study design focuses on finding out as much as possible on one or few cases, while an extensive design aims at mapping issues and common patterns across cases (Stoecker, 1991; Eriksson & Kovalainen, 2008). This study builds on complementary in-depth case studies (Table 2 and Table 3) exhibiting the intensive dimension with action-oriented and retrospective cases. Applying abductive logic (which is generally found especially suitable for analyzing system aspects; for instance, by Dubois and Gadde, 2002), the present study builds a synthesis of the cases and prior theories to understand the described phenomenon within the research context (Figure 5).
3.3 Research design, unit of analysis and case selection

Yin (2009) states that for case studies, five components of a research design are especially important: 1) a study’s questions; 2) its propositions, if any; 3) its unit(s) of analysis; 4) the logic linking the data to the propositions; and 5) the criteria for interpreting the findings. These components should be in line with the unit of analysis and especially with the definition of the cases and used theories.
The focus of this study is the meso-level (Figure 6). In general, a meso-level analysis indicates aspects (e.g., population size) that fall between the micro- and macro-levels, (such as a community or an organization). The meso-level also refers to analyses that are specifically designed to reveal connections between micro- and macro-levels (Turner, 2005). The investigation of organizing for systemic innovations involves both aspects, from intra- and inter-organizational perspectives. This study focuses on the parts of organizations (Figure 6) that enable interaction with other actors and adaptation to the changing environment. The study is challenging due to the fact that it is impossible to precisely define beforehand who the collaborating parties will be in emerging alliances as the systemic entity evolves in nascent systemic innovations. Some methods can help researchers manage this complexity, such as qualitative methods with a retrospective perspective and longitudinal view and an action research orientation. These methods were applied in this study. The above presented can be seen as being in line with the general network approach of the “IMP scholars” who utilize the ARA model as described by researchers such as Valkokari (2009) in her study of business networks. This present study focuses on the feedback and changes caused by systemic innovations among the actors involved and on loops creating new complementary innovations. This study starts from the premise that individuals and networks play important roles in aspects of organizing (e.g., Thompson, 1967; Rothaermel & Hess, 2007). This study is
also constructed in a subjectivist way that accepts organizations as constructions of the human
mind and that varying interpretations of what are understood as systemic innovation and
environmental changes are relative to observer’s viewpoint. It also accepts the dynamism
present in changes in the system and the changes in interpretations related to the system. The
basics are, therefore, closer roots to what Stacey (2011, Chapter 3 and 9) calls second-order
thinking: the social nature of organizational processes instead of hard, first-order systems
thinking. It also acknowledges the fact that individuals belong to several systems
simultaneously and drawing the boundaries of systems as well as defining organizations is
very challenging because of this. This naturally concerns the systemic innovation itself and
the actors participating in it.

Based on the information presented above, the analysis covers systemic innovation as it
influences an organization’s interactions – accepting possible changes in the innovation
conventions and actors related to the activities and the in-built dynamics of organizations and
institutions. The universal elements summarized by Hekkert et al. (2011; 2007) and Coenen
and Díaz López (2010), including system boundaries, actors and networks, institutions,
knowledge, dynamics and policy, offer guidelines for observing the systemic innovation
interconnection among the actors involved when applying system results on an organizational
level. An organization’s limits and conditions are also considered from various dimensions
impacting interaction and interdependencies, like those presented by Santos and Eisenhardt
(2005, p. 502): “The efficiency conception adopts a legal view in which boundaries are
determined by the efficient locus of transactions. The power conception adopts a permeable
view whereby boundaries are conceptualized in terms of the sphere of influence over other
organizations and institutions. The competence conception is a dynamic view whereby
boundaries are seen in terms of the resource portfolio that coevolves with the environment.
The identity conception takes a holistic view, such that boundaries are the often unconscious
mind-set that organizational members use to gain cognitive and emotional coherence about
‘who we are.’” Case studies were seen as a suitable approach for capturing the various
dimensions, and one case (Case 4) was especially chosen to focus on this issue.

All research projects have a specific time-span and limitations in terms of resources (Eriksson
& Kovalainen, 2008), which is especially relevant in the systemic context. The cases in this
study were selected to cover a wide range of the actors involved in innovation networks. Each case investigates unique aspects of systemic innovations and the changing environments and their impacts on organizations. The cases enrich and complete each other, bringing new insights to topic under investigation. When it comes to strategic considerations in the selection of cases (Flyvbjerg, 2006, p. 230 and Patton, 1990, p. 169-186), it must be noted that the various strategies for selection are not necessarily mutually exclusive. For example, a case can be simultaneously extreme, critical, and paradigmatic, and it is sometimes impossible to determine this in advance. The interpretation of such a case can provide a unique wealth of information, because various perspectives and conclusions are obtained from the case (Flyvbjerg, 2006). Eisenhardt (1989) advises that cases should follow replication rather than the sampling logic often used in surveys. According to Yin (2009), in the replication approach, each individual case study consists of a “whole” study, in which convergent evidence is sought regarding the facts and conclusions for the case; each case’s conclusions are then considered as the data needing replication in the other individual cases. The results of both individual cases and multiple cases can and should be the focus of a summary report, as also done in this dissertation.

In this study, the cases were designed to capture a variety of elements involved in organizing for systemic innovation. To make this possible, the case selection included different dimensions of the field and various actor-specific factors.

- Different fields of business with different built-in dynamics (mature vs. rapidly changing environments)
- Technology and customer-driven sectors, as well as sectors combining both
- Different types of actors, organizations and network structures undergoing change
- Private organizations and politically steered public organizations, as well as collaboration between the two
- Constructions challenging formal organizational boundaries in innovation activities, models other than purely closed models or purely open models often discussed
- Various aspects of sociotechnical transition while organizing for systemic innovation from the actors’ perspectives

Cases 1-6 were chosen based on the following criteria regarding various complementary aspects of organizations:
1. In systemic contexts, it is very important for actors to anticipate the future, or even foresee what is coming in the technology and business environments. This being the case, it is important to explore the literature on foresight and find empirical evidence on what takes place in firms and participatory organizations delivering future-oriented information. This step was conducted applying aspects of bridging innovation and foresight in a practice-based approach (publication 1) and then observing the challenge between the SMEs and intermediaries in foresight information processing (Case 1, publication 2).

2. A case organization considered to be innovating in a rather settled, mature field of business was found in the food industry (Case 2, publication 3). This industry offered interesting insights on combining complementary processes and product innovations with changing consumer trends. The purpose was to analyze knowledge and interaction dynamics in a very traditional context of actors performing R&D tasks. Another focus was internal organizational aspects related to external knowledge.

3. A case that could deliver the challenge of internal organizational adaptation under tremendous changes in the organization’s field due to technological developments and rapidly changing customer habits was found in the field of media (Case 3, publication 4). The purpose was to analyze forced changes in organizational design and their impact on innovation processes and collaboration across traditional unit boundaries, along with the capabilities of utilizing external parties in innovation activities.

4. Discussions of innovation and system approaches focus primarily on organizations with legal standing, like firms and public-sector organizations or institutions. Nevertheless, some discussion has dealt with dimensions of less clearly defined organizations, such as open software communities, skunkwork groups or communities of practice (Wenger, 1998). As people usually belong to several systems simultaneously, as do the organizations led by these people, a case that investigates this perspective is interesting. A case that combined aspects of hidden interdependencies and several interconnected systems while still capturing the organizational perspective was found in a family business context. The innovation literature in the field of family business argues primarily whether or not family firms are more innovative than other companies, while the entrepreneurial literature has captured some of the
longitudinal systemic aspects in the context of a family business portfolio. By including such “long-time institutions” like family in systemic innovation contexts, we should be able to find some important insights on individuals, organizations and businesses related to systemic innovations (Case 4, publication 5).

5. Some institutions, such as educational ones, play an important role in innovation activities. Studying Finland’s universities of applied sciences (UAS) with an approach that focused on structures of collaboration with SMEs was a natural choice. A suitable case was determined in southern Finland; it covered several UAS and their cooperative activities with wide range of SMEs. The Finnish education system has been undergoing major shifts lately, and it is still searching for optimal intra- and inter-organizational approaches to fulfilling its regional role in the national innovation system. The role of UAS as an educational actor and service provider between universities of the sciences and firms is interesting from our knowledge-based research view of systemic innovations (Case 5, publication 6).

6. Since many systemic innovations evolve and are developed in the public sector, it was necessary to find a case capturing the essence of change in this field. An excellent case was found in home-care services, describing the challenge of interdependencies in public-sector organizations and the need to meet external pressures regarding efficiency. These public-sector organizations have to combine several different types of innovations and carefully focus on their customer demands and normative issues related to service, while collaborating on development with private-sector firms such as IT or sub-service providers. The public sector has also often been accused of having more inertia than the private sector and being less willing to renew, building up pressures for forced change due to limited resources and financial demands in the current economic situation (Case 6, publication 7).
Table 2. Case selection and a general description of the chosen foci and approach in each case.

<table>
<thead>
<tr>
<th>Focus</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
<th>Case 5</th>
<th>Case 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector / field</td>
<td>General foresight information for firms, delivered by public intermediaries</td>
<td>Food industry, private.</td>
<td>Media, private.</td>
<td>Private business portfolio, including several business sectors</td>
<td>UAS, public education.</td>
<td>Home care, public sector.</td>
</tr>
<tr>
<td>Focus on organizing</td>
<td>SME – Intermediaries. Focus on SME characteristics in organizing to utilize foresight information for innovation.</td>
<td>Medium/large size – open-context collaboration. Internal and external organizing dynamics with multiple actors related to a field.</td>
<td>Large size, internal multi-unit perspective to enable internal and external collaboration across internal boundaries.</td>
<td>Using several legally determined firms from different fields as an interaction platform in organizing for innovation.</td>
<td>SME – UAS; focus on organizing universities for SME collaboration.</td>
<td>Collaboration dynamics between politically steered public organizations and privately owned SMEs. Analyses of the development of home-care service delivery.</td>
</tr>
<tr>
<td>Knowledge</td>
<td>AC; Foresight type knowledge and context related process challenge; knowledge transformation</td>
<td>Sourcing and creating knowledge, process dynamics.</td>
<td>Separate operational knowledge stocks and processes.</td>
<td>Knowledge embedded in the systems of several firms and social constructions.</td>
<td>Different knowledge creation modes (STI and DUI).</td>
<td>Combining context-related knowledge from various actors.</td>
</tr>
<tr>
<td>Interaction</td>
<td>AC; transformation platform for SME interaction</td>
<td>Openness, internal and external collaboration.</td>
<td>Internal organizational designs and innovation process.</td>
<td>Interaction for and due innovation activities in multiple firm constructions, guided by individual, social and business drivers.</td>
<td>The role of AC and SC in interaction for utilizing knowledge, produced with different modes by different actors.</td>
<td>Private – Public collaboration, emerging interaction networks based on actors, activities and resources.</td>
</tr>
<tr>
<td>Interdependencies</td>
<td>SME characteristics in anticipatory activities, utilization of context-related information produced in innovation system – actors with rising business interests sharing and interpreting information.</td>
<td>Dynamism in internal and external organizational interdependencies – interconnectedness of internal and external openness.</td>
<td>Linking internal organization structures and processes to adjust for rapid external socio-technical change.</td>
<td>Social relationships and ownership forms an interactive organization over formal boundaries in which resources are used for innovation activities.</td>
<td>Inter-organizational interdependencies in national and regional innovation systems, organizational aspects of complementary innovation activities.</td>
<td>Organizational interdependencies in national innovation systems and socio-technical transitions, organizing aspects in innovation activities dependent on political guidance.</td>
</tr>
</tbody>
</table>
3.4 Data collection and analysis

Data was collected and analyzed according to the general principles outlined in Sections 3.3 and 3.4 and Table 1, and good case study practices as suggested by Yin (2009), Eisenhardt (1989), Pålshaugen (2009), Voss et al. (2002); Gomm et al. (2000), Denzin and Lincoln (2008), Flyvbjerg (2006), Patton (1990; 1999; 2002) and Gummesson (2000). Several data acquisition methods were used, based on the mix best matching each case (Table 3). Every case is slightly different, and detailed information on the methods used is provided in the publications presenting the cases and their results, but summarized overview is presented in Table 3. The data in the cases was arranged in written format, e.g. any interviews conducted were transcribed primarily by a professional transcription service with independent verification of transcription accuracy, and the qualitative content of those transcriptions was then analyzed (Miles & Huberman, 1994; Patton, 2002). Patton (1999) states that the researcher is the instrument of qualitative study, and therefore information on researcher roles are essential. In publications 2, 3, and 5, the author of this study was an external observer of the case data, but the cases in publications 4, 6, and 7 featured action-oriented elements (Coughlan & Coghlan, 2002) that challenged the researcher’s objectivity, due to the dual role of participating in development activities and data acquisition for research. In any event, this study does not focus on the success of individual development actions; the research focus is on the phenomenon of organizing in general, and several methods, such as triangulation and member check, were used to ensure accuracy of data acquisition and analysis, as explained in Section 3.5. Table 3 summarizes the cases, objectives and methods, and describes the researcher’s role.
Table 3. Summary of the objectives, methods, data and analysis, and researcher’s role in each of the publications.

<table>
<thead>
<tr>
<th>Type</th>
<th>Publication 1</th>
<th>Publication 2</th>
<th>Publication 3</th>
<th>Publication 4</th>
<th>Publication 5</th>
<th>Publication 6</th>
<th>Publication 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Combining foresight and innovation literature, theory-based synthesis.</td>
<td>SME – intermediary organizations, organizing for practical foresight activities.</td>
<td>Food industry, traditional organization in mature business, organizing aspects of R&amp;D work.</td>
<td>Media company, several internal units organizing for rapidly changing business – enabling collaboration for innovation.</td>
<td>Business portfolio – family-driven such firms structure organizing for endogenous and exogenous change.</td>
<td>UAS (universities), organizing to serve SMEs in innovation system, boundaries in knowledge production.</td>
<td>Public home-care organization delivering services, the development of multi-actor collaboration, SF-MEP and NS.</td>
</tr>
<tr>
<td>Theoretical base, literature focus</td>
<td>Foresight literature, innovation literature, absorptive capacity, brokering.</td>
<td>Foresight literature, innovation literature, absorptive capacity, SME context.</td>
<td>Open innovation and dynamism in innovation processes, internal and external aspects, food industry.</td>
<td>Innovation process and organizational change, internal matrix structure and innovation, media business.</td>
<td>Innovation and business portfolio, individual, social and business drivers, system aspects for organizing.</td>
<td>AC, SC, and different innovation modes – DUs and STJs, UAS and SME context.</td>
<td>Innovation systems, systemic innovations, interaction models (ARA), and home care.</td>
</tr>
<tr>
<td>Method</td>
<td>Literature review, concept building.</td>
<td>Case study</td>
<td>Case study</td>
<td>Case study with action research orientation</td>
<td>Case study</td>
<td>Case study with action research orientation</td>
<td>Case study with action research orientation</td>
</tr>
<tr>
<td>Data collection, (Details presented in each publication)</td>
<td>Extensive literature review</td>
<td>8 Interviews, 2 Session observations</td>
<td>Qualitative Content analysis</td>
<td>Qualitative Content analysis</td>
<td>Qualitative Content analysis</td>
<td>Qualitative Content analysis</td>
<td>Qualitative Content analysis</td>
</tr>
<tr>
<td>Analysis</td>
<td>Extensive literature review</td>
<td>Qualitative Content analysis</td>
<td>Qualitative Content analysis</td>
<td>Qualitative, Qualitative Content analysis</td>
<td>Qualitative, Qualitative Content analysis</td>
<td>Qualitative, Qualitative Content analysis</td>
<td>Qualitative Content analysis</td>
</tr>
<tr>
<td>Researcher role</td>
<td>Supporting role – 2nd author. Exploring recent and seminal papers on foresight and innovation.</td>
<td>1st author, literature review, participation in observations and analysis.</td>
<td>1st author, literature review, participation in analysis of data accessed and delivered by 2nd and 3rd authors.</td>
<td>1st author, literature review, data acquisition with 2nd and 3rd authors, analysis of data.</td>
<td>1st author, literature review, data acquisition and analysis of data from innovation aspects, data accessed and delivered by 2nd author.</td>
<td>1st author, literature review, data acquisition with 2nd author and other researchers, analysis of data.</td>
<td>1st author, literature review, data acquisition and analysis.</td>
</tr>
</tbody>
</table>
3.5 Quality control in qualitative case studies

This study followed the principle that emphasizes that research should be evaluated throughout the entire research project, not only the end of the project. Core elements of research are the scientific nature, transparency, quality and trustworthiness of actions taken during data acquisition and the analysis and reporting of findings (Eriksson & Kovalainen, 2008; Denzin & Lincoln, 1998; Lincoln & Guba, 1985; Brinberg & McGrath, 1985).

Classic criteria for study quality are 1) reliability, 2) validity and 3) generalizability. Reliability refers to achieving the same result during repeated trials; the issue is consistency in research, in the sense that would another researcher who replicated the study arrive at similar findings and conclusions. Validity refers to the extent to which the conclusions drawn during the research are an accurate description or explanation of what happened – are they true and certain? Generalizability deals with the issue of whether the results can be extended to a wider context one way or another. The literature on qualitative research is not in full agreement when it comes to the importance of generalizability, and validity often refers to findings being correct via analytic induction and reflexivity. (Eriksson & Kovalainen, 2008)

Lincoln and Guba (1985) substitute reliability and validity with a parallel concept, trustworthiness, which exhibits four aspects: 1) dependability, 2) transferability, 3) credibility and 4) confirmability. Dependability refers to research that has been logical, traceable and documented. Transferability refers to establishing connections between the study and previous results; it is not concerned with replication, however, it is concerned with similarities in other research contexts. Credibility questions whether the data is sufficient to merit the claims made based on logical links between observations and agreement as to the interpretations. Confirmability guarantees that the data and interpretations of an inquiry are not just imaginary. The concern is about linking the findings and interpretations of the data in ways that can be easily and correctly understood by others (Eriksson & Kovalainen, 2008). Miles and Huberman (1994, p. 277-280) have presented some guidelines and relevant queries for qualitative research that were also partly applied in this study. Yin (2009, p. 40-41) has listed four tests for case studies which are common to all social science methods: 1) Construct validity: identifying the correct operational measures for the concepts being studied. 2)
Internal validity: establishing a causal relationship whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships. 3) External validity: establishing the domain to which a study’s findings can be generalized. 4) Reliability: demonstrating that the operations of a study – such as the data collection procedures – can be repeated with the same results. These aspects were followed as guide to achieve high-quality studies in the selected framework of qualitative case studies.

Since cases are unique, they are almost impossible to repeat. This being the case, reliability can be provided by following case study protocols (Eisenhardt, 1989; Yin, 2009). Brinberg and McGrath (1985) see validity as having different meanings at different stages of the research process – valuation validities, correspondence validities and generalization validities – and describe validity as a matter of logical possibilities as well as empirical outcomes. Commonly used procedures for establishing validity are triangulation and member check (Eriksson & Kovalainen, 2008). Member check is a procedure whereby the interpretations of researchers are fed back to participants (Eriksson & Kovalainen, 2008). This can also support the research process, due the various meanings and “truths” of the participants, and can be seen as a useful tool during the research process itself, and not only as final check regarding the findings. Triangulation is the process of using multiple perspectives to refine and clarify findings. It has many alternative forms that can be used separately or in combination (Guba & Lincoln, 2005): 1) Triangulation of methodologies: combining qualitative and quantitative approaches. 2) Triangulation of methods: combining several methods and analysis techniques to validate findings. 3) Triangulation of data: combining evidence from multiple sources. 4) Triangulation of theories: combining several theories to understand and interpret the case. 5) Triangulation of the researchers: several researchers participate and investigate the empirical material; cross-checking the interpretations and conclusions. This study followed the case study protocols presented by Eisenhardt (1989) and Yin (2009), paying attention to validity throughout the process (Brinberg & McGrath, 1985) and using common procedures like member check and various forms of triangulation (Eriksson & Kovalainen, 2008; Guba & Lincoln, 2005).

Several in-depth case studies were conducted as part of this umbrella study, with aspects of reliability and validity as mentioned above. Each of the sub-studies was conducted and supported by a team of researchers in a professional academic environment. The team varied...
from study to study but generally consisted of one experienced, senior researcher (PhD) and others with slightly different backgrounds and different focus than the author but familiar with the research methods used. This ensured the necessary experience and the potential for multiple viewpoints in the interpretation of the interpret data. The final summary was also checked by one of the co-authors participating in each case, as a sort of member check and triangulation for the final synthesis.

The cases were chosen from different angles to gain a variety of aspects to study the selected phenomenon. None of the participating researchers had any conflicts of interest (monetary or otherwise) in any of the case studies. The analysis and writing of the articles took place collaboratively to gain multiple interpretations and arrive at a common, shared “truth”. Member check was also included in various forms and phases of the research project to ensure the validity of results. Triangulation (Guba & Lincoln, 2005) was used in various forms, like using quantitative methods alongside qualitative methods, acquiring data using various methods from several sources in each case, and exploring different theories around the same phenomenon from various aspects (Table 3). Combining these various angles and theories from the scholars was time-consuming - not only due the research, but also due the demands of coherent publication.
4 RESULTS; SUMMARIZING FINDINGS

This section presents summaries of the publications, including for each the objective and contributions to the umbrella study, scheme in Figure 7.

![Scheme Image]

Figure 7. The role of the sub-studies in this dissertation

The findings of each sub-study are summarized in Table 4, which also presents more detailed accounts of the contributions. The results of the umbrella study can be summarized thusly: Systemic innovation is neither pure process nor pure outcome; it is a set of activities related to structures and processes that enable ideas to transform into innovation in a dynamic environment, often exhibiting a feedback loop back to the organization(s) participating in the innovation activities. Organizing for systemic innovation requires organizations to make constant adjustments that enable collaboration in shared activities, to redefine and develop the capabilities they need in changing conditions and to seize emerging opportunities. Multi-actor collaboration can be supported with structures and processes that enable certain self-organization, but management of multiple levels is challenging when actors have divergent and changing sub-targets for their activities.
### Table 4. Summary of the findings

<table>
<thead>
<tr>
<th>Summaries</th>
<th>Publication 1</th>
<th>Literature</th>
<th>Publication 2</th>
<th>Case 1</th>
<th>Publication 3</th>
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<tbody>
<tr>
<td>Contribution to this dissertation</td>
<td>Presents and combines foresight and innovation literature with new insights. Also points out the various distances in innovation activity between different actors. Introductory, opens the reader to the topics at hand.</td>
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<td>Knowledge aspects</td>
<td>Absorptive Capacity (AC); Acquisition, Assimilation, Transformation, Exploitation.</td>
<td>Knowledge is context-dependent, future-oriented information and can be assessed from individual, organizational and political perspectives with operational and strategic aspects reflecting the past.</td>
<td>Knowledge is the result of sourcing and creating information from various sources with multiple internal and external innovation partners.</td>
<td>Knowledge is the key resource for innovation in social processes, but knowledge is hard to access and forward inside organizations.</td>
<td>Knowledge is formed through intertwined activities and does not necessarily follow the formal boundaries in or between firms.</td>
<td>Knowledge is cross-sectional and different types of knowledge diffusion and utilization.</td>
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<tr>
<td>Interaction aspects</td>
<td>Distances in innovation networks; Geographic, Cognitive, Communicative, Organizational, Functional, Cultural, Social, Temporal.</td>
<td>AC is strongly related to persons and organizations, certain path dependencies are embedded in AC and anticipatory culture. Challenge in overcoming distances. Foresight interaction can create new innovation activities.</td>
<td>Interaction is a dynamic construction of different partners and directions of opening (or closing) in knowledge sharing. Interaction is a multi-level activity with embedded internal and external dynamics.</td>
<td>It is important to understand internal organization boundaries and interdependencies in knowledge activity – structures and processes should enhance social interaction.</td>
<td>Interaction can be driven and guided by subsystems other than formal ones related to business.</td>
<td>Absorptive capacity and social capital, their interconnected role in interaction. Path dependency and earlier activities form earlier conventions.</td>
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<tr>
<td>Organization and interdependencies</td>
<td>Different foresight modes: Explicit, Emergent, Embedded.</td>
<td>SME characteristics easily lead to assimilation (AAE) of foresight information.</td>
<td>Transforming future-oriented in formation into innovation knowledge is highly context dependent. This challenges knowledge producers’ and users’ approach to foresight. Foresight</td>
<td>Opening and closing innovation processes always impacts innovating organizations.</td>
<td>Organizations have their interdependencies, past structures and processes. These impact knowledge flows internally and the capability to connect to external information sources. Innovation is challenging, while it requires different types of management in different phases of process, in exploration and</td>
<td>Aspects other than those legally defining an organization are highlighted. Social and ownership (as from portfolio platforms for innovation; these are presented from a systemic perspective. Systemic interplay of innovations and organizations and vice versa are presented.</td>
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activities and joint interpretations can create future activities in business.

exploitation.

dependency is visualized.

collaboration.

to participate in a dynamic manner.

| Theoretical implications | Different types of learning; AAE and ATE, related to foresight exercises and leading different types of innovations due to path dependency and mental lock-ins. | Organizations need to find the appropriate balance between AAE and ATE foresight activities. Indications that SMEs need facilitation for ATE. | Innovation discussions should not focus on the exclusive alternatives of closed or open innovation models; instead, the dynamics present in activities should be considered at multiple levels. This impacts collaboration “platforms”. | Different phases of the innovation process have different characteristics and needs regarding the organization. It is important to allow and benefit from the dynamics present in activities. | Systemic drivers and linkages between business portfolios and innovation are presented in a dynamic context. A business portfolio is presented to illustrate one form of innovation platform having systemic elements. | Highlights the different roles of organizations as knowledge producers for innovation. Innovation modes are connected to networked innovation activities. | Firms and organizations are path-dependent, but develop their capabilities to meet changing expectations. In cross-sectoral innovations, private and public organizations are managed differently – this impacts interaction and definitions about the shared activities. Organizational dynamics are interlinked with temporal challenges of exploration and exploitation on a shared platform. |

| Practical implications / Managerial implications | Knowledge brokerage plays a crucial role in transforming future-oriented information into innovation knowledge. SMEs need facilitation to benefit from the available external information, often in rather distant form from daily operational activities. | The dynamics of innovation processes challenge the management of innovation. Opening up or closing has not only strategy-level impacts, but internally influences organizational behavior and management. | Innovation research and management should better recognize invisible interlinking elements and multi-level system dynamics instead of focusing on linear innovation inside and between legally determined firms. | Stresses the importance of learning and social constructions between different organizations. The need for practical interaction platforms for organizations delivering important elements of innovation activities. | To create systemic innovations, a coalition management requires a different approach than traditional autonomous “product”-focused innovation. Innovation diffusion varies according to the chosen track. |

| Summary: Organizing for systemic innovation | The phenomenon of systemic innovation is not pure process or outcome; it is set of activities related to structures and processes performed by actors in related innovation systems, enabling ideas to transform into complementary innovations with the available resources. Interaction is required to reorganize interdependencies due to dynamics. | | | | | |
4.1 Publication 1:

Combining Foresight and Innovation: Developing a Conceptual Model

Foresight and innovation are closely linked activities, especially in systemic contexts, and bridging these two activities is desirable. The article presents a conceptual model depicting the connections between foresight and innovation. The model combines much-used and well-known concepts, such as exploration and exploitation, absorptive capacity, the three modes of foresight activities, and information brokerage, in a novel way.

Findings and Contribution

Knowledge brokering is seen to play a crucial role when future-oriented information is used to facilitate innovation processes within an organization. Brokering is an activity that promotes information flows and knowledge creation in innovation networks. Knowledge brokering also helps increase the absorptive capacity of the various actors involved in activities. The different foresight modes (explicit, emergent and embedded) are presented in relation to organizing for innovation from the perspectives of knowledge and interaction.

4.2 Publication 2:

Issues in Absorbing Foresight Knowledge for Innovation in SMEs

This paper examines the challenges of small and medium-sized enterprises (SMEs) using the foresight knowledge provided by intermediary organizations. Relying on the theory of absorptive capacity (AC), it points out some of the issues, as well as possibilities, in facilitating interaction for SMEs in order to make it possible for them to utilize foresight knowledge for innovation.

Findings and Contribution

While innovation these days is of an increasingly systemic nature, the complex combination of knowledge regarding technological and business environments poses a challenge for foresight
activities and makes a future-focused orientation more important. The dynamism related to innovations in a changing business environment makes organizing for shared foresight activities crucial. This highlights the need for action-based transformation platforms to combine firms’ embedded prior knowledge with the foresight information available to them. This transformation occurs best when SMEs work together to refine the information available to them and delivered by intermediates. Different organizations and individuals interpret information differently, and shared foresight activities can lead to practical business collaborations with complementary innovations supported by different parties working together.

4.3 Publication 3:

*The Dynamics of Openness in Innovation Processes – A Case Study from the Finnish Food Industry*

Recent practice-based discussions in business and academic research highlight the collaborative nature of innovation activities. Today, almost all innovations are generated in co-operation with others in a systemic world. The role of openness is widely acknowledged, it is less studied and discussed. By observing the dynamics of openness in innovation processes, this study extends current theories from the perspective of the open and closed phases of innovation processes. The analysis is based on a case study on a large Finnish food industry company and its long-term innovation process regarding the utilization of rye fibre since the early 1990s.

*Findings and Contribution*

This paper elaborates on the dynamic interconnection of internal and external organizing and illustrates the impact of feedback. It also stresses the asymmetry of relationships, as well as temporal elements related to openness and the direction of openness. Organizational openness varies across the duration of the project, and openness might be interpreted differently by the different organizations in the network. Minor changes in the direction of openness in networks might lead the other party to interpret the process as closing – and these different opinions may still exist at various levels of the organizations. Results show that it is crucial to understand these critical points of interaction in the innovation processes. Comprehending the phases of openness
and closure is key to successful innovation. The paper also stresses the challenge of strategic organizing for such dynamics of openness.

4.4 Publication 4:

Interaction and Innovation - Reframing Innovation Activities For a Matrix Organization

In terms of this dissertation, the objective of this article is to understand the challenges of organizing innovation activities across a company’s internal boundaries. The focus is on collaboration, processes and structures as external and internal requirements change. This study presents the activities and resources needed in knowledge production, organizational interdependencies related to change, and the importance of reframing and orchestrating an innovation process while adopting a matrix organization structure. Some studies indicate that a matrix organization offers flexibility while supporting sharing of information and efficient use of resources within an organization. However, matrix organizations are also the target of serious criticism by real-life operational actors in organizations performing daily tasks. To determine the reasons underlying this discrepancy, the transformation of an organization from a line organization to a matrix organization was followed and investigated; in addition, the organization was simultaneously developing its innovation process. The case company was a media company, a challenging subject due to external, systemic change in technology and consumer habits.

Findings and Contribution

Understanding the interplay between organizational change and innovation activities is the key to success in today’s dynamic, rapidly changing business environment. To survive and compete in business, firms adjust their organizational designs and processes to foster innovations and connect to external sources of innovation. Organizations undergoing constant change have to update their innovation process management to match their organizational designs and vice versa. This study also highlights the fact that different phases of the innovation process need different types of management and cross-organizational support. Social interaction is required to adapt in the face of these various reciprocal internal and external requirements: nowadays, innovations straddle traditional boundaries of technology and media units due to customers’ demands for “total
service”. Firms participating in this rapidly changing environment speed up the cycle of ongoing change with their own innovations.

4.5 Publication 5:

*Systemic Innovation in Complex Business Portfolios – A Case Study*

This paper presents the interaction between various systemic innovation-activity elements in complex business portfolios. The interaction between innovation and portfolio transformation is investigated in two empirical case studies. Systemic challenges with various drivers and external impacts are presented. This study creates a link between innovation literature and portfolio business literature, making the multiple interlinked systems visible and extending discussions of innovation towards the organizing structures of portfolio businesses.

*Findings and Contribution*

This paper describes and increases understanding of how business portfolios are used to organize for innovation, illustrating the continuous loops of adjustments that trigger new innovations. It presents the innovation-based renewal of a system, with sub-systems framed in terms of social ties and ownership. It shows that interconnected systems impact each other and co-evolve due to activities and exogenous reasons. It also delivers alternative views on the closed aspects of corporations, purely open community development, and set of transaction-based network relationships. At the analytical level, it links a strong institution, the family, alongside legally defined organizations. It shows that organizing for innovation can and should be analyzed in certain cases by defining the organizational boundaries according to perspectives other than purely legal ones due to “hidden” interdependencies.
4.6 Publication 6:

*Developing Collaboration Structures for University–Industry Interaction and Innovations*

The purpose of this paper is to examine learning through *doing, using, and interacting* (DUI) at Finland’s universities of applied sciences (UAS) to develop structures for small and medium-sized enterprise (SME) collaboration, and to review recent literature on the roles of absorptive capacity (AC) and social capital (SC) in DUI. This paper presents some challenges to facilitating innovation and creating supportive structures for innovation activities.

*Findings and Contribution*

This paper shows how educational networks create value for firms based on various innovation modes (STI and DUI). It also stresses the challenge of interlinking different type of knowledge networks, and uses AC and SC accumulated in organizations as a frame. The study stresses that even educational institutions are facing constant change in structures and people, and how these structures and people should be developed to facilitate innovation. It also shows that defining an organization based on name does not always describe the deliverables for innovation networks. Different intermediates and universities of applied sciences have different skills and resources, regionally and internationally, and this should be considered when organizing for innovation. The different roles of governmental bodies are also stressed when forming collaboration relationships. Finally, this paper shows that prior successful collaboration in innovation activities creates possibilities for future collaboration and extends networks, creating more activities for actors.

4.7 Publication 7:

*Redesign of Home–Care Service Delivery – A Systemic Approach to IT Innovations*

This paper describes how systemic innovations evolve and presents how IT and other complementary innovations can lead to cost efficiency and quality improvements in home-care delivery services. It shows alternatives for how systemic innovations can diffuse based
on collaborative development activities or more transaction-based, transitional organizing structures, each of which requires a different management approach. The study is conducted in the context of home care, observing public organizations from the perspective of acting as a collaboration partner for SMEs in a complex development environment.

Findings and Contribution

This study illustrates the complexity of developing innovative solutions with actors that have different focuses, interests and interdependencies. It presents the customer, home-care personnel, public organizations, firms and institutions having interlinked connections in systemic innovation activities. It shows why it is so difficult to change public services due to path dependencies and inertia, but it also shows the external forces that speed up change at turning points. The paper creates understanding about the phenomenon of organizing for systemic innovation, interpretations “between” multiple organizations delivering resources for shared activities, and their interconnections to other actors with their on-going activities. It shows the roles of and differences between private and public organizations involved in multi-actor collaboration. It also describes how evolving innovation impacts other organizations, requiring them to reorganize due on-going change.
5 DISCUSSION AND CONCLUSIONS

This dissertation focused on understanding the phenomenon of organizing for systemic innovation. It combined several theoretical aspects involved in this phenomenon and, through six complementary case studies, revealed a number of observations in the case organizations. The main findings of these analyses were summarized in the form of this dissertation.

5.1 Theoretical contribution, findings in the context of prior literature

5.1.1 Organizing for systemic innovations

The study’s overall contribution is the clarification of various systemic innovation-related aspects from an organizational perspective. The roles of knowledge, interaction and organizational interdependencies in innovation were observed in terms of these aspects. The aim was to analyze and understand organizing for systemic innovations, and to provide insights about interconnected innovations and the organizations producing them under changing conditions. The study illustrated that instead of drawing strict lines between systemic innovations and innovation systems, analysis can be supported by combining both concepts. The interrelationships between different types of actors and their contributions to innovation activities are interconnected in systemic contexts during sociotechnical transitions.

The research problem was presented in the form of the following research questions: How can various actors organize for systemic innovations, and how do systemic innovations interact with the actors as part of the system itself?

A succinct answer to these questions, one that crystallizes the findings for discussion is: Organizing for systemic innovations requires good connections to information flows, with pools of heterogeneous actors producing different types of knowledge for processes. Systemic innovations often take place in trans-sectorial environments, which demands often-proactively transforming information from these various domains into innovation knowledge. Interaction is needed in knowledge creation, as is simultaneous adaptation to other actors and environmental changes. Instead of viewing interaction in these processes only as a purely
pooled or serial set of activities, organizing for systemic innovation more closely resembles the interdependencies described in the literature as reciprocal (Thompson, 1967), in which one actor can impact collaboration by affecting everyone else at any time, and actors also constantly need to adapt to each other (Christensen, 2007). This is the reason that organizing problems in systemic innovation activities cannot be solved solely by synchronizing parallel development processes (e.g. by following overly rigid state-gate models, Cooper 2008); solving them also requires structural changes and development of capability in the participating actors (Table 4). Such reconstructing of the interdependencies linking actors, their resources and activities can also be seen as an effort to build social networks that match the nature and intended flow of knowledge, as asserted by Sorenson et al. (2006). Self-organization (Fjeldstad et al., 2012), in the sense it is referred to in management practices rather than system theory, is one way of describing the flexibility to organize resources for shared activities in an agile manner. One important observation from the case studies is that interdependencies become visible during innovation activities in dynamic environments, since no one has total picture of interlinked elements beforehand – activities create understanding by reflecting prior interdependencies and gained knowledge (publications 2–7). Attracting and retaining the commitment of actors with their external partners in development communities is crucial for the success of the systemic innovation (Maula et al., 2006). This is because systemic innovations are not directly under control of any individual actor (Chesbrough & Teece, 1996; Davies et al., 2013). Nor can the links to collaborative formation of normative and regulative issues be bypassed at any level; the dynamics of such path dependency and the related future alternatives have roles in the systemic context of innovation. It is worth noting that actors partly create the future environment through their own activities. This being the case, approaching the various theories through real-life cases was a worthwhile process that provided new theoretical and practical insights.

A comparison between the novel results of this study (2009-2014) and other more-or-less simultaneous findings reveals a consistency. For instance, Fjelstad et al. (2012) propose in that new organization designs will be based on an actor-oriented architectural scheme composed of three main elements: 1) actors who have the capabilities and values to self-organize; 2) commons where the actors accumulate and share resources, and 3) protocols, processes, and infrastructures that enable multi-actor collaboration. The results from this
study support other findings from the context of systemic innovation and provide complementary suggestions for future research (ibid). This study provided insights on incentives that stimulate multiparty collaboration, the limits of actor-oriented control mechanisms, and the transformation from hierarchical to actor-oriented organizations and value appropriation while spanning structural holes. Some implications were discovered regarding the organizational development of situational awareness in multiparty collaboration in complex environments. This study also dealt with some of the future research aspects pointed out by Lam (2006), on how organizational choice and evolutionary processes interact to facilitate change and innovation. As she points out, this requires “real-time” research instead of retrospective case studies (publications 4 and 7).

Jaspers indicates some future research interests (2009, p. 197) in his work, which draws primarily on aspects of systems integration and focuses on a different approach to organizing systemic innovations than this study does. Partly due the slightly different approach, this dissertation was able to contribute to some of those gaps in the research noted by Jaspers in the context addressed. This study focused particularly on the dynamics related to organizations and processes from the fuzzy front end of innovation to commercialization and the related diffusion, the roles and requirements of organizational forms related to activities influenced by market and strategic considerations. The roles of different intermediary aspects to integrating knowledge from the systemic innovation perspective are discussed. This dissertation also presents the interconnected emergence of purposefully developed systemic innovations to seek competitive advantages on a larger scale and collaboration activities that lead to the discovering of interdependencies and complementary configurations that were previously unknown (e.g. Jaspers, 2009; Adner, 2006; Pisano, 2006) (publications 2-7).

One of the first papers that addressed the difference between autonomous and systemic innovations from organizing perspective was written by Chesbrough and Teece (1996). Their paper focuses primarily on aspects of outsourcing in collaboration between industrial firms and issues of control in centralized and de-centralized approaches. Since then, Chesbrough (2003; 2010) and many others (Huston & Sakkab, 2006; Lundberg & Andresen, 2012; Lehenkari, 2006; Bishop et al., 2011; Kaufman & Tödtling, 2001; Tödling et al., 2009; Faems et al., 2005; Powell & Grodal, 2005), have pointed out the heterogeneous actors fuelling
innovations, including firms and universities, due to various types of knowledge and their production. The role of trust in the formation of innovation networks have been extensively studied (e.g. Blomqvist, 2002; Miettinen et al., 2006; Seppänen, 2008; Ellonen et al., 2008). This dissertation continues prior discussions, taking them more deeply into the collaboration aspects of private and public organizations, and their different type managements in emerging networks. The complementary roles of DUI and STI modes of innovation are linked to parties playing supplementary roles in shared activities. As proposed by Johannessen (2009, p. 170), change processes with a knowledge focus were connected to various interlinked levels of systems, generating innovations in social systems. This study pointed out the asymmetry between openness and organizations’ various hidden layers for controlling collaborative activities; these include the embedded social sub-systems that link “legally” independent firms, like ownerships and social capital, in larger innovation systems. It was also stressed that researchers should be aware of the different roles that might be awarded to different firms playing certain roles in systemic innovation activities, for instance analyzing one firm instead of a set of firms with hidden ties might lead to different outcomes (publications 1-7).

5.1.2 Knowledge, interaction and organizational interdependencies

The process of refining information into useful knowledge is common to all interrelated innovation activities. Assimilation was used to describe the easy fit between current schema and a transformation expressing the need for rethinking information in its potential context. Interpreting information is always context related, which poses a challenge to multi-actor networks in terms of knowledge creation. For each actor, especially newcomers in specific fields, only part of the innovation landscape is visible (Håkansson & Olsen, 2011), discovering knowledge is a result of activities in the landscape, giving advantages to those who are familiar with the context.

Interaction in all of its forms is inherent to systemic innovation activities, which are often described in the literature as “networks of interaction, patterns of collaboration, rival competition, co-opetition in markets, path dependency, etc.” – concepts referring to knowledge as cumulative key asset. Organizations and individuals have to be able to connect to information flows (Ståhle & Grönroos, 2000, p. 86) and utilize other context-related
resources to refine information into knowledge and profitable actions. Different distances and organizational interdependencies challenge these activities, while innovation activities often use shared resources in other operative actions and development tasks. As noted by Håkansson and Olsen (2011), management of innovations has to do with the interactions between two very different processes – one highly uncertain, creative and full of surprises, the other systematically related to each other’s economic entities in the business landscape. It is also heavily dependent on the new economic entity created by the innovations in contrast to the existing economic entities – where actors control resources and perform activities in order to reach economic goals. Businesses and organizations tend to interact in multiple ways while forming commercially viable cross-functional business networks, highlighting the communicative reality of these arenas (Håkansson & Olsen, 2011). Like knowledge, innovation is highly context related and relational to developmental interactions but faces challenges in issues related to the varying exploitational interests of the participating actors – which sometimes leads to unwanted interactions reflecting prior assets and interdependencies.

These are often also discussed in terms of inertia, friction and rigidities in activities (Hannan & Freeman, 1984; Rumelt, 1995; Pardo del Val et al., 2003; Collinson & Wilson, 2006; Liao et al., 2008; Godkin, 2008; 2010; Håkansson & Olsen, 2011; Leonard-Barton, 1992; Pihkala et al., 2007; Steinhilber et al., 2013). As stated by Pfeffer and Salancik (1978, p. 40): “Interdependence is the reason why nothing comes out quite the way one wants.” Doz and Kosonen (2010) stressed that sometimes prior interdependencies have to be reconsidered; interaction is about building, decoupling and creating new interdependencies. This can also be seen in the forms of changing structures (Table 4). These interdependencies can be intra-organizational or inter-organizational and assessed from a multi-level perspective. Figure 8 illustrates how knowledge for innovation activities is created through a dynamic manner of interaction – interdependencies change as the actors reorganize their activities and resources. This also impacts back on the actors’ vision of the systemic innovation under construction and their adaptation to changing innovation spaces (Figure 4).
Håkansson and Olsen (2011) see innovations emerge through increased internal and external interdependencies. According to them, relatedness is a core dimension of what constitutes an innovation, and asymmetry plays a certain role in these activities. When an innovation is introduced, it creates change for everyone in the landscape, including the actors that originate it (Figure 4). Like individuals, organizations have their various past interconnections and mental lock-in’s based on prior activities. There is a certain path dependency in the development of absorptive capacity (Cohen & Levinthal, 1990), social capital (Tura & Harmaakorpi, 2005) and anticipatory aspects in organizations (Ahlqvist et al., 2012). These influence an organization’s knowledge acquisition, assimilation, transformation and exploitation for innovation (Zahra & George, 2002), and how the organization formally and informally defines the structures and processes through which they internally and externally explore and exploit information (March, 1991), having impacts on the capability development for collaboration. As indicated by Van de Ven and Poole (1995) and Lam (2006), theorists have different views on how organizational change takes place. Lam (2006) uses the following categories in innovation context; 1) incremental/evolutionary, 2) punctuated equilibrium and discontinuous organizational transformation, and 3) strategic organizational adaption and continuous change. She comes to the conclusion that relationships between
organizations and innovation is a complex, dynamic and multilevel phenomenon that should be better understood.

In a dynamic, systemic context, one part of an organization participating in innovation activities impacts the other parts of the organization (endogenous adjustments, either planned or organic, or due to exogenous reasons). It is worth noting that internal adjustments in organizations almost always impact external knowledge connections – and these are not always those that are aimed for (publications 2–7). Both internal and external changes impact interpretation and steer activities based on interests and partial pictures of the whole, while no one has a full understanding of the complex interplay and systemic outcomes in the innovation landscape. Characteristics like emerging networks impacted by dynamics from various levels and nonlinear innovation processes featuring feedback loops require a constant redefining of actors, resources and activities. Both internal structures (Mintzberg, 1983) and external links are forced to adapt. Organizational boundaries (Santos & Eisenhardt, 2005) are not determined purely on legal grounds, and who is in and who is out is partly result of self-organization and co-evolution caused by dynamics, rather than pure strategic planning (publications 4, 5, 6 and 7). Even though capability development is an essential part of an organization’s response to dynamics, it cannot always solve challenges rising from the levels of regime and landscape (publication 4).

The results of this dissertation indicate that innovation diffusion is partly a result of shared activities, which also challenges traditional policy-level approaches to guiding transitions. The collaborative aspects familiar from open innovation (Chesbrough, 2003; Boudreau & Lakhani, 2009) and user-driven contexts (Von Hippel, 2005) can lead to widely accepted and diffused dominant designs forming standards, normative regulations and legislation, from an informal to a formal extent. One important notion related to interdependencies has been previously described by Pfeffer and Salancik (1978) that, instead of influencing various organizations individually, controlling resources and activities can take place through a few core organizations and by shaping regulations. In systemic innovation, these aspects are important determinants for turning ideas into innovation. This can also be seen to take shape as politically driven arenas for transition.
5.1.3 Future orientation; strategic and operational aspects

Grasping one’s environment is crucial for organizing in the systemic context, as changes create innovations and innovations create changes. A substantial amount of foresight information is available for firms and other organizations, but it is not sufficiently well connected to innovation activities (publication 2). Transforming such indefinite information into innovation knowledge instead of filtering easy-to-assimilate knowledge for operational advantage requires alternative interpretations. As stated by Salmenkaita (2004), the knowledge required to identify beneficial collaboration opportunities may involve significant tacit elements, different anticipatory cultures (Ahlqvist et al., 2012), and must overcome various context-related (e.g. business/policy) levels of analysis. It therefore requires facilitation and brokering activities. When acknowledging these challenges in complementary foresight processes (explicit, emergent and embedded), various platforms can be used to support organizing for innovation (publications 1-2). The implication is that foresight is not a distant, distinct exercise from business. It can be used as a merging platform for actors and their resources, creating concrete activities by sharing information in the right context with complementary interpretations and insights. This can be seen as being in line with Maula et al. (2006) and Salmenkaita (2004), while adding some further insights to an organizing perspective.

The aspects of foresight presented here also provide views supplementary to the two-sided foresight process described by Maula et al. (2006); first, providing input into the company’s internal resource allocation, and second, focusing on the company’s external coordinating, referred to as a shaping process that proactively influences the evolution of technologies, markets and resource allocation decisions of others in their environment. This dissertation challenges us to rethink traditional timeframes, such as the 3-10 years often used in strategic foresight schema, since rather long, less-dynamic periods may exist, as well as sudden, drastic, surprising changes that are very hard to predict, even immediately before they occur. According to complexity theory, these changes can take very different unpredictable steps forward, while still demanding radical changes from the point of view of strategic and operational management (see also Levy, 1994). It has been claimed that upper management has to make decisions partly based on intuition (see Dane & Pratt, 2007; Snowden & Boone,
– even though a significant amount of information is available, often the possibilities and capabilities for analyzing all of its complex dimensions (within a set timeframe and with the resources available under dynamic conditions) do not exist. This easily leads to a trap in which management relies primarily on past decisions and previously learnings and takes action based on that knowledge (Ahlqvist et al., 2012; Rinkinen & Mäkimattila, forthcoming), which is quite different from what the context should be in changed circumstances. When foresight takes place and decisions are made based on this schema, the enduring elements of organization are challenged – especially if the organization is forcing its prior interdependencies to survive, to sustain the forms used to guarantee its previous success.

Another important future oriented notion is presented by Håkansson and Snehota (1995) concerning innovation activities: There are always undeveloped resource ties among the already used resources that could be tried out, but the heterogeneity makes it impossible to foresee which will be the right ones – finding out is a process of trial and error. The question then becomes one of how to detect the currently critical components and interconnections, support adaptation in managerial manner and define the boundaries of the organization so that it can create value for others in the network in addition to its own profits. If there is no flexibility, the organization will be replaced by better-fitting candidates that do more to profit the other organizations in the systemic innovation network in the future.

5.2 Practical and managerial implications

This study contributes to the field by showing that, based on MLP dynamics, three temporal innovation landscape phases can be identified (reproduction, transformation, and transition by Geels & Kemp, 2007 and technological substitution, reconfiguration, and re-alignment by Geels & Schot, 2007) to support management activities. First comes the phase where systemic innovations are created based on current the innovation landscape and regimes (reproduction and transformation). This is heavily concerned with traditional innovation management in networked environments, with organizations searching for optimal ways through incremental adjustments, with sprouts of larger, more radical, and discontinuous innovation (publication 3). The second phase is one of radical change of environment, where regimes and the
landscape are in a rapidly transition phase towards new innovation space (publication 7). This change poses challenges to organizations, forcing them to reorganize for survival, to do something radical in every way. The third phase is recovery, the rather balanced stage after regime and landscape have found a new order for their constituent elements. Actors and activities are part of this process, finding their own value-adding space (publication 4). Organizations search for equilibrium through the same principles as in first phase, but challenges arise due to the revaluing of the existing knowledge embedded in their structures. They try to make sense of how to use and connect to information flows to create new, profitable innovations. Organizations can be hampered by surprising change destroying their previously profitable business and causing a lack of resources needed for exploration. This can lead them to stay in suboptimal position in the landscape, without the possibility to move into successful “ecosystems” rising in the innovation landscape.

Interestingly, this study shows that rather distant actors and businesses are interconnected in a reciprocal manner – organizations are impacted by converging entities, but not always at the same time (publications 4, 5 and 7). This temporal issue is challenging, especially when it comes to trans-sectorial innovations. MLP might give the impression that niche and regime changes impact actors simultaneously, but business sectors and actors have interdependencies with each other, and often some sort of sequence in rising activities and emerging political guidance. A lot of current potential for shared innovation activities is in the form of knowledge based in “structural holes” (Burt, 2004; 2005; Powell & Grodal, 2005) between public and private actors and combining product and service innovations. The catalyst for these innovations lies in various types of discontinuities and is hindered by the inbuilt inertia in systems. Public organizations are managed within a framework of legally mandated tasks and structures, often based on political drivers. Private organizations are freer to move based on business prospects and the owner’s willingness to take risks. Both public and private entities can develop their capabilities inside these frames. This creates certain tensions for collaboration, especially for larger system changes to take place in an emergent manner.

When it comes to organizing for systemic innovation from a managerial aspect, some of Thompson’s views (1968) describing synthetic organization are applicable today to what can be seen during the early phases of systemic innovation processes, especially in relation to
transitions in turbulent environments: in conditions of great uncertainty, an organization has to learn the nature and extent of the overall problem to be solved and to find relevant resources. At the same time, it has to assemble and interrelate the components without the benefit of established rules and commonly known channels for communication. It cannot take inventory before swinging into action, and problems are redefined during emerging actions. Task priorities change as information mounts, challenging resource allocation. An organization must simultaneously establish its structure and carry on activities, which is not efficient in the long run and later leads to continuous fine-tuning of structures and processes to reach more efficient ways of working. When systemic innovations mature, this leads to intra- and inter-organizational adjustment, featuring the reciprocal challenge of adaptation and co-evolution with multiple actors in a changing environment.

Organizations develop certain knowledge bases embedded in structures and individuals, and these are dynamic in nature. Resources in organizations are often further discussed in terms of dynamic capabilities (Teece et al., 1997; Eisenhardt & Martin, 2000; Rothaermel & Hess, 2007), mostly assumed to increase competence over time, but in dynamic contexts the direction can be also opposite, absolute or relative in a competitive environment. It is important to notice that certain path dependencies impact the interpretation of information (Dixon, 1994) and the alternative choices available for organizations. This can also be observed from the perspectives of network maturity and integration development as presented the in Theory section of this dissertation – and the ability of centrally positioned organizations to orchestrate collaboration based on knowledge and network activities (Powell & Grodal, 2005; Pfeffer & Salancik, 1978). On a larger scale, this is also seen as regime and landscape level changes (Geels, 2002; 2004; 2005; Geels & Kemp, 2007; Geels & Schot, 2007).

This study also provides supplementary perspectives on what Maula et al. (2006) and Christensen (1996) have already pointed out about strategic resource allocation processes of larger corporations during incremental, radical and disruptive innovations. Maula et al. (2006) reassess the Bower-Burgelman process model (Burgelman et al., 2006), viewing resource allocation as part of a larger strategic management process conceptualized as consisting of multiple simultaneous, interlocking and sequential activities that take place on the frontline and at the middle and top management of an organization. The challenge comes when
resources compete for managerial attention and resource allocation. Maula et al. (2006) and Christensen (1996) state that radical and disruptive innovations, which do not directly fit into the current schema of the core business or threaten it, are often ruled out. In many larger corporations, this is solved by establishing separate new venture divisions or other solutions that create space for renewal from the perspective of long-term survival. Maula et al. (2006) also mentioned the need of continuously employing varying and changing cognitive frames, which is close the ATE path presented in this study (publication 2). However, as Maula et al. (2006) highlight, in a systemic innovation context even these aspects do not suffice, while partners and external development communities make up a significant resource pool in complementary innovations and their components. They come to the conclusion that systemic innovation requires open innovation tools utilizing external resources, while the majority of potential resources are located outside the boundaries of the corporations (Ibid). This can be viewed from the SME and public organization perspective in emerging networks, which source complementary external assets and partners in innovation activities. This should also be considered when smaller actors are working with large corporations. As discussed regarding the dynamics of openness (publication 3) critical points can also emerge due to project shifts between large corporations’ divisions as they focus on new ventures or actual production operations. Approaches to collaboration and innovation (commitment and impacts due to differing interests, interpretations and tacit knowledge) can vary, and such changes should be considered in the management of systemic innovation alliances. This also concerns change in smaller organizations due to successful growth and adaptation thanks to business prospects or political rationales. The management aspects presented above – synthetic (Thompson, 1967) and open (Maula et al., 2006) – and related to organizing in dynamic environments highlight why future-oriented information and anticipatory aspects are important in the context of systemic innovation. In practice, this naturally means managing internal and external resources according to environmental dynamics, but it also highlights the transformation of foresight information into practical innovation knowledge.
5.3 Limitations of the study

Although the aim of the study was to increase understanding of the phenomenon of organizing for systemic innovations, some constructive advice can also be drawn from the case contributions when carefully considering the context applied. This study has been qualitative in nature, which leads to different types of generalizations than quantitative studies. It should also be noted that the context of data acquisition has existed mainly at the organizational level in a national context, including actors and networks of various types. The analysis presented here has been based on small and medium-size organizations and their public partners, instead of large international multi-unit corporations. Furthermore, even though the interrelationships studied were dyadic, data acquisition focused primarily on one party. It would have been fascinating to conduct simultaneous, in-depth studies of each of the actors in the networks and compare results. The methodology section explains why this study approached organizing for systemic innovation within a relatively simple framework and from a single-actor perspective: in order to keep the size of the study manageable in terms of the corresponding project dynamism. The alternative used is based on interest in the phenomena, instead of limiting research to an in-depth study of the organizations in one case. The key consideration was richness of outcome balanced with the time and resources available. Reaching the rich results this study also demanded the acceptance of certain subjective aspects, such as social actors producing social reality through social interaction and elapsing time impacting interpretations made on objective data. Different theories are presented to show the multifaceted nature of innovations linked to various aspects of system, while recognizing that some of the shared terms are originally rooted in different concepts. When citing this dissertation, one should be cautious when using such terms (e.g. self-organization, systemic innovation, innovation system) to avoid confusion. The literature introduced in this thesis has been selected to prevent such confusion, even with the minor risk that compressing the large amount of literature might lead to unintended impressions among readers not familiar with the topics.
5.4 Suggestions for future research

One very interesting topic for future research could be drawn based on this dissertation, combining the notion proposed by Doz and Kosonen (2010) of “embedding strategic agility” from the points of strategic sensitivity, leadership unity and resource fluidity, in the context of the characteristics of heterogeneous multi-actor collaboration presented by Fjeldstad et al. (2012), with the interrelated, multi-functional managerial network and management challenges faced in organizing and re-organizing interdependencies related to multi-relational systemic innovations (Håkanson & Olsen, 2011). Future research could also analyze the roots of emerging ecosystems instead of preplanned alliances in greater depth, and study the role of co-developing a shared “vision” altered by dynamics (see e.g. Valkokari, 2009; Carleton 2010). Instead of traditional aspects of business capability that explain rationales through transaction boundaries, the focus could be on the converging technologies merged by the actors in a system through their activities. It is important to more deeply understand the platforms that can foster shared activities and emerging networks. One very interesting path could be the deeper analysis of open and closed phases in the creation of systemic innovations, organizing boundaries in the various stages of interlinked innovations. Such strategic management of interdependencies could be interesting also from the perspective of intra- and inter-organizational dynamics. Cross-organizational situational awareness is an interesting issue when discussing the current business environment – especially in context of whether an organization’s strategy steers innovation activities or innovation activities steer its strategy.
5.5 Summary

Innovations are coming increasingly systemic, featuring interdependencies in multiple directions through participating organizations and normative environments. This dynamism challenges actors to redefine ongoing activities, share and control resources – while changes in the environment create changes for actors and can affect the balance of their networks. The ongoing change in the innovation environment is also partly catalyzed by systemic innovations. The “problem” and “vision” of ongoing systemic innovations are continuously reconstructed, while activities make hidden interdependencies visible (Figures 4 and 8).

Actually, when it comes to this phenomenon (Davis, 1971), what seemed to be different interpretations of systemic innovation concepts are actually descriptions of interactions with different organizational interdependencies.

This study points out that organizing for systemic innovation requires a good understanding of existing dynamics, which can be supported with active foresight exercises and creating organizational capabilities that can support information flow during activities. In their best forms, organizations can connect and interpret information from ongoing activities on multiple levels and form good situational awareness. Social interaction is needed and should be embedded in processes and organizational structures. This dissertation also describes the informal and formal forms of organizing used in shared innovation activities, the social capital needed to overcome emerging problems and constantly adjusting activities and organizations based on continuously redefined aims and available resources.
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PART II: PUBLICATIONS
Publication 1:


Combining Foresight and Innovation: Developing a Conceptual Model

In Melkas, H. & Harmaakorpi, V. (eds.)

*Practice-based innovation: Insights, applications and policy implications*
Chapter 3
Combining Foresight and Innovation: Developing a Conceptual Model

Tuomo Uotila, Martti Mäkimattila, Vesa Harmaakorpi, and Helinä Melkas

Abstract Foresight and innovation are activities closely linked with each other, the former providing inputs for the latter. However, there have been few attempts to build conceptual and theoretical bridges between these two activities. In this chapter, we present a conceptual model depicting the connections between foresight and innovation activities and learning. Into this broad model we have combined, in a novel way, much-used and well-known concepts and ideas, such as exploration and exploitation, absorptive capacity, three modes of foresight activities, information quality attributes, and information brokerage.

3.1 Introduction

The success of economic actors is strongly related to their adaptability to the emerging techno-economic environment. Sotarauta and Srinivas (2005: 35–36; 2006) make a distinction between strategic adaptation and pure adaptation; the former refers to an actor’s capacity to change its destiny by adapting itself to changes and reshaping its local environment. Pure adaptation is more reactive by nature than this more proactive strategic adaptation, which is also strongly related to an actor’s ability to learn.

Strategic adaptation is based on decisions that have to be made in a great uncertainty. This uncertainty can be reduced by creation of future-oriented knowledge. Future-oriented knowledge is often very challenging to use in an actor’s renewal process, since (1) the possible futures are hard to outline, (2) future-oriented knowledge is even more abstract than tacit knowledge, and (3) due to its nature, future-oriented knowledge is hard to adopt in an actor’s organisational learning processes and strategic routines (Uotila et al. 2006). To make use of
future-oriented knowledge, actors need a special dynamic capability: visionary capability. In this context, visionary capability refers to an actor’s ability to outline the potential development directions based on paths already travelled — utilising the opportunities emerging from the changing techno-economic paradigm (Harmakorpi 2004).

Nowadays, knowledge is generally considered the most important source of competitive advantage, but even the most specialised forms of knowledge are becoming a short-lived resource — due to, for example, the accelerating pace of technological change. This emphasises the need for foresight activities at all levels — national, regional, and organisational — and the integration of foresight, innovation, and learning activities. Eerola and Väyrynen (2002: 15) and Salo (2000: 207) see the need to integrate foresight activities more closely into today’s decision-making and (action) planning processes as an important challenge for those carrying out foresight activities. This integration is needed in order to increase the effectiveness of foresight activities.

According to Bootz (2010), an agreement between practitioners and theorists about the strong ties linking strategic foresight and learning processes (especially organisational learning) seems to be emerging, but the true nature of this link still remains vague. In this chapter, we elaborate on a conceptual model depicting the connections between foresight and innovation activities and learning. The proposed model makes use of concepts and ideas presented earlier by March (1991) (exploration and exploitation), Cohen and Levinthal (1990), Todorova and Durisin (2007) (absorptive capacity), Salmenkaita and Salo (2004) (three modes of foresight activities), Melkas (2004) (information quality attributes), and Burt (1997; 2004) (information brokerage). Although the basic elements of the model are already well known and documented, in the proposed model they are combined in a novel and holistic way, making the theoretical contributions presented here valuable. The model emphasises the role of absorptive capacity as an important dynamic capability for an actor’s success in carrying out innovation processes and discusses ways of enhancing absorptive capacity in order to better link the results of foresight processes and organisational innovation activities and learning. Absorptive capacity includes features of both visionary and innovation capabilities. In order to use and absorb information and knowledge, an actor needs to be able both to explore the future-oriented knowledge generated through foresight processes and exploit it in its innovation processes.

### 3.2 Networked Innovation Processes

Adaptability, a crucial factor affecting the economic success of actors, depends on their existing resources and capabilities for renewing these resources in order to keep them competitive (Pihkala et al. 2007). Visionary capability is becoming more
and more important in renewing an actor’s resource base as well as in network leadership (Harmaakorpi 2004), which again can be defined as action that leads all operations and resources of the network in the desired direction (Pihkala et al. 2007).

This chapter takes a resource-based view as its point of departure. In a shift from the earlier research focusing on internal resources, there is an increasing interest in external resources and capabilities available to the actor through networks (Zaheer and Bell 2005). Accordingly, and in line with the teachings of non-linear, multi-actor innovation processes, economic actors are not seen as isolated islands, but as entities belonging to regional, interregional, and global innovating networks and searching for information and knowledge from these networks. Therefore, competitiveness-securing resource configurations have to be considered at the level of innovation networks – as individual actors are embedded in these networks. The capacity to absorb future-oriented knowledge in a dynamic fashion is seen as a crucial competitiveness factor for individual actors and innovation networks (Uotila et al. 2006).

Social structure, especially in the form of social networks, affects economic outcomes, since these networks affect the flow and quality of information (Granovetter 2005). Granovetter (1973) defines the concepts of strong ties and weak ties in social networks. The strength of a tie is a combination of the amount of time, emotional intensity, intimacy, and reciprocal services that characterise the tie. Strong ties are characterised by common norms and high network density. These strong ties are easier for innovation, since they normally include a relatively high amount of trust, common aims, and the same kind of language for communication. However, weak ties are reported as more fruitful for innovations, because more novel information flows to individuals through weak ties than through strong ties (Granovetter 2005). People in the same strong networks tend to share the same knowledge basis, which prevents the Schumpeterian knowledge-combining innovation processes from emerging. Burt (2004; 2005) has developed the ‘strength of weak ties’ argument further by arguing that innovations are most likely to be found in structural holes between dense network structures (see also Burt 1992; Walker et al. 1997; Zaheer and Bell 2005). An actor able to span structural holes in a social structure is at a higher ‘risk’ of having good ideas: new ideas emerge from selection and synthesis across the structural holes between groups (Burt 2004). An innovation system rich in structural holes offers a lot of opportunities for new, networked innovation processes.

The weak links or structural holes enabling the biggest innovation potential are somewhat problematic for innovation processes. In order to be able to utilise the innovation potential in these structural holes, information should often be transferred between partners who have totally different knowledge interests. However, this information transfer is hampered by what is called distances in the innovation network; and in order to promote and facilitate information transfer between partners in the innovation network, it is important to acknowledge these distances and their origins.
### 3.3 Crossing Distances as an Enabler of Learning and Innovation

Following Burt’s structural hole argumentation, several authors – for example Knoben and Oerlemans (2006) and Harmaakorpi et al. (2006) – have analysed distances in innovation networks, drawing on the earlier analysis of Boschma on cognitive distance (2005), but describing the relevant dimensions a bit differently. The concept of cognitive distance (and other distances as well) refers to the fact that people belonging to different communities use different frameworks and language, which makes it difficult, sometimes even impossible, to share knowledge (Cillo 2005). According to Cillo (2005), some researchers have even rejected the idea of knowledge transfer models among people who do not share the same context where the knowledge was created. The distinction between ‘knowledge’ and ‘information’, which is brought up later in this chapter, sheds some light on this issue.

Harmaakorpi et al. (2006) have identified six central dimensions of distance. The first dimension is the pure physical closeness of the actors, labelled as geographical distance. Harmaakorpi and his colleagues claim that this dimension should be approached as nothing more than what its name indicates. As argued in many studies concerning proximity and distance, this analytical separation enables us to see the real effect of being geographically close to each other, as opposed to the effects of other forms of distance. Cognitive distance refers to closeness of knowledge bases and forms of expertise of the relevant actors. Cognitive distance contributes to accumulation of knowledge and efficiency of interaction. Cognitively close actors are able to assume a certain common knowledge base that does not have to be defined or negotiated. Organisational distance refers to arrangements to coordinate transactions and enable exchange of information within and between organisations. The importance of organisational distance lies in the need to organise utilisation of knowledge and other resources owned by a variety of actors (Boschma 2005: 64). A close but not identical notion to organisational distance is functional distance. Functionally close actors act in areas of expertise close to each other – for example, in the same industry.

While organisational and functional distances are connected purely to relationships between institutions, social distance is fundamentally about relationships between people. It refers to the intensity of trust-based social relations, such as friendship or kinship. The notion of social proximity comes close to the concept of social capital as defined, for example, by Tura and Harmaakorpi (2005) and Burt (2005). When moving from the micro-level of social capital to the macro-level, Harmaakorpi et al. (2006) also identified an institutional or cultural form of distance that is sometimes seen within the context of social capital. Knoben and Oerlemans

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1 Harmaakorpi et al. (2006) and Knoben and Oerlemans (2006) have used the term ‘proximity’ instead of ‘distance’, but here we prefer using the latter term in order to emphasise the challenges of crossing distances.
have, in their literature review, identified an additional component of proximity and labelled it technological proximity. It is based on shared technological experiences and knowledge bases. Technological proximity between actors facilitates acquisition and development of technological knowledge and technologies.

In addition to these distances presented (see Table 3.1), Parjanen et al. (2011) have proposed yet another variety that they labelled as *temporal distance* – referring to differences in the ability to imagine potential futures and make use of future-oriented information and knowledge generated through, for example, foresight activities. This temporal distance manifests itself in the ways in which actors perceive the future – in a reactive or proactive manner. In terms of the arguments presented in this chapter, it is of special interest (see Table 3.1).

<table>
<thead>
<tr>
<th>Distance type</th>
<th>Source</th>
<th>Innovation potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Geographic</td>
<td>Physical distance between actors</td>
<td>Geographic proximity does not automatically lead to innovations, but it may, for instance, facilitate social proximity.</td>
</tr>
<tr>
<td>2. Cognitive</td>
<td>Differences in ways of thinking and knowledge bases</td>
<td>A certain degree of cognitive distance enables creation of new innovations.</td>
</tr>
<tr>
<td>3. Communicative</td>
<td>Differences in concepts and professional languages</td>
<td>When making a new idea understandable, concepts from other fields or sciences, for instance, may be utilised.</td>
</tr>
<tr>
<td>4. Organisational</td>
<td>Differences in ways of coordinating the knowledge possessed by organisations and individuals</td>
<td>An organisation should have both strong and weak links in its network.</td>
</tr>
<tr>
<td>5. Functional</td>
<td>Differences in expertise in different industries or clusters</td>
<td>It is useful to obtain novel information from outside of one’s own field of operation. In such cases, the information often needs to be adapted to the field of operation in question.</td>
</tr>
<tr>
<td>6. Cultural</td>
<td>Differences in (organisational) cultures, values, etc.</td>
<td>The challenge is to get people working in different organisational cultures to collaborate.</td>
</tr>
<tr>
<td>7. Social</td>
<td>Social relationships and the amount of trust included in them</td>
<td>Innovations require interaction among different kinds of actors. Trust helps in creation of radical ideas.</td>
</tr>
<tr>
<td>8. Temporal</td>
<td>Differences in ability to imagine possible, potential futures</td>
<td>The challenge is to acquire and assimilate future-oriented knowledge so that it could be exploited in a proactive manner.</td>
</tr>
</tbody>
</table>
3.4 The Interplay between Foresight and Innovation

New, networked leadership tries to promote learning and includes an active interpretation of signals for change (Pihkala et al. 2007). Aside from technological signals, these signals can be political, social, environmental, and so on. In order to receive these signals, central players and decision makers need tools that can provide them with meaningful, future-oriented information and shared visions (or frames of reference) that they can use to anticipate the consequences of their choices and negotiate relevant strategies. Foresight is among the tools considered useful in this respect (Eerola and Jørgensen 2002).

Coates (1985: 30) defines foresight as the overall process of creating an understanding and appreciation of information generated by looking ahead. It goes further than forecasting, including also aspects of networking and preparation of decisions concerning the future. Still, it is not planning, but provides ‘information’ about the future and is therefore one step in planning and preparation of decisions (Cuhls 2003). It includes qualitative and quantitative means for monitoring clues and indicators of evolving trends and developments, and is best and most useful when directly linked to the analysis of policy implications. Thus, technology (and also other) foresight activities may, at best, have a vital role in this renewal process by ‘giving time and direction’ to decision-makers and thus supporting, for example, strategy formulation.

Learning is facilitated by questioning of either decision-makers’ or more widely all actors’ representations in the organisation, and learning phenomenon then may be expressed through collective change, mobilisation, and strategy appropriation (Bootz 2010). Foresight can be used to acquire new knowledge from outside sources or conventional domains of the actor, which further enriches and complements the actor’s existing knowledge. In this way, foresight processes facilitate the recombination of explicit knowledge and its absorption and conversion into tacit knowledge (Roveda and Vecchiato 2008). Also Cuhls (2003: 96) sees the communication effect of pre-assessing future options or decisions and mobilising and bringing together the different stakeholders of the innovation system (the ‘wiring up’ effect) as an important result of foresight processes.

Indeed, many authors have related innovation to the concept of future, and in some cases even consider the use of futures research (in its various forms) in innovation processes crucial for the success of an innovation, or argue that at least it can contribute positively to the quality of an innovation process (Van der Duin 2004; du Preez and Pistorius 1999: 215). But even though this relation is acknowledged and although foresight activities can be regarded as an activity providing inputs to the learning and innovation process, not much literature has been published on how foresight is actually used to facilitate innovation processes and how it relates to organisational renewal processes. According to van der Duin (2004), “futures research seems to have the most impact in the first phases of the innovation process, the fuzzy front-end, where it has the function of inspiring people to think about new innovations, new future developments and to challenge prevailing perceptions”. 
Although foresight exercises have supplied evidence on claimed benefits – such as the generation of future-oriented knowledge and strengthening of collaborative networks (Salmenkaita and Salo 2004), there are still several challenges related to foresight, especially how to improve the effectiveness of foresight and how to strengthen the dialogue between foresight, planning, and innovation processes (Major and Cordey-Hayes 2000; Salo 2000; Eerola and Jørgensen 2002: 29; Eerola and Väyrynen 2002: 15). One special challenge is related to SMEs, where scarcity of time, money, resources, and personnel cause difficulties in utilising the results of foresight exercises (Major and Cordey-Hayes 2000).

3.5 Elements of the Conceptual Model

3.5.1 Exploration and Exploitation

A central issue in studies of adaptive organisational processes is the relationship between the concepts of exploration and exploitation, the former relating to the search for new possibilities and the latter to old certainties (March 1991). According to March (1991), exploration includes things captured by terms such as search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation. Exploitation, on the other hand, includes such things as refinement, choice, production, efficiency, selection, implementation, and execution. In his article, March (1991) noted that both exploration and exploitation are essential functions for organisations to prosper in the long run, but problems stem from the fact that they compete for the same scarce organisational resources. Thus, the big challenge at an organisational level is to find a suitable trade-off between exploration and exploitation.

The concepts of exploration and exploitation also include a temporal conflict. According to March, adaptive processes characteristically improve exploitation more rapidly than exploration. However, remaining competitive in the long run depends critically on sustaining a reasonable level of exploration, so these tendencies to increase exploitation and reduce exploration can increase unwanted path-dependent behaviour in organisations – being potentially, as March said, self-destructive. So finding a suitable trade-off between exploration and exploitation also involves conflicts between short-term and long-term gains and between gains to individual knowledge and gains to collective knowledge (March 1991). In the case of practice-based innovation, the overarching theme of this book, when innovation processes occur within a very practical context, it seems reasonable to argue that there is an in-built tendency to emphasise exploitation-type activities at the expense of exploration-type activities.

According to Li et al. (2008), some scholars interpret exploration as distant and exploitation as proximate knowledge searches in an innovation network. They concluded that most studies that employed the idea of local or distant knowledge
search interpreted exploitation as activities that search for familiar, mature, current, or proximate knowledge, while exploration was seen to consist of activities that search for unfamiliar, distant, and remote knowledge. This notion relates especially to technological innovation: a local search provides a firm with advantages in making incremental innovations, while a distant search might bring opportunities for a firm to achieve radical innovations.

### 3.5.2 Absorptive Capacity

Information and knowledge are fuels for innovation, and in sourcing them from networks, organisational absorptive capacity becomes a key issue. Absorptive capacity was originally defined by Cohen and Levinthal (1990) as an organisation’s ability to value, assimilate, and apply new external knowledge. Kim (1998) argues that absorptive capacity requires learning capability and develops problem-solving skills; learning capability, again, is the capacity to assimilate knowledge for imitation, while problem-solving skills create new knowledge for innovation. Moreover, Zahra and George (2002) define two different types of absorptive capacity: potential absorptive capacity, which is important in acquiring and assimilating external knowledge, whereas realised absorptive capacity refers to the functions of transformation and exploitation of the knowledge collected. Both are, naturally, important in innovation processes: potential absorptive capacity enables the exploration of knowledge (often) through the weak ties of the innovation network, and realised absorptive capacity secures the exploitation (often) through the strong ties of the networks. Absorptive capacity is crucial when pondering questions about future-oriented knowledge adaptation in innovation networks; higher absorptive capacity enables easier crossing of structural holes in the innovation system.

To better understand the characteristics of absorptive capacity as a dynamic capability, we have to take a closer look at its different parts:

1. Acquisition, referring to an actor’s capability to identify and acquire externally generated knowledge that is critical to its operations;
2. Assimilation, referring to the actor’s routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources;
3. Transformation, denoting an actor’s capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge;
4. Exploitation, which as a capability is based on the routines that allow actors to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into their operations (Zahra and George 2002).

According to these definitions, absorptive capacity is like a funnel, where potential absorptive capacity (visionary capability) secures the newness and
diversity of the knowledge needed, whereas realised absorptive capacity (innova-
tive capability) stands for operationalisation of the new knowledge within the 
existing processes in order to make the actual innovation processes to take place.

Todorova and Durisin (2007) have, in their article, presented an interesting 
interpretation of the concept of absorptive capacity. They have criticised Zahra 
and George’s (2002) model based on several points, the main being that the phases 
of absorptive capacity presented by Zahra and George (acquisition, assimilation, 
transformation, exploitation) are not consecutive but alternative routes (route one 
being acquisition – assimilation – exploitation, AAE, and route two being acquisi-
tion – transformation – exploitation, ATE) in a learning process. Based on findings 
from cognitive psychology, they propose that when a new idea fits well into existing 
cognitive schemas, it is only slightly altered to improve the fit and then incorporated 
into the existing cognitive structures. The existing cognitive structure does not 
change, and the knowledge is ‘assimilated’. On the other hand, a process of 
transformation takes place when new situations or ideas cannot realistically be 
altered to fit existing knowledge structures. In the latter case, the cognitive 
structures of the individuals themselves must be transformed to adapt to an idea 
or a situation that they cannot assimilate (Todorova and Durisin 2007).

3.5.3 Explicit, Emergent, and Embedded Foresight Modes

A fruitful starting point for constructing a conceptual model linking foresight, 
organisational renewal, and innovation is offered by Salmenkaita and Salo 
(2004), who have typified three different kinds of technology foresight exercises – 
explicit, emergent, and embedded – and explored their interrelationships. Although 
their analysis is related to the context of shaping and implementing science and 
technology policies, we think the classification they used is applicable also in a 
wider organisational context.

The first foresight mode is what Salmenkaita and Salo (2004) call an explicit 
foresight process, in which the participants in the process represent their own 
separate interests and areas of expertise. They are also implicitly influenced by 
their own organisational context. Salmenkaita and Salo see an explicit foresight 
process as a highly structured approach to the development of shared visions about 
future priority areas, where systematic methodologies are used in order to integrate 
expert inputs through voluntary consultations and contributions.

The second foresight mode is what Salmenkaita and Salo call an emergent 
foresight process. It presumes that the participants have overlapping interests, are 
already sharing similar views of future opportunities, and are willing to commit 
resources to ‘target activity’. Their perhaps competing and complementary views are, 
through iterative discussions, synthesised into increasingly comprehensive visions of 
the future, which may embody competing or even contradictory views, but are 
nevertheless helpful in identifying avenues for further collaboration. The primary
benefit for the participants lies in their enhanced capability to acquire resources for further work and to commit other stakeholders to their future-oriented efforts.

The third foresight mode is called embedded foresight, where participants are already involved in collaborative activities, and the organisational framework for such collaboration is intentionally utilised to facilitate future-oriented discussions beyond the scope of individual projects. This kind of continuous consultation among participants supports the adaptation of activities to perceived opportunities and threats. The characteristics of these different foresight modes are compared in Table 3.2.

<table>
<thead>
<tr>
<th></th>
<th>Explicit</th>
<th>Emergent</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interests</td>
<td>Disparate</td>
<td>Overlapping</td>
<td>Within same domain</td>
</tr>
<tr>
<td>Approach toward</td>
<td>‘Policy-makers decide’</td>
<td>‘Policy-makers follow’</td>
<td>‘Policy-makers adapt’</td>
</tr>
<tr>
<td>innovation policy</td>
<td>Consultative</td>
<td>Competitive</td>
<td>Continual</td>
</tr>
<tr>
<td>Methodology</td>
<td>Systemic</td>
<td>Ad hoc</td>
<td>Structured ad hoc</td>
</tr>
<tr>
<td>Organisational</td>
<td>Implicit</td>
<td>Both</td>
<td>Explicit</td>
</tr>
<tr>
<td>influence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource allocation</td>
<td>Batch-mode</td>
<td>Continuous</td>
<td>Staged</td>
</tr>
<tr>
<td>Result</td>
<td>Recommendations</td>
<td>Actions</td>
<td>Adaptation</td>
</tr>
<tr>
<td>Other observations</td>
<td>‘All are equal’ (expert contributions)</td>
<td>Less competent viewpoints tend to be discounted (‘meritocracy’)</td>
<td>Promotes self-guidance</td>
</tr>
<tr>
<td>Functions</td>
<td>Establish S&amp;T priorities and support ‘five C’s’ in innovation system</td>
<td>Identify RTD opportunities and seek coalitions for RTD activities</td>
<td>Adaptation and adjustment of RTD activities in RTD programmes</td>
</tr>
<tr>
<td>Structures</td>
<td>Project organisation</td>
<td>Adaptive ‘ad hoc’ networks with some management structure</td>
<td>No separate management structures; embedded in RTD programme</td>
</tr>
<tr>
<td>Strengths</td>
<td>Ability to seek nonpartisan view of RTD opportunities across established domains</td>
<td>Close links to RTD efforts and participants’ RTD priorities</td>
<td>Tight interaction between policy-making and RTD efforts</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Actionability of recommendations may remain weak</td>
<td>Lead roles required to catalyse networking</td>
<td>Constrained to areas in which RTD activity is already established</td>
</tr>
<tr>
<td>Pitfalls</td>
<td>Undue political and other nonmeritocratic pressures affecting priority setting</td>
<td>Corporatism may prevail</td>
<td>‘Lock-in’ of assumptions and actions</td>
</tr>
</tbody>
</table>
3.5.4 **Information Quality and Foresight Activities**

Salmenkaita and Salo (2004) also discuss difficulties related to different kinds of foresight processes and challenges in the utilisation of the results of those exercises. According to them, there is “an inherent tension in selecting the appropriate level of detail, or granularity, in analysing key technologies”. When defining technologies too narrowly, the list of technologies may become excessively long and hence unmanageable, and during the foresight process one cannot pay much attention to interconnections among technologies. Then again, if technologies are defined very broadly, the results may lack the level of detail that would be needed to derive and implement recommendations in specific settings. There can also be a tension between the ‘richness’ of informational outputs from a foresight exercise and the usability of such outputs for subsequent action plans. These difficulties are reflected in the outputs of foresight processes – the information produced during the process, which again can be approached from the information quality perspective.

Information quality is not an entirely new concept, but it has gained increasing attention during the last few years (Melkas 2004). Several researchers have defined attributes or dimensions of information quality (for a detailed discussion, see Wang and Strong 1996; Appendix 1). Information quality, as well as data quality, has been studied mainly by researchers interested in computing, management information systems, databases and their management, data security, and data warehouse quality, to mention a few. Researchers have mostly concentrated on company environments and business information (cf., e.g., Wang et al. 1998; Becerra-Fernandez et al. 2004; English 1999; Huang et al. 1999), but for example Uotila and Melkas (2007) have used the information quality approach when analysing the information produced in a regional technology foresight process.

For our purposes, it is useful to make a distinction between data, information, and knowledge, although in many studies these concepts are used interchangeably (Melkas 2004), which creates considerable conceptual unclarity. The situation is further complicated by different types of knowledge, such as explicit, tacit, and self-transcending knowledge (see Nonaka and Takeuchi 1995; Scharmer 2001).

Data – for instance, numbers – are the factual content of information, and only meaningful information can be the basis for purposeful action (Melkas and Harmakaorpi 2008). When data are put into a meaningful context and processed, they become information (Lillrank 1997; 2003). When analysed critically in this context, and when its underlying structure in relation to other pieces of information and conceptions about how the world works is understood, this information is transformed into a component of knowledge (Miller et al. 2001; Melkas and Harmakaorpi 2008). The idea that knowledge is much more than information stems from the view that knowledge consists of an assortment of inputs: information, experiences, beliefs, relationships, and techniques that an individual mentally synthesises to determine what a specific situation means and how to handle it (Becerra-Fernandez et al. 2004).
When taking this discussion back to foresight, for example Horton (1995) discusses the elements that should constitute a successful foresight process. According to her, successful foresight consists of three consecutive phases:

1. Phase one comprises the collection, collation, and summarisation of available information and results in the production of foresight knowledge;
2. Phase two comprises the translation and interpretation of this knowledge to produce an understanding of its implications for the future from the specific point of view of a particular organisation;
3. Phase three comprises the assimilation and evaluation of this understanding to produce a commitment to action in a particular organisation (Horton 1995).

When making a distinction between the concepts of ‘information’ and ‘knowledge’, Uotila and Melkas (2007) suggested that phase 1 may not result in foresight knowledge but in foresight information (of a ‘lower level’), and the interpretation process in phase 2 is of utmost importance in order for the results to benefit the stakeholders. Assessing the hierarchy and quality of data, information, and knowledge is thus necessary, both in the collection of background materials and in the analysis and reporting of results in order to avoid what Uotila and Melkas call the ‘black hole of interpretation and implementation of foresight knowledge’ (Uotila and Melkas 2007).

### 3.5.5 Information Brokering as a Facilitator of Organisational Learning and Innovation

Sorenson et al. (2006: 996) state that even within the supportive infrastructure of an organisation, receiving and building on new knowledge can prove difficult: recipients assimilating new knowledge must actively process it by experimenting with its application in new problem domains and environmental contexts. Hence, the act of receiving and building on knowledge can be regarded rather as the beginning of a trial-and-error process than as the acceptance of a complete, well-packaged gift.

Partners participating in networked innovation processes on different sides of structural holes have different knowledge interests. They also have information of a different quality and generated for their own purposes (Melkas and Harmaakorpi 2008). The difference is often so great that a special interpretation function is needed. Burt (1997) calls this special function ‘information brokerage’ in a ‘structural hole’. A structural hole is an opportunity to broker the flow of information between people and control the form of cooperation that brings together people from opposite sides of the hole. However, brokering means more than just linking together partners involved in an innovation process. It also includes the aspect of transforming the ideas and knowledge being transferred, and – at best – allows the widening of optimal cognitive (as well as social, cultural,
temporal, and so on) distance between partners in an innovation process and enhances their absorptive capacity (Howells 2006; see also Nooteboom et al. 2007).

Brown and Duguid (1991) also refer to brokering-type activities but use the term ‘organisational translator’. Organisations tend to emphasise routine and ‘canonical’ practice over improvisation, innovation, and adaptation, although in practice, both are needed. Brown and Duguid further note that allowing practice in organisations to evolve unchecked leads to increasing fragmentation, whereas checking it too firmly leads to rigidity; and that over-formalised relations within a firm can lead to endangering weak or informal ties that build unexpected but productive bridges across organisations. Organisational translators are thus actors who can frame the interests of one community in terms of another’s practice-shaped world-view.

3.6 The Conceptual Model Integrating Foresight Activities, Absorptive Capacity, and Innovation

According to Major and Cordey-Hayes (2000), translation and interpretation is the most crucial step in a foresight process, but it is still poorly understood and has only a few theoretical techniques. Our aim is to build a bridge between foresight, information brokering, absorptive capacity, and innovation. The idea behind the proposed model is that technology foresight as such (as well as other kinds of foresight processes) can only produce information about possible future development of certain technologies. When this information is contextualised and embedded back into the environment where it will be utilised, into an organisational context, it will be refined or transformed into future-oriented innovation knowledge to promote innovation processes (Uotila and Ahlqvist 2008). This is done via information brokerage, which requires, among other things, a deep understanding of the users’ knowledge interests, prior technological choices, and general knowledge level.

Firstly, the model (see Fig. 3.1) assumes, in line with the reasoning of Salmenkaita and Salo (2004), that different foresight modes – explicit, emergent, and embedded – result, in terms of information quality, in different kinds of information. This variation in the resulting information is reflected in information quality, and this again affects the way the information can be absorbed by organisations and further utilised in learning and innovation processes.

When combining this notion with the new interpretation of the model of absorptive capacity presented by Todorova and Durisin (2007), we propose – as is shown in the model – that information resulting from embedded foresight activities is more easily absorbed by organisations and likely to support AAE-type learning and innovation activities, which can usually be characterised as incremental innovations from the organisational point of view. Especially when talking about practice-based innovation, there can be an inherent tendency to over-emphasise AAE-type learning. In this case, there is also a possible risk of ‘path-dependency’ and ‘mental lock-ins’. Path-dependency, or lock-in effects – whether technological
or institutional in nature – may support the efficient exploitation of present resources in the short run, but in the longer run they can limit the range of technological options, visions, and value networks, and in so doing reduce innovation capabilities (Könnölä et al. 2007). Using the terminology of March (1991), embedded foresight and AAE-type learning and innovation activities relate to exploitative organisational processes.

On the other hand, explicit foresight exercises result in information that, from the organisational point of view, is more difficult to absorb; but if absorption succeeds, it supports ATE-type learning and more radical innovations. Linking this notion with the terminology used by March (1991), explicit foresight and ATE-type learning relate to explorative organisational processes. When further combining this notion with the concept of information brokering, we propose that the intensity of the necessary brokering is different in different learning or innovation types. This implies that the intensity of brokering needed when an organisation is trying to absorb information resulting from an explicit foresight exercise is greater than that needed in the case of an embedded foresight exercise. When hypothesising further, we suggest that from the point of view of organisational renewal, it is important to find an appropriate balance between, on the one hand, embedded foresight and AAE-type learning and innovations, and, on the other, explicit foresight and ATE-type learning and innovations.

3.7 Summary and Conclusion

Future-oriented knowledge is very tightly centred around the ‘knowing self’ (see Howells 2002) and is often difficult to articulate and communicate, as well as very sticky and resistant to knowledge-transfer efforts. In his study on the use of
future-oriented knowledge in regional innovation processes, Uotila (2008) concluded that the more a foresight process relies on the use of outside expertise (referring here to explicit foresight), the more emphasis also has to be placed on knowledge brokering.

In this process of transforming ‘foresight information’ into ‘innovation knowledge’, knowledge brokers play an important role as facilitators of information transfer and new knowledge creation. Parjanen et al. (2011) state that when actors in networks communicate along strong ties and across short distances, what is communicated is more ‘knowledge-like, ready-to-use inputs’ for learning and innovation processes. On the other hand, when communication takes place across greater distances and along weak links, what is communicated is more ‘information-like’ inputs, and much greater effort and resources are needed in the interpretation process in new contexts before these inputs can provide support for learning, new knowledge generation, and innovation. People who act as brokers can provide the necessary extra resources, and thus they may help also the innovating actors of a network to cross greater distances.

In the proposed conceptual model, knowledge brokering is seen to play a crucial role when the results of foresight – future-oriented information and knowledge – are used to facilitate innovation processes in organisations. Brokering is an activity promoting information and knowledge flow in innovation networks by helping to decrease different kinds of distances, including temporal distance, between actors in networks. Thus, knowledge brokering and knowledge brokers help also to increase the absorptive capacity of different actors in innovation networks. How they actually do it is still very much uncharted territory. According to Reichert (2006), a new knowledge broker profile is very similar to the “old eighteenth century host or hostess of a salon: smart intellectuals who love to discover nearly as much as they love the sharing of discovery, who not only have the talent for both, but also the communicative disposition and generosity to develop this combination into a human art form, a celebration of shared knowledge development”. But were these hosts or hostesses born with their talents and competences, or can they be developed? If one ends up with the latter alternative, then further research is needed concerning the search mechanisms of knowledge, personal incentives and motivating factors of knowledge brokers, personal competencies, and so on, in order to fully understand knowledge brokering and its critical role in facilitating knowledge transfer, learning, and innovation processes.

In this chapter, our aim was to build a holistic model integrating different kinds of foresight approaches, and organisational innovation and learning modes. This was done by combining established and tested theoretical concepts in a novel way. Still, one has to bear in mind that – however conceptually appealing the model might seem – further research is needed to empirically test and validate it.
Appendix 1: Definitions of Information Quality Dimensions
(Wang and Strong 1996)

Believability: The extent to which information is accepted or regarded as true, real and credible.
Value-added: The extent to which information is beneficial and provides advantages through its use.
Relevancy: The extent to which information is applicable and helpful for the task at hand.
Accuracy: The extent to which information is correct, reliable, and certified as being free of error.
Interpretability: The extent to which information is in an appropriate language and units and the information definitions are clear.
Ease of understanding: The extent to which information is clear, unambiguous, and easily comprehended.
Accessibility: The extent to which information is available or easily and quickly retrievable.
Objectivity: The extent to which information is unbiased (unprejudiced) and impartial.
Timeliness: The extent to which the age of the information is appropriate for the task at hand.
Completeness: The extent to which information is of sufficient breadth, depth, and scope for the task at hand.
Traceability: The extent to which information is well documented, verifiable, and easily attributed to a source.
Reputation: The extent to which information is trusted or highly regarded in terms of its source or content.
Consistent representation: The extent to which information is always presented in the same format and is compatible with previous information.
Cost-effectiveness: The extent to which the cost of collecting appropriate information is reasonable.
Ease of operation: The extent to which information is easily managed and manipulated (i.e., updated, moved, aggregated, reproduced, customised).
Variety of information and information sources: The extent to which information is available from several differing information sources.
Concise representation: The extent to which information is compactly represented without being overwhelming (i.e., brief in presentation, yet complete and to the point).
Access security: The extent to which access to information can be restricted and, hence, kept secure.
Appropriate amount of information: The extent to which the quantity or volume of available information is appropriate.
Flexibility: The extent to which information is expandable, adaptable, and easily applied to other needs.
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Combining Foresight and Innovation: Developing a Conceptual Model


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ISSUES IN ABSORBING FORESIGHT KNOWLEDGE FOR INNOVATION IN SMEs

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ABSTRACT
This paper examines the difficulties of small and medium-sized enterprises (SMEs) in absorbing foresight knowledge for innovation. The research indicates a gap between the information produced by outsiders and SMEs’ ability to use it for innovating. Based on the literature on absorptive capacity, it is suggested that SMEs enhance transformation, in addition to assimilation, to better use foresight knowledge. This is to better balance transformation and assimilation under operative pressure while aiming to maximize benefits of the internal and external resources available for continuous innovation.

Keywords: Innovation, Absorptive capacity, Foresight, SME

1. INTRODUCTION

This paper examines the challenges of small and medium-sized enterprises (SMEs) in absorbing the foresight knowledge provided by intermediary organisations. Leaning on the theory of absorptive capacity (AC), it points out some of the issues, as well as possibilities, for facilitating SMEs to use foresight knowledge for innovation.

The theory of AC describes the ability to recognize, acquire, assimilate, transform and exploit external knowledge (Cohen and Levinthal, 1990). Zahra and George (2002) divide the concept into potential and realised AC and claim there is a discontinuity between the phases of assimilation and transformation. They call for studies on social integration mechanisms to bridge the gap (Zahra and George, 2002). Whereas Zahra and George (2002) saw assimilation and transformation as successive phases, Todorova and Durisin (2007) stated that they are different phases with different characteristics. Relatively familiar knowledge can be assimilated while information that challenges the current thinking requires transformation.

Uotila et al. (2012) further discuss the two learning paths of AC in an innovation context: acquisition–assimilation–exploitation (AAE) and acquisition–transformation–exploitation (ATE). They propose that the AAE path leads to incremental innovations and exploitation, while the ATE path is related to explorative innovation processes (Uotila et al., 2012).

In Finland lots of resources are used to collect foresight information, both at national and regional levels (for example: Popper et al., 2007; Kaivo-Oja and Marttinen, 2008). However, this knowledge resource is not utilized to its full potential in SMEs. Consequently, valuable knowledge is not utilized, the resources used to collect it are partially wasted and the ability of SMEs to renew and innovate is reduced. This might lead to SMEs failing to adapt to a changing environment.
This paper aims to identify the reasons for the lack of interest towards foresight knowledge and the challenges of utilizing available foresight knowledge in SMEs. The study follows the call of Volberda et al. (2010) as an AC study that states what kind of knowledge is being absorbed. The research questions are: 1) What hinders the absorption of foresight knowledge in SMEs? and 2) How can absorption be enhanced in SMEs? These are examined with two case studies and six expert interviews.

The paper is structured as follows. First, the combination of the theories of AC and foresight are presented, followed by an extension to the innovation field. The characteristics of SMEs are discussed shortly. The empirical part of the paper presents data on absorption of foresight knowledge in the context of SMEs. A framework is created to visualize the results and to highlight the importance of transformation and required interaction platforms. The implications and future research avenues are then discussed.

2. THEORETICAL BACKGROUND

2.1 AC AND FORESIGHT

AC was originally defined by Cohen and Levinthal (1990) as an organization’s ability to value, assimilate and apply new knowledge. Zahra and George (2002) developed the concept further by distinguishing between two different types of AC: potential AC, which is important in acquiring and assimilating external knowledge, and realised AC, which refers to the functions of transformation and exploitation of knowledge.

Todorova and Durisin (2007) question Zahra and George’s (2002) model, where assimilation and transformation are consequent phases, and propose that assimilation and transformation are different processes and require different mechanisms. Cognitive structure defines whether it is assimilation or transformation. If the cognitive structure does not change, it is assimilation, and when the new knowledge cannot be fitted to the existing knowledge structures, it is transformation.

Following Todorova and Durisin (2007), Uotila et al. (2012) propose that there are two types of learning paths - AAE and ATE - and then combine explicit, emergent and embedded foresight exercises (of Salmenkaita and Salo, 2004) with AAE and ATE learning paths (of Todorova and Durisin). Their aim is to bridge foresight, information brokering, AC and innovation activities. According to Uotila et al. (2012), it is important to find an appropriate balance between embedded foresight and AAE-type learning and innovation, and explicit foresight and ATE-type learning and innovation.

On the other hand, Lichtenthaler (2009) highlights issues related to exploratory, transformative and exploitative learning in using external knowledge in turbulent environments. Firms should keep assimilated knowledge alive by maintaining and reactivating it. Sometimes assimilated knowledge has to be maintained for years until it can finally be utilized and applied in new products. Transformative learning has essential role in this. Exploratory, transformative and exploitative learning have complementary positive effects on profiting from external knowledge, and further studies are encouraged for small firms’ managerial challenges in these three learning processes (Lichtenthaler 2009).

Proposition 1: AAE and ATE have different mechanisms to utilize foresight information.
2.2 FORESIGHT AND INNOVATION

Coates (1985) defines foresight as the process of creating an understanding of information generated by looking ahead. Foresight can be seen as a process of collecting signals, analysing them and using the resulting knowledge in decision making. Interplay between foresight and innovation is also multifaceted (Kaivo-oja 2006; 2012). Based on Kaivo-oja’s (2006) work, Gracht et al. (2011) summarize: “Foresight and innovation systems can interact in different ways; foresight knowledge is not the only kind of knowledge needed for the innovation process; in different innovation models the strategic role of foresight knowledge is different”.

Traditionally in AC, knowledge has been seen as technological knowledge (e.g. Cohen & Levinthal, 1990). However, the signals absorbed can also be political, social, environmental etc. (Uotila et al., 2012; Berkhout et al., 2010). In order to receive the signals, a certain kind of leadership and tools are needed for meaningful interpretation of foresight knowledge (Pihkala et al., 2007; Uotila et al., 2012).

Major & Cordey-Hayes (2000) state that effective innovation requires the transfer of knowledge and introduce a node-process of translation, which is related to data, information and knowledge: understanding, wisdom and action. Ansoff (1984) and Ilmola and Kuusi (2006) also point out the role of different filters, such as surveillance, mentality and power filters, that data has to pass when capturing the relevant information of the environment and making decisions and actions based on it. Godkin (2010) discusses the AC related insight and action inertia in organizations. These issues might be strongly linked to scanning data and refining it to knowledge on behalf of someone else.

March (1991) writes that the central challenge to the exploration of new possibilities and exploitation of old certainties is finding the right balance in these processes. Adaptive systems that focus mainly on exploration easily lead to many undeveloped new ideas and less distinctive competence, and systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in a suboptimal situation. The search for new ideas, markets or relations has less certain outcomes, longer time horizons and more diffuse effects than does the further development of existing ones. Compared to the returns from exploitation, the returns from exploration are less certain, more remote in time and organizationally more distant from the locus of action and adaption. As a result, maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity, while what is good in the long run is not always good in the short run (March 1991).

Proposition 2: An AAE and ATE balance is needed for innovation activities

2.3 SMEs, FORESIGHT AND INNOVATION

A common impression is that the European economy is dominated by large, multinational enterprises, but more than 99% of all European businesses are SMEs (by the EU’s definition, an SME has under 250 employees and a turnover under 50 million euro). “They provide two out of three of the private sector jobs and contribute to more than half of the total value-added created by businesses in the EU. Moreover, SMEs are the true back-bone of the European economy, being primarily responsible for wealth and economic growth, next to their key role in innovation and R&D” (EU and EK). SMEs are often also part of a large firm’s value adding R&D, production and service networks. SMEs are a crucial part of business networks and seen as key source of competitive innovations (Gray, 2006; Major & Cordey-Hayes, 2000).
Literature and previous studies implicate that SMEs are strongly reliant on the attitudes, education, skills and expertise of their personnel (Atherton & Hannon, 1995; Major & Gordey-Hayes, 2000; Gray 2006), and therefore SMEs can also be characterized by their attitude to the future (Major & Gordey-Hayes, 2000). Anyhow, SMEs often lack the resources and time to look beyond their immediate short-term needs. SMEs want knowledge that is both discrete and concrete, while foresight knowledge is often strategic and abstract rather than operational and tangible (Major & Cordey-Hayes, 2000). This challenge can be related to foreseeing technological issues and business environmental changes impacting on SMEs. In various studies, like Major & Cordey-Hayes’ (2000) and Kaivo-ojas (2008), attention is paid to the challenge of dissemination and absorption of available foresight information by practical actors, like SMEs. According to Major and Cordey-Hayes (2000), translation and interpretation is the most crucial step in a foresight process, but it is still poorly understood and needs more investigation.

Proposition 3: In the SME context, AAE occurs naturally; translation and interpretation are crucial for ATE to take place

3. Methodology

In order to enhance understanding about the absorption of foresight knowledge in SMEs, two foresight workshops were observed in autumn 2011 and spring 2012, and six semi-structured expert interviews were conducted during spring 2012. The experts were a purposive sample of experts on a national level who agreed to be interviewed. The first interviewees were chosen as they were on the board of the research project, and further pyramidning (Hippel et al., 2009) was used to identify other experts.

The two particular cases focus on absorbing foresight knowledge in the context of international business. Both were initiated by an intermediary organization.

Case 1 focuses on studying how collected weak signals could be categorized, analysed and presented so that they will be more accessible to SMEs. The signals of energy technology development in China were collected by Chinese specialists. The data in Case 1 is from a two-day workshop that was organized to screen the signals and find out how they could be presented to SMEs. Five people from different development organizations participated in the workshop. They worked in one group during the workshop and the work was observed and documented by one researcher. The two days had a different observer (Oikarinen and Kallio, 2012, p.5).

In Case 2 there were two workshops organized for SMEs interested in the cleantech business in Russia. The aim was to facilitate social interaction and collective interpretation of weak signals and new ideas. In the first workshop there were four participants from three SMEs operating in the cleantech industry. In addition, there were five participants from intermediary organizations in Finland and Russia. The workshop lasted one day and was facilitated by a Finnish intermediary organization. The participants in the workshop were divided into two groups. Both groups were observed by one researcher (Oikarinen and Kallio, 2012, p.6). The other workshop was organized six months after the first. The workshop lasted half a day and consisted of presentations given by participants. Table 1 presents the data collection.
Thus, Case 1 focused on opportunity recognition and collecting signals. The viewpoint is that of experts who are collecting signals so that companies can absorb them later. The signals were scattered, therefore the companies did not have much interest in them. Case 2 on the other hand had signals collected like in Case 1, but there were also elements of acquisition, assimilation and transformation present. The timeline was short and the signals were quite familiar to the companies, therefore they started a joint development project in Russia.

After the two first workshops, it was felt that more knowledge was needed in order to understand the capacity of SMEs to absorb foresight knowledge. To get another perspective, some of the leading Finnish authorities in using foresight for innovation were invited for an interview. Semi-structured interviews (Kvale, 1996) were conducted and carried out by one, two or three researchers. In cases where there were two representatives from the same organization, the interview was a discussion between interviewees and interviewers. The interviews included open questions about foresight in Finland in general, how foresight knowledge and signals are collected, the methods that are used to facilitate organizations to absorb foresight knowledge and the follow-up on the absorption of foresight knowledge. Also, the type of knowledge was brought into the discussion: easy-to-swallow knowledge versus irritating, unpleasant things. As a linking theme, the question of how foresight knowledge was absorbed by SMEs was asked.

Researcher triangulation was used to validate the interpretations of the data. Three researchers read the same interview transcripts as well as workshop observation diaries and made interpretations. Then, the researchers discussed their findings and searched for mutual understanding, as well as differences in interpretations. They compared the

<table>
<thead>
<tr>
<th>Case 1: Expert panel</th>
<th>Participants</th>
<th>Working methods</th>
<th>Documentation</th>
<th>Date</th>
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<tbody>
<tr>
<td></td>
<td>5 experts from 3 intermediary organisations, 1 facilitator</td>
<td>Facilitated discussion</td>
<td>2 researchers as observers</td>
<td>December 2011</td>
</tr>
<tr>
<td>Case 2: SME workshop</td>
<td>4 participants from 3 SMEs operating in the cleantech industry, 5 participants from intermediary organisations, 1 facilitator</td>
<td>Facilitated participative methods</td>
<td>2 researchers as observers</td>
<td>Day 1: October 2011</td>
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<td></td>
<td>8 participants from 3 SMEs operating in the cleantech and energy industries, 4 participants from intermediary organisations, 1 facilitator</td>
<td>Presentations</td>
<td>1 researcher as observer</td>
<td>Day 2: April 2012</td>
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<td>Interviews</td>
<td>Leading Specialist, Strategic Research</td>
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<td>January-March 2012</td>
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<td>Director of Information Society Development</td>
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<td></td>
<td>Senior Research Scientist</td>
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<td>Consultant</td>
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<td></td>
<td>Foresight Manager</td>
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Researcher triangulation was used to validate the interpretations of the data. Three researchers read the same interview transcripts as well as workshop observation diaries and made interpretations. Then, the researchers discussed their findings and searched for mutual understanding, as well as differences in interpretations. They compared the
data to the literature on AC: social integration mechanisms (Zahra and George, 2002), the difference between the assimilation and transformation processes (Todorova and Durisin, 2007) and further, the AAE and ATE learning paths of absorbing future oriented knowledge (Uotila et al., 2012).

3.1 REFLECTING ON THE PROPOSITIONS

To find the answers to the following questions: 1) What hinders the transformation of foresight knowledge in SMEs? and 2) How could transformation be enhanced in SMEs?; the examination of the data is divided into three main topics in the form of the previously presented propositions, based on the literature.

P1: AAE and ATE have different mechanisms to utilize foresight information

P2: An AAE and ATE balance is needed for innovation activities

P3: In the SME context, AAE occurs naturally; translation and interpretation are crucial for ATE to take place

These propositions are rather giving the direction to qualitative research and analysis than treating them as hypotheses.

3.1.1 AAE AND ATE HAVE DIFFERENT MECHANISMS TO UTILIZE FORESIGHT INFORMATION

Observing and analysing the workshops confirmed the gap between elsewhere produced foresight information and the capability to utilize it.

“Producing knowledge. Our job (as an intermediary organization) ends here. But an SME cannot take it from there. The knowledge is the type that cannot be assimilated. Transformation is needed.” (A researcher observation from the workshop, Case 1)

And a similar indication was made based on interviews:

“They even gave up their signal bank because they got frustrated of producing signals that were not used. Finpro is doing it with a light touch, so that it is not a burden to their employees but rather a business opportunity for them. ...FinNode (at TEM) uses Finnish experts who live in a certain culture and observe the phenomena that they consider relevant for Finns to know.” (Industrial Counsellor)

It was also noticed that foresight information is not systematically processed in organizations, and especially in SMEs, which often focused only on information that fitted the prior thinking and current processes of daily business.

“I think that, unfortunately, in organisations signals are not being observed or collected. Often foresight is left to the strategic level and even there it is an occasional, maybe one could say ad hoc, activity. And that is the search for trends, sometimes there are no signals anymore. The companies that really collect weak signals are rare.” (Consultant)

“If we take individual signals, they are never looked at very deeply or proven to be right. We proceed with case examples; how some technology has been used, for example according to someone’s business. In a way they are more like teasers that challenge one to think that the world is heading in that direction and we are working in the same field - how about finding our own roles in this value network? That is to consider digging that much deeper, or finding partners who could do that. Foresight can be also that.” (Industrial Counsellor)
“...whether a new way of discussing things has been created. Has it opened mental locks? Has it opened up hierarchical structures? I think that these are most essential and desirable.” (Senior Research Scientist)

SMEs’ knowledge about foresight and its terminology is rather inadequate: processes and objectives are often missing and foresight is seen more as a side task of sales. To get SMEs involved in going through large amounts of signals is challenging. It takes time to build up the trust necessary in strategic discussions. Information should have a clear connection to business; otherwise external interpretation of information remains rather loose. Firms expect ready answers (direct benefits) and are not willing to utilize available information for long-term capability development and product ideation. Firms need someone in charge of future oriented projects and foresight should be an ongoing process.

In the observations of Case 2, seeing how the signals started to form into knowledge that the SMEs could use was almost tangible. At first, when the signals were presented, some people seemed to agree while others did not. When reading the transcribed observation document from the workshop, it was interpreted that the tone of the conversation changed as it proceeded. First, the lines are individual: everyone has one thing that they try to say, but they are not talking about the same thing. As the conversation proceeds, they build more on what the other one has said and are able to come up with an mutually acceptable idea.

It was only during the conversation that the signals were shaped. The above could be the start of transformation. When people think about something for a second time, they question their current way of thinking. When people did not only listen to a signal but also had to think of the signal in the context of their business, the signal became different. This may not lead to the immediate execution of ideas, but will start something that can be beneficial in the long run. Here is a change for the common ground of researchers and practitioners: the role of intermediaries could be more that of a facilitator, rather than a knowledge pourer.

3.1.2 AN AAE AND ATE BALANCE IS NEEDED FOR INNOVATION ACTIVITIES

“...the operative pressure is so huge, and there is always too little time and too many things to decide... And us, as future researchers, we paint different future visions and make future paths. But what it means in practical decision making - that is left open. And that is quite a step to take for the SME alone, if they are not specialized in doing this kind of thing.” (Senior researcher)

SMEs do not have time for “formal” foresight due the high operative pressures. Instead, foresight is built in daily actions: informal discussion about the future is also a form of foresight. Foresight is a personal issue and often, especially in SMEs, it is the CEO’s task to turn insights into actions. Foresight is often seen as strategic issue and is therefore rarely shared with others. This is why it is very hard to get exact information about the processes and benefits of foresight in SMEs.

“...companies are straightforward, hierarchical, even dictatorial systems. There, the CEO says where to go. ...and of course, a company needs to have boundaries, especially an SME, it cannot focus on everything. There is logic there.” (Senior Research Scientist)

“...we have also left crazy ideas in the roadmap and new kinds of visions. For example, what kinds of actors there could be and what assignments might be set... and leave it
there. This is to give a change to the customer; to use the roadmap in many ways, including rational groundings... we also give reading instructions that it can be used in other ways... For example, some company can see their previous role, but they want to be something else in the future...” (Senior Research Scientist)

“I have been involved in Finpro developing a tool with companies that aims to collect weak signals. There, they crowdsource the future with the whole organization. There, I think we were getting somewhere... The whole organization collects weak signals, not just management. Practically, they probably do not even see any weak signals because they have something else to do.” (Consultant)

As a result of the analysis of the data from the interviews, two main foresight practices were found. First, there is a formal strategic model for foresight where the signals are provided by, for example, intermediary organizations. This is done currently, even though the SME context would get more out of it if it were networked, rather than for one company only. The second model, which is not yet as common, is more informal. There, the whole organization takes part in collecting the signals. This is internal in the company.

3.1.3 IN THE SME CONTEXT, AAE OCCURS NATURALLY; TRANSLATION AND INTERPRETATION ARE CRUCIAL FOR ATE TO TAKE PLACE

“...many SMEs do foresight, but it can be in the form of a CEO thinking alone. Inevitably, he is looking at data and drawing conclusions and thinking about a few options and then decides... scenarios as an image are probably used a lot there... I think that the foresight methods are rarely used in SMEs.” (Senior Research Scientist)

Firms are relying on their own information sources with inbuilt trust related to data and actors, also including processes and the value expectation of the business they are in.

“We only came here because it was a social obligation” (A participant speaking their mind when coming to a workshop, Case 2)

Various tools have been developed to enhance the absorption of foresight. They have characteristics that support collaboration, and also lower the threshold to finding a balance between assimilation and transformation. For example, at FinNode (a tool of the Ministry of Employment and the Economy in Finland) the term foresight has been avoided when working with SMEs. The main idea in FinNode is to transmit knowledge about upcoming phenomena and challenge SMEs to rethink their functions. Another example is the use of roadmaps by VTT Technical Research Centre of Finland. They use visualization to show all the wild ideas and familiar improvements. This way, even if the participants want to take actions on the assimilation side, there is a possibility they will later come back to the transformation ideas.

“They (SMEs) might collect a lot of knowledge... but they are stuck in certain sector... especially subcontractors... Actually they are like dolphins that swim behind a ship and try to stick with it. More likely they aim closer and closer to the same ship’s hull, rather than heading for the open blue seas to look for new ships.” (Senior Research Scientist)

Many SMEs are subcontractors of multinational companies. They are highly dependent on their (sometimes) only customer and their needs. This can be a hindrance to their incentive to renew their business in the long run.
3.2 **SUMMARIZING THE ANALYSIS**

The data was analysed by using three propositions rising from the literature. The aim was to use them as a guideline to observe issues that might hinder the absorption of foresight information in SMEs and enhance the understanding of the AC in the context of foresight and SMEs.

Three issues hindering the absorption of foresight knowledge in SMEs were revealed. First, offered future oriented information did not get put into practice in SMEs. Instead, SMEs were interested in information fitting directly into their daily business activities, indicating that AAE and ATE have different mechanisms.

Second, many SMEs are focusing on daily operative routines to fulfil the needs of a major customer (often incremental innovations for customer needs) or targets of prior set goals and interests (such as the mindset of start-ups based on radical innovation). It is easy to try to fit all available information into these schemas and leave data that does not fit out, without a second thought of its possible meaning. The AAE - ATE balance is needed when exploring future opportunities and working with current business activities.

Third, the language of foresight is not applicable to the SME context and methods better directly linked to daily operations might help forming the data into practical shape. To get SMEs interested they have to be able to see the value or possible profit in a very practical manner with other companies at a strategic and practical level. Facilitating such future oriented information is necessary: while AAE occurs naturally, transformation needs more effort. Table 2 presents the way the different phases of AC are seen in the study in SMEs.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Observation / Implication</th>
</tr>
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<tbody>
<tr>
<td>Acquisition</td>
<td>By intermediary organisation (workshops interviews)</td>
</tr>
<tr>
<td></td>
<td>The CEO, or a key individual (interviews)</td>
</tr>
<tr>
<td></td>
<td>Informal discussions (interviews)</td>
</tr>
<tr>
<td>Assimilation</td>
<td>A signal is ready to be executed (interviews, workshops)</td>
</tr>
<tr>
<td></td>
<td>To do what the customer asks (interviews)</td>
</tr>
<tr>
<td>Transformation</td>
<td>Discuss more; to think the same thing over after having first rejected it (workshops)</td>
</tr>
<tr>
<td></td>
<td>To open up mental locks and hierarchical structures (interviews)</td>
</tr>
<tr>
<td>Exploitation</td>
<td>Currently there is no systematic evaluation of what happens to the foresight signals in the organisations (interviews)</td>
</tr>
</tbody>
</table>

Table 2. The phases of AC in the context of SMEs absorbing foresight knowledge

4. **ILLUSTRATING THE RESULTS OF ANALYSIS**

Figure 1 illustrates what hinders the absorption of foresight knowledge in SMEs. In assimilation, the acquired data is easy to combine to earlier knowledge, whereas in transformation, the data needs to be converted into meaningful information and knowledge. Transformation is considered good for radical innovation while assimilation assists incremental innovation (e.g. Uotila et al., 2012). In SMEs, the acquisition is
often executed by an individual (e.g. the CEO) and assimilated. Further, it is not always even assimilated, but in the circumstance of scarce resources, there is a tendency to move straight from data to action. The language of foresight knowledge mainly needs interpretation and processing of the data to information and still to knowledge before it can be exploited in action.

Figure 1. Absorption of foresight knowledge in SMEs

5. DISCUSSION

In this paper our goal was to integrate foresight approaches and innovation by testing the established theoretical concepts of AC with empirical findings in an SME context. Issues found are linked to the very practical approach of SMEs aiming to do straightforward business. The old saying, “If all you have is a hammer, everything looks like a nail” rather well describes the challenges of assimilation and transformation processes linked to utilize available data to actionable knowledge.

5.1.1 WHY DON’T SMEs USE FORESIGHT KNOWLEDGE?

SMEs have to be able to see opportunities with high potential, or likely to realize business opportunities, to benefit from foresight activities. They are seldom interested in exploring scenarios and future oriented information without seeing the invested time and resources being paid back soon. Anyhow, we have to remember that there are a variety of SMEs, almost like individual persons with their personal characteristics, and therefore generalizations are limited.

Some foresight models are based on the idea that signals can be gathered and knowledge created by an external party, for example a university, a research institute or a consultant. Intermediary organizations are often supposed to transfer this knowledge to the organizations and firms are seen as knowledge users. In practice this does not seem to be working in an SME context. Instead, the knowledge producers and users should be seen as simultaneous actors in the collaborative work of interpreting the signals and knowledge based on their context. Another aspect often bypassed is the build-in mechanism based on prior knowledge in organizations and the “intuition” of actors utilizing their own information networks.
5.1.2 How does foresight work in SMEs?

In large companies someone might be assigned to explore future oriented information, but in SMEs it is mostly done as a side job, based on practical experience and often on an intuitive level by a few actors. Employees’ backgrounds have a huge effect on opportunity recognition. An engineer sees technologically valuable signals, whereas a salesman spots the changes in customer behaviour. If the provided signal is presented from the “wrong” point of view, or if the “wrong” person is listening to it, the signal will not be received. One of the challenges is that world is changing around us and the interpretation context might be different than it was previously. For example, the current CEO might still interpret new rising information based on a past situation and seen through a previous interface. To find the time and the balance (AAE – ATE) when in an operational rush is challenging, especially when SMEs are highly steered by the needs of their larger customers.

In penetrating an organization, the signal must pass many mental filters (Ilmola and Kuusi, 2006). A shop floor employee sees things very differently from the CEO, and sales has a different perspective than R&D, so in order to balance transformation with radical innovation and assimilation with incremental improvements and routines, different methods are needed.

5.1.3 What should be done in the future?

Social integration mechanisms (Zahra and George, 2002) can facilitate SMEs to move from straightforward implementation to assimilation and transformation. For example, creating workshops that examine the signals in an SME’s language within one company or multiple companies could assist transformation. In the case of SMEs, a network would be beneficial since it makes it possible to introduce many perspectives.

Our study confirms the results of Major and Cordey-Hayes (2000), that translation and interpretation seems to play a key role in the absorption of foresight knowledge in SMEs. The role of facilitating and brokering, as well as used methods, seems to be important and need development. The challenge is that not all firms are willing to share information because they see it as strategic knowledge that they would rather keep to themselves.

While innovation has nowadays a more and more systemic nature, the complex combination of technological and market knowledge challenges foresight and simultaneously makes future orientation more important. The dynamism related to concluding linked innovations into finalized product and services in a changing business environment with changing consumer habits makes predicting issues more crucial - especially when systemic innovations take relatively more time than basic linear R&D projects. This highlights the needs of action based transformation platforms to combine firms’ embedded prior knowledge with available foresight information, with operational goals driving SMEs forward in their business. We see that the transformation naturally occurs best when SMEs working together refine available information supported by intermediates. An important aspect is to realize that different firms and intermediate organizations might be in different phases of their acquisition-assimilation-transformation-exploitation path of refining meaningful data in their context of business.

Understanding how AC phases, translation and interpretation are linked allows us to generate information paths suitable for transferring foresight data into innovation knowledge. Just speeding up the information transition processes is not enough. Intervention, to add and combine complementary information, is crucial; as is a
synchronization of these processes. This is applicable for foresight and innovation information.

6. LIMITATIONS AND FUTURE RESEARCH

This study focused on extending the understanding of issues hindering SMEs foresight and linking it to related AC theory. The purpose was to connect theory and practice by combining interviews and session observations. Future research should examine in more depth the tools helping SMEs to integrate available foresight information into innovation activities. Furthermore, research should also include follow-up on the absorption of foresight knowledge; SMEs need examples of how they can benefit from investing in foresight.

“The biggest gap in foresight knowledge is that... we really have very little evidence on how is this knowledge is really applied and upon what it has effect.” (Senior Research Scientist)

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Other references

A project report from an intermediary organization (2012) (Signal sessions, internal report LSBP)

Publication 3:


Dynamics of Openness in Innovation Processes – A Case Study in the Finnish Food Industry


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Case Study

Dynamics of Openness in Innovation Processes—A Case Study in the Finnish Food Industry

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Recent practical business discussion and academic studies highlight the collaborative nature of innovation activities. Today, almost all innovations are generated in cooperation with others in a systemic world. The role of openness is widely acknowledged, but the dynamics of openness in innovation processes is studied and discussed less. There is a lack of understanding about the open and closed phases during innovation processes. By observing such dynamics, this study extends the current theories from the point of open and closed phases in innovation processes. The analysis is based on a case study on a large Finnish food industry company and its long-term innovation process concerning the utilization of rye fibre since the early 1990s. The results show that it is very important to understand the interaction and the critical points during dynamic phases of innovation processes. Seizing the phases of openness and closure is crucial for successful innovation. Copyright © 2013 John Wiley & Sons, Ltd.

Keywords: Innovation process, open innovation dynamics, food industry

INTRODUCTION

Generally, innovation models are quite static in nature reflecting the factors affecting innovation and the related interaction from a rather stationary and short-term perspective, or categorizing innovation into pure closed or open models (e.g., Chesbrough 2003; 2006). Recently, attention has also been focused on the appropriate strategic mix of closed and open models, as well as the challenge of categorizing these (Dahlander and Gann, 2010; Huizingh, 2011; Drechsler and Natter, 2012; Trott and Hartmann, 2009; Barge-Gil, 2010). However, the general dynamics during the process of innovation as well as fluctuation between open and closed phases have often been bypassed.

Because Chesbrough (2003) heavily influenced the academic (and pragmatic) discussion concerning innovation with his open innovation paradigm, the debate about open and closed innovation has been ongoing. Recent research has respectfully pointed out the interplay in organizational designs and innovation activities capable of answering today’s and future’s collaborative needs (Fjeldstad et al., 2012; Lakhani and Tushman, 2012). What have attracted less attention are studies investigating the dynamics relating to the innovation interaction, as well as the level of openness that occurs during the collaborative innovation activities. Regardless of whether the linked innovation processes are seen as parallel, analytic or interpretative multilateral in nature, it seems that the level of openness in interaction varies among organizations and the individuals involved.

In this study, when investigating a rather old innovation, bread, we will demonstrate interesting insights into ongoing innovations related to processes, business environments and organizations developing products for changing markets. By introducing a qualitative case study related to a well-known daily product, our objective is to make visible the dynamics hidden in innovation processes. We claim that by recognizing and accepting the dynamic nature of innovation and temporal challenges in interaction, information can be better utilized to create useful knowledge for business purposes.

The paper is structured as follows: based on a literature review of the theories of innovation
processes and recent open innovation debate, we build a case study focusing on innovation dynamics and collaborative innovation activities. This paper discusses the interplay of mechanisms linked to closed and open innovation models as well as analyzes the innovation process towards dynamic elements related to alternating closed and open phases. We provide insight into the dynamic and asymmetric nature of innovation processes and challenges to today’s organizational constructs. We also make visible the nonlinear nature of innovation and feedback loops in different phases of the innovation processes. Finally, this paper provides a summary conclusion relating to our research and presents some managerial suggestions while developing processes aiming to build an innovative organization and to answer dynamic challenges present in innovation activities.

LITERATURE REVIEW

Open innovation

Open innovation (Chesbrough, 2003) has received significant attention from innovation scholars. The use of external knowledge in internal development activities, the utilization of networks in commercializing outcomes and the use of all forms of intellectual property rights are at the core of the open innovation paradigm (Chesbrough, 2003; 2006). The assignments related to different phases of innovation activities derive benefit from the information and channels available through the networked environment (Rothwell, 1994; Tidd et al., 1997; Johannessen, 2009; Lichtenhaller, 2009). According to Buganza et al. (2011), some firms using open innovation focus on exploitative inter-organizational networks with strong ties and other networks for explorative purposes. Capabilities related to information brokerage play a significant role in these activities (Parjanen et al., 2011; Cillo, 2005; Burt, 2004).

Firms may choose strategies supporting open innovation and act based on these strategies. However, there is always some concern in business life about which information is shared and which is protected (Ritala, 2009; Paasi et al., 2010; Luoma et al., 2010; Olander, 2011). This is also clearly a significant concern of organizations seeking to adopt aspects of open innovation and using its tools (Chesbrough, 2003). Various methods and tools can be used not only to protect information but also to utilize and commercialize innovation outcomes such as products, services and related knowledge. Firms have to develop an understanding of these available tools and how to use those, especially when combining the closed and open principles in a dynamic environment.

Should one adopt an open or closed innovation mode?

Dahlander and Gann (2010) pointed out that while there may be an initial positive effect on openness, firms can over-search or rely too heavily on external sources of innovation. It also seems that the degree of openness varies as technologies mature (Christensen et al., 2005). Barge-Gil (2010) indicated that firms’ own capabilities direct the choice of using open, semi-open or closed innovation modes. According to Drechsler and Natter (2012), openness in innovation complements a firm’s internal R&D activities. Huson and Sakkab (2006) pointed to the need of internal capability development to be able to use external knowledge sources. The overall practical implication of this research based on the work of Prajogo and Ahmed (2006) is that to achieve high innovation performance, organizations first need to develop the behavioural and cultural context and practices for innovation to flourish. According to them, only within such conducive environments is it possible for organizations to develop innovative capacity in order to more effectively deliver innovation outcomes and performance. This insight is also related to use of external information sources and open innovation tools to commercialize outcomes.

Hacievliyagil (2007) described situations where a company opens up to other companies, but internal boundaries of the company have tightened, decreasing and limiting the free flow of knowledge between different departments within the company. Pihkala and Harmaakorpi (2011) further noted with respect to the open innovation model that there are many differences between the openness of the innovation processes inside the companies and external openness. Pihkala and Harmaakorpi (2011) identified ‘several different worlds inside a company’ and claimed that companies may be classified into four types with respect to their innovation practices, namely: (i) closed inside and outside; (ii) closed inside but open outside; (iii) open inside but closed outside; and (iv) open inside and outside. They argue that attention should be paid to all these categories when asking about corporate culture and entrepreneurship. However, we would note that this is representative of a static rather than a dynamic approach.

Trott and Hartmann (2009) have stated that open and closed systems of innovation are mostly presented as two alternatives for firms. However, the impression that these options are mutually exclusive is not really the case. Barge-Gil (2010) has also argued that the empirical literature tends to be biased towards an open versus closed dichotomy and put forward three possible strategies for firm innovation—open, semi-open and closed. A preponderance of the literature approaches the change proceeding from closed to open in firms (e.g., Chiaroni et al., 2010); likewise, the paradigm change is often described (Chesbrough, 2003). It is hard to find any
A cyclic innovation model

Berkhout et al. (2010) criticized the linear pipeline models dominating the current innovation discussion. According to them, also the open innovation model presents the innovation process as a funnel that begins with scientific research and progresses linearly via technological and product development to the market. This generalized chain of causation only holds for a minority of innovations, which is why Berkhout et al. find the model problematic. There are many feedback loops that occur between the various stages of the process, and these need to be taken into account. They agreed with Chesbrough (2003) that in most industrial firms, specialized skills of technical suppliers from outside the firm play an important role in making the innovation process successful. They also shared the view of Nonaka and Takeuchi (1995) that innovation can be described as an information-creation process that arises out of social interaction. These interactions provide the opportunity for thoughts, potential ideas and views to be shared and exchanged. Building on this, they proposed a cyclic innovation model with four ‘nodes of change’. This model expresses a system of linked cycles, which in turn also influence each other. The result is a more or less synchronized regime of highly nonlinear dynamic processes that spark a creative interaction between changes in science and industry, and between changes in technology and market. From what was presented, they concluded that the innovation circle acts as a socio-technical framework that offers insight into the heart of the innovation process by asking the relevant questions, such as the following: ‘What needs to be done where? Who are the collaborating parties? Where are they active in the circle? Is there a balance in investments between the different parts of the circle?’ To them, the key issue is whether there exists sufficient interaction around the circle. ‘Innovation projects must not be managed along the familiar linear pipeline but should be organized via cross-disciplinary networks along an innovation circle with ample internal feedback paths. Innovation may start anywhere on the circle and previous innovations will inspire new ones: innovations build on innovations’ (Berkhout et al., 2010, p. 487).

Organizational designs and openness

Lakhani and Tushman (2012) suggested that when critical tasks can be modularized and when knowledge is widely distributed and available, open innovation complements traditional innovation logics. Generally speaking, different logics of closed and open innovation are challenging the management of organizational boundaries and organizational designs related to innovation streams. They note that the strategic decomposition of issues enables to use simultaneously open and closed boundaries for strategic tasks. It may be argued that the capability of continuously shifting boundaries to suit the strategic, technical and competitive needs of an organization is seen as one of the bases of developing a competitive advantage. These boundaries are related to internal firm activities and external partners as well as to the development of open innovation. Lakhani and Tushman (2012) also draw a link to the emerging dominant designs and technological cycles related to incremental, radical and disruptive innovations. Thus, in dynamical situations, senior executives and managers are seen as playing an important role in controlling decomposition and openness (Lakhani and Tushman, 2012).

While some degrees of openness and collaboration, in different forms (Dahlander and Gann, 2010; Huizingh, 2011; Von Hippel, 2005), are almost always present in innovation activities, they also have an important impact on intra-organizational and inter-organizational designs. Miles et al. (2010) have stated that traditional organizational forms will not be able to respond effectively to the opportunities and challenges in the future. It is argued that new organizational designs that can mobilize large sets of actors who have the ability to self-organize and collaborate are needed. Fjeldstad et al. (2012, p. 734) proposed that these new successful organization designs are based on an actor-oriented architectural scheme composed of three main elements: (1) actors who have the capabilities and values to self-organize, (2) commons where the actors accumulate and share resources, and (3) protocols, processes, and infrastructures that enable multi-actor collaboration. The locus of control and coordination is the organizational actors themselves and their dynamically evolving networks of relationships and interdependencies. This ‘autonomy’ will also cause challenges for strategy and operational management with respect to the level of openness and for guiding its directions within networked innovation activities.
Learning and networking in open innovation

Open innovation can also be seen to be related to DUI (Doing, Using, Interacting) and STI (Science, Technology, Innovation) innovation modes (Jensen et al., 2007; Lundvall, 2007). The STI mode refers to the way firms use and further develop science-like understanding in the context of their innovative activities, and it relates to the use of explicit knowledge. The DUI mode refers to know-how and know-who, which is tacit and often highly localized. Jensen et al. (2007) emphasized that the DUI mode can be intentionally fostered by building structures and relationships that enhance and utilize learning by doing, using and interacting. In a study based on a combination of survey and existing data for Danish firms, it was demonstrated that firms that engage in R&D without establishing organizational forms that promote learning and neglect customer interaction are much less innovative than firms that are strong both in terms of STI and DUI learning (Jensen et al., 2007). The DUI and STI modes are likely to have their own kind of varying openness. They are not mutually exclusive but complementary, just like closed and open innovation, in networked innovation activities.

Lichtenthaler (2009) demonstrated that outbound open innovation strategies have a positive effect on firm performance in environments characterized by high degrees of technological turbulence, transaction rate and competitive intensity. Network scholars such as Beckman et al. (2004) have earlier pointed out that firms tend to network differently under firm-specific and collective uncertainty. In the first scenario, forging new ties is a typical behaviour, and the latter scenario leads to strengthening existing affiliations. The greater the uncertainty that a firm faces alone, the more likely the firm will broaden its set of ties by establishing ties with new organizations. Likewise, the greater the market or industry uncertainty is, the more likely the firm will strengthen the ties it presently has. The aforementioned research related to exploitation and exploration (March, 1991), as well as findings by Buganza et al. (2011) concerning firms using open innovation with the aim of building strong tie exploitation networks with customers, suppliers and universities, or exploration networks by establishing weak ties to research centres or universities.

The dynamics of the networked innovation processes

Smedlund (2008) presented a knowledge system of a firm and characterized the dynamics of knowledge into a threefold system. Different types of innovation networks were identified based on social capital and different knowledge types. The social network structure for explicit knowledge is centralized and maintained by clearly defined rules, beliefs in high quality and trust in organizational hierarchy. The social network structure for tacit knowledge is distributed and maintained by the norms of reciprocity, beliefs in lifelong learning and an incremental trust. The social network structure for emergent, potential knowledge is decentralized and maintained by liberal norms, beliefs in innovativeness and an enabling type of trust (Smedlund, 2008).

The innovation potential emerging through the interplay of different forms of heterogeneous knowledge has been noted widely (Nonaka and Takeuchi, 1995; Cook and Brown, 1999; Amin and Roberts, 2008). This clearly encourages studying how the combination of interpretative and analytical mode can be fostered. Olkarnm et al. (2010) concluded that an innovation process implies constant swinging between interpretation and analysis. Knowledge leveraging, sharing, meaning-making and co-constructing as well as making decisions about resources, timetables, responsibilities, targets and evaluations, are constant processes. There is no comprehensive management method or approach to provide a framework for linking them (Olkarnm et al., 2010). These findings are interesting in light of the dynamics of innovation processes within firms.

Innovation in the food industry

The food industry is often defined as low-tech. Yet, the introduction of new products is an essential element of competition between food companies, and the successful management of new product development a key determinant of business performance. The low R&D intensity of the industry is claimed to depend on importing many of the industry’s ‘more significant’ technological innovations from outside the industry—equipment, ingredients and packaging suppliers, for example. At the same time, the industry shows a significant flow of technological innovations, especially incremental process innovations (Grunert et al., 1997; cf. Lagnevik et al., 2003; Galizzi and Venturini, 1996; Martinez and Briz, 2000).

In their study of innovation in food-manufacturing companies in six European countries, Traill and Meulenberg (2002) suggested that the traditional ‘demand-pull’ versus ‘technology-push’ versus ‘a mixture of both’ debate is too simplistic for the food industry. They found that firms behave differently depending on their dominant ‘orientations’ towards the product, the process or the market, the types of market they supply (particularly whether they supply branded or private-label products), the nature of their ownership (public, private or cooperative), market size and scope, and company size. The ways in which these firms innovate, their motivations and emphasis on product or process innovation thus vary a lot.

Wilkinson (1998) noted that ‘While in the post-war boom product innovation was primarily directed to
Summary of the literature review

Current innovation research highlights the roles of interactive elements in innovation activities, harnessing knowledge from various sources and commercializing the outputs. Open innovation has an important role in these activities, and it has been studied quite a lot from various aspects presented earlier, also in the food industry. However, the literature has a gap with respect to understanding open innovation and the related practical changes in openness as well as occurrence of critical points in dynamic interaction (cf. Figure 1). Some elements are found in research literature categories other than open innovation, but these do not entirely cover the complexity in theory and practical implications while using open innovation tools and managing the interaction of innovation activities.

By observing the shifts in interconnected innovation processes among the external and internal dynamics linked, we can study openness related to information sharing and cooperative knowledge generation between the parties involved. There are numerous studies about social capital in innovation activities (Tura and Harmaakorpi, 2005; Smedlund, 2008; Alguezaui and Filieri, 2010), the role of trust (Blomqvist, 2002), intellectual property issues (Paasi et al., 2010; Luoma et al., 2010; Ölander 2011) and methods to ensure information transfer in development projects (Cooper, 2003). Much less emphasized are the interaction openness and reasons behind opening or closing the interaction process when appropriate for the actors involved. It seems that a variety of drivers impact the temporally chosen level of openness. It seems that not only natural rent-seeking issues and transition cost aspects are present but also a large variety of not yet recognized and understood issues hidden in the structures and practical procedures of real life.

METHODS AND CASE DESCRIPTION

Objectives, methods and the data

We believe that our literature review has shown the lack of understanding concerning open and closed phases during innovation activities and their drivers. By observing the dynamical aspects of innovation and innovation practices through a longitudinal study, we thus aim to extend the current theories with challenges from the point of view of open and closed phases in innovation processes. The analysis
presented here is based on a case study (Yin, 1994; Eisenhardt, 1989; Voss et al., 2002) on a large Finnish food industry company.

The objective is to demonstrate variation in openness of an organization and investigate how this may vary in different phases of the innovation process. The starting point is the open innovation literature. We propose that both the closed and open models vary in a dynamic way; they alternate and fluctuate in different phases of the process.

This case study is based on empirical research concerning a significant, long-term innovation process concerning the utilization of rye fibre within the case company since the early 1990s until the late 2000s. The results are also considered in the context of some earlier research results concerning two other Finnish breakthrough innovations in the food industry—xylitol and cholesterol-lowering margarine, Benecol (Uusitalo and Grønhaug, 2008; Mäkinen, 2000; Lehenkari, 2000).

In-depth interviews with six key persons who participated in the innovation process in question were conducted in the autumn of 2008. They represented different professions and backgrounds—from top management to shop-floor employees. The selected product innovation process—with characteristics such as duration, starting point, aim, participating actors and other characteristics—was studied in detail. For reasons of confidentiality, no further background information on the company’s products or processes or the interviewees can be given here, and also, the time frame of reporting the study has been planned accordingly. The interviews were semi-structured to explore interviewees’ views on how they see innovation activities within their company and the particular innovation process in question. The interviews lasted for 1–2 hours, and they were recorded. There were both women and men among the interviewees. The interviews were analyzed qualitatively.

Case description

Competence and long traditions in baking traditional Finnish rye bread existed and were cherished in the case company, but in the early 1990s, it was noted that the consumption of traditional rye bread was decreasing. All consumers did not want to or could not eat traditional sour rye bread because of its strong taste or dense structure, but desired less sour, lighter and softer alternatives. On the other hand, knowledge about significant health impacts of rye was beginning to increase. Development work to separate the healthiest parts of rye grain began. The company did not want to lose its core competence and traditions in baking rye bread but wanted to invest more in maintaining them, as this was considered to be the fundamental basis of the company’s identity.

Whole grain rye and the health impacts of its bioactive agents have been investigated for some 20 years. It has been found out in the studies that the health impacts are mainly attached to the fibre part of the rye grain. There are the vitamins, minerals and other healthy bioactive compounds as well as agents that have an antioxidant impact: sterols, lignans and phenolic acids. On the basis of such research results, the case company managed to develop a novel innovation, rye fibre, in which the healthiest parts of the rye grain have been collected. With the rye fibre, it was again possible to produce lighter products containing the healthy agents of rye, such as rye toast that was nominated foodstuff of the year in Finland in 2006. With the help of rye fibre baked in the bread, also light bread may carry the health impacts of rye. Rye fibre is unique as compared with other fibres, and the case company also developed rye fibre concentrate that has both a high fibre concentration and the bioactive agents attached to the fibre.

ANALYSIS AND RESULTS

Internal critical points/factors in the innovation process

The process that led to utilization of rye fibre took about 15 years to mature. A large number of factors of different levels affected the process during a long period of time. Some of the factors were external; they just happened to occur at a suitable time, but the case company could not affect that. Some of them were, again, internal; by chance, they occurred at a suitable time, or they were knowingly made to facilitate the process. Some of these factors appeared both as internal and external. The process is depicted in Figures 2 and 3. On the basis of the interviews, internal critical points in the innovation process were divided into research-oriented, strategy-oriented and individual-oriented factors that are described in the following.

Internal research-oriented factors

An important internal research-oriented factor was that a person who had already been involved in the research as an employee of a competitor company, and who thus had ‘bought into’ and was enthusiastic about the theme already, became the R&D Manager of the corporation. At the corporation level, a group was formed at the turn of the twentieth century to think about functional foods. Research collaboration projects were chosen very carefully to gain basic information and to avoid exuding of information to the competitors. The aims of the research were changed as appropriate; it was understood that not everything succeeds—for
instance, differences between women and men in the health impacts of rye were a surprise.

In general, research tends to delve deeper and deeper unless some check is made on the process; hence, choices have to be made concerning how deep one should go in order to still gain advantage for the business, mentioned the interviewees. Many kinds of research are monitored but not engaged in. In projects, a ‘balance of terror’ prevails, as also competitors are involved; in the case company, however, trust in the personnel’s own abilities has been particularly cherished. The interviewees

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Figure 2. The rye fibre process in the 1990s (source: the interviews, September 2008)

Figure 3. The rye fibre process in the 2000s (source: the interviews, September 2008)
emphasized that the company ‘succeeded to become the leader and got a head start as compared to the competitors in the way in which common, prevalent knowledge could be harnessed to support our strengths’. In other words, successful interpretation, exploitation and accommodation of research knowledge into the company itself was the key.

It has also been seen in the company that R&D projects also lead to benefits other than those established a priori for the project; the significance of projects has increased compared with the level it has at the beginning of the project. In the company, one aim is to actively obtain research knowledge also ‘from between the lines’ for quick application in marketing and product development. The interviewees noted that the attitude towards projects is an essential factor: ‘Are results expected at the end of the project after two years or is something expected from every meeting?’

**Internal strategy-oriented factors**

The interviewees emphasized that rye has been the company’s traditional strength. The whole process ‘from the field to the table’ can be planned and implemented internally within the company. In the beginning of the rye fibre process, there was opposition in the company: ‘Shall we stick with rye or move to wheat?’ The gains were potentially distant and not well understood; there were many people thinking ‘why should we drop the old way of doing business?’ It was necessary to find a balance between systems and being systematic, on the one hand, and nurturing creativity, on the other, and this succeeded.

The need to apply knowledge creates challenges. The marketing department tends to think in the relatively short time focusing on ‘this year’s results’, whereas large long-term research projects tend to adopt a much longer-term view. The company has recognized this discrepancy and reacted to it by emphasizing a fruitful attitude towards projects as described in the establishment of research-oriented factors discussed earlier. The interviewees also noted that a lot of attention has been paid to communication and public relations (PR) as part of the strategic issues that have been established. An expert in nutrition helps in communication issues, and an important part of the rye fibre process was the ‘Rye by [Company name] PR programme.

**Internal individual-oriented factors**

It is emphasized in the company that gaining experience of succeeding at the individual level is vital; this is to be achieved by looking at things from a wide perspective and focusing on motivation and ‘guts’. It was also important during the rye fibre process that even though rye fibre had not yet ‘conquered’ the company in a wider sense, in the R&D department, there was a small group of ‘rye fibre believers protecting the flame’—there was mental space for open-mindedness. There were also many multi-talented people within the company with solid experience in many fields, and they took part in the process. There was, for instance, readily available competence in separating fibre from oats, which lay the ground for separating rye fibre, too.

**Critical points/factors that were both external and internal**

The faith in the cause persisted, even though the results were slow in coming and did not show in consumption of rye. The deep economic recession in Finland in the early 1990s caused a decrease in the consumption of bread in general. The company’s mill had a hard time with poor financial results, and a short-term perspective tended to be dominant. Still, the importance of fibre and bioactive agents started to be recognized in research, although there was no prior knowledge about issues related to fibre.

The process descriptions in Figures 2 and 3 show that external and internal factors supported and fed each other. In the figures, external factors have been placed below the timeline, and the company’s internal factors are above it. Figures 2 and 3 demonstrate a wealth of different factors and point that the interface of the company is diffuse; a lot takes place inside the company, and many kinds of signals also come from outside. This can be seen in Figure 4 that depicts an individual product development process of the sliced version of the traditional Finnish rye bread within the company.

In general, it is difficult to distinguish internal and external factors from each other—sometimes, this can even be considered to be an artificial distinction, because a company is in so many ways tied to the surrounding society, and in addition, the staff members have their own backgrounds, connections and characteristics that together form the ‘innovation platform’. This was apparent in the interviews, too.

The interviewees explained, for instance, that competitors had maybe bought appliances necessary for separation of oat fibre, but their plans had seized up because it was thought that separation of rye fibre is carried out in the same way as separation of oat fibre. When this was not possible, it may be assumed that innovation activities suffered a heavy blow in these companies. What was the distinctive, decisive factor in the end—the ability to exploit research knowledge, competence of the personnel, possibility to use the company’s own mill...? This study does not give a response to this query but, presumably, success if likely to be a result of the interaction of factors and the strong
innovation platform formed by them. One crucial factor, however, appears to have been that the original aim of the process, to launch new products, persisted in the participants’ minds during the whole process. It was not seen as necessary to ‘know all’ about the issue being investigated, just to know ‘enough’ so that development of new products became possible.

Open and closed phases and their drivers

Figure 5 illustrates our general interpretation concerning open and closed phases of innovation according to this study. The phenomenon is the same, an innovation process, but the process is asymmetric; openness seems different from different sides and in different phases. Openness may seem different to individual people, if the direction of openness changes, one person may think that the process is open, while another sees it as closed. The critical points offer specific opportunities for enhancing the innovation process. Openness can in practice be open with respect to different directions in different phases. For instance, in the case company, certain changes in openness were caused as a result of the research and development process becoming closer to business and thus appearing as potentially forming the basis of competitive advantage. Furthermore, the nature of the process changes, the aims change, different interest groups join in and new participants also join in; thus, opening and closing the process also change. Individual people within the company may also have different motives. What then is the added value that is expected from opening or closing the process? The changing in the extent of openness due to the relationship between the organization and the individual is beyond the scope of this study but would be intriguing in future research.

In Figure 5, similar funnels could be placed all around the one that we have illustrated. This would then illustrate the numerous challenges in collaboration between different companies. Each company has its own funnel(s). In future research, through several case studies, Figure 5 could also be linked with the cyclic innovation model loops (Berkhout et al. 2010, p. 485) as well as Pihkala and Harmakorpi’s (2011) list of four kinds of companies. This illustration of the interaction of open and closed phases (Figure 5) could then be turned into a 3D model that would be even more true with regard to daily practices in companies. The swirls in the funnel do not only rotate around the hub but may also, in between times, make smaller loops. This is an issue to come back to also in future research.
Acquisition and exploitation of information and knowledge—openness of interaction in parallel processes

With respect to the use of external sources of information, it was noted by the interviewees that information is not distributed in meetings. However, representatives of the company have to be able to pick up ideas from the discussions. It is not necessary to engage in in-depth discussions, but the essential thing is how you pick up, combine and apply ideas. Inputs for innovation activities are obtained primarily in informal discussions rather than in formal meetings. To facilitate ideation, it is important that there is no written agenda, and it is not necessarily organized in a meeting room environment. Furthermore, gaining an industrial scale for a new product requires its successful integration into the existing production and product assortment. This, again, requires a particular kind of competence that includes cooperation with suppliers of appliances, acquisition of raw materials and freight arrangements. It also includes being able to ensure that ‘byproducts’ (residues) of milling are utilized appropriately. A special advantage of the case company was that in its own mill, it was possible to test appliances, machines and processes in the actual working environment of the company. According to the interviews, a prerequisite of the actual working environment of the company to be able to test appliances, machines and processes in the case company was that in its own mill, it was possible to test appliances, machines and processes in the actual working environment of the company. According to the interviews, a prerequisite of the actual working environment of the company to be able to test appliances, machines and processes in the case company was that in its own mill, it was possible to test appliances, machines and processes in the actual working environment of the company.

One of the supporting practices the interviewees identified was the fact that there has been freedom within the company to act in one’s own way, and training has been given. Investment programmes have been flexible, so it has been possible to make decisions quickly, if needed, and even purchase machines before getting the actual investment decision. This also reflects commitment to common goals, trust and a sense of community. The successful management of the collaboration of staff members is also important. If a product development idea goes through the innovation screening, an assessment is made concerning the selection of a pair of individuals (of a product developer and a product manager) who start to develop it further. It is likely that these people usually work together. The interviewees noted that sometimes changes are made with respect to the pairs of people selected, but usually, they are kept unchanged, because these pairs typically constitute very strong ‘battle couples’, where people’s different competencies complement each other. This choice also relates to the balance between the extent of internal and external openness. The choice of the pair of individuals can potentially prevent internal closing. It might also prevent or at least decrease external closing, too.

An innovation process within the case company—such as the rye fibre process—has evolved so that information and knowledge have been integrated into it alternately from within the company and from external sources. In this way, it fulfills the criteria of an open innovation process. In the interviews, the process’s critical points were also recognized—points at which the progress of the process has been ‘on a knife-edge’. These critical points may have had to do, for example, with situations in which the ownership of the process has been transferred from one person to another, or when the overall confidence of the process’s key people in the progress of the process had faltered. In such cases, the faltering in the overall confidence in progress of the process may have depended on very minor things. In general, it would be important to be able to recognize these critical points also in other innovation processes so that people could be better prepared for ‘keeping the process alive’. It is important to note that, in addition to particular points or unclear situations or moments of change, it may also be a question of generally encouraging or hindering factors in the operational environment (Figures 2 and 3). Such (hindering) factors are even more difficult to influence or be prepared for.

In the case company, product developers and the other professionals work in ‘battle couples’ (a product developer–a product manager), which also appears to speed up the pass-through of the innovation process, because many issues to be solved can be handled simultaneously because of the wide-ranging competence of the individuals engaged to the process. The example case that was investigated in the case company appears to have been somewhat self-organizing after its start-up—a process taken forward in a very independent way by experienced developer pairs. In such an environment, the role of management appears to have been to create opportunities and facilities for developers to accomplish what they can: to realize their competencies.

With respect to the management and openness of processes, there are challenges relating to ensuring that different staff members’ directions of movement are similar and coordinated. Furthermore, how can managers recognize all the little partial changes that are needed in order to make a bigger change, react to it, and plan and schedule the little changes? A big change is not one big change, but a sum of little partial changes, which makes, for instance, staff members’ retirement a big management challenge due to loss of specific knowledge. The retirement issue came up in the interviews, too, in terms of how it impacts innovation activities with respect to the ‘battle pairs’ and product development in a wider sense.

DISCUSSION, CONCLUSION AND MANAGERIAL IMPLICATIONS

Investigating innovation activities statically does not allow for understanding the full richness of
innovation and innovation processes. Approaches based on interactive and systemic innovation models including loops to different dimensions can provide some of the necessary richness (Berkhout et al., 2010). In this study, the innovation process studied was of a very long duration, and it became clear that the openness of the company changed a lot during the process. Openess of the other parties involved in the innovation process also varied and changed over time. Moreover, STI and DUI innovation modes have often been presented as separate alternatives, but in this study, it appeared that they are not separate, but rather consecutive and intertwined. They functioned as inputs for each other during the innovation process. In the case company, the rye fibre process was first triggered by the company’s strong DUI competence in baking rye, and after that, an STI type of process was launched, leading eventually back to a DUI process, too. Thus, we would suggest that firms should build capabilities to merge information and refine it to quality knowledge in combined STI and DUI processes (cf. Jensen et al., 2007).

This case study has demonstrated that even with the very traditional and mature products like bread, there are always possibilities and needs to develop new innovations related to products, processes and services for the continuously developing markets in which firms are operating (Utterback, 1994). There is no achieved sustainable position for firms to satisfy external competition and development trends—short-term and long-term external dynamics force firms to take steps to survive in a competitive environment. By exploring a product and markets traditionally considered as quite settled, we are able to confirm this insight. User-driven trends may also quickly challenge the industry; one major challenge for the industry has been the sudden recent trend to particular diets such as those involving high fibre. As Earle noted back in 1997, innovation strategies for the food industry need to be concerned not only with the technological changes but also with the scientific (nutritional and medical), social and environmental changes, so as to produce food that satisfies not only the nutritional but also personal and social needs and wants.

Firms answering the challenges that occur with innovation are forced to choose a certain level of collaborative information sharing and refining (Chesbrough, 2003; Trott and Hartmann, 2009; Johannessen, 2007). Even though a firm can choose a general strategy with respect to open or closed innovation, it became clear that during the process, the levels and directions of openness may actually vary. Those critical points relate to both internal and external dynamics. These dynamics are related to technology development, external business pressure and strategic decisions made, the evolving networks at organizational and personal levels, and continuously varying motives of actions. In systemic processes, several participants are taken into networks. The actors can be firms, universities, research centres and customers impacted by media-related trends.

Our study shows that during an innovation process that starts with an idea and terminates in commercial outcomes, there are several critical points where decisions are made. At these points, the decision with respect to opening or closing the process was made based on organizational or personal drivers and motivations, and was impacted by various distances in innovation networks (cf. Harmaakorpi et al., 2006; Parjanen, 2012). A sporadic action, a communication challenge or an individual act can lead to partly closing the process or isolating the firm from the core process in networked innovation. Opening the process is much harder and requires willingness at both ends of actor networks. One can close the process, but two or more are needed to open it at a critical point. For the successful interaction between parties, organizational and personal targets have to be aligned between the actors involved. Personal-level interests and motives may vary and even be in conflict with those at the organizational level. Some process may begin as very open but due to changes in staff members or alike the nature of the process may begin to change. If very open, trust-based collaboration has been achieved at first, a change of individuals involved may completely change the situation. Also, timing seems to be an important factor in identifying and understanding different stages of innovation interaction.

Opening and closing the process were related not only to the alternatives concerning inbound and outbound activities but also the directions while choosing organizations and persons internally and externally participating in these innovation activities. At these critical points, very minor issues can impact the chosen route of information processing and refining. Lakhani and von Hippel (2003) and von Hippel (2005) have earlier pointed out that many firms and individuals may have similar information and ongoing competitive innovation activities. Hence, very different innovations and business networks may emerge based on decisions at those critical points.

While this study has its limitations (one company, a small data set), it has hopefully increased understanding concerning critical points in innovation processes. Our contribution points out that interlinked innovation activities are challenged by the changing openness and the tools available in an open innovation context. We assume that in the future, firms and other organizations will be able to respond appropriately to the challenge to identify an appropriate balance between open and closed activities. Furthermore, we hope that further research will identify appropriate frameworks and tools for managing innovation and the necessary
balance between open and closed innovation. Competence in managing appropriate networks to support open innovation dynamically is also a key factor in developing successful innovation strategies. Thus, management’s ability in guiding organizations, departments and individuals in adopting appropriate open and closed innovation strategies with partners and consumers will also be an important factor in achieving success in innovation. We have noted that the research literature already recognizes the different intra-organizational needs with respect to these issues (Fu, 2012; Haciveliyagil, 2007; Barge-Gil, 2010; Pikhal and Harmakorpi, 2011). Shifting boundaries (Lakhani and Tushman, 2004) may be seen as strategy tools in such business game. Managing these dynamically is a complex task especially in future organizations with reasonably autonomous actors (Fjeldstad et al., 2012), complex knowledge networks (Smedlund, 2008) and their individual interests. Future research needs to focus on this dynamic interaction instead of considering that open and closed innovation strategies are mutually exclusive approaches to developing and managing innovation processes. Developing and managing innovation is much more nuanced. It would also be interesting to investigate interactions between appropriate innovation strategies and other contextual factors such as the maturity of technologies concerned, the level of knowledge of customers and suppliers, and many other environmental factors. Research could also be directed to investigating the alignment and impact of personal and organizational interests dynamically on the relationships and commitments that are developed during the innovation process. Finally, there are interesting interactions between knowledge types and the extent to which some collaborators are at the exploration phase with respect to their knowledge while others may be at the exploitation phase.

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Interaction and Innovation -
Reframing Innovation Activities
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Abstract

In this article we point out the importance of reframing and orchestrating an innovation process while adopting a matrix organization (MO) structure. Some studies implicate that a MO gives the flexibility desired and supports sharing of information and efficient use of resources in an organization. However, the MO is also a target of hard criticism by real life operational actors in organizations performing daily tasks. To find out reasons behind this gap, we studied the transformation phase of an organization from a line organization to a MO while simultaneously participating in innovation process development. The assumption was that collaboration with a motivated firm developing innovation activities and simultaneously adopting a MO gives exceptional insight into analyzing the change in a practical manner. Understanding the interplay between the organizational change and innovation activities is the key to success in today’s pace of change in the dynamic business environment. Our case study was done in the field of media, which is one of the most challenging due to the external systemic change of technology and consumer habits. To survive and compete in business, firms adjust their organizational designs and processes to gain innovations and to connect external innovation sources. Our study shows that different phases of the innovation process need different types of management and support from the organization. Organizations under constant change have to update their innovation process management to match their organizational designs.

Keywords: Innovation; Innovation process; Matrix organization; Organization design, Case study

Introduction

Many firms have adopted a matrix organization (MO) structure to utilize the firm’s knowledge and resources across the firm activities. Changing to MO has been in fashion in the last few years, but the theories have their roots way back in the 60s and 70s. It has been claimed that MO is flexible and supports innovation (Galbraith, 1971; Van der Panne, Van Beers & Kleinknecht, 2003). Finding the right organizational form is about balancing between different needs, requirements to be fulfilled, and resources available. A
functional line organization has its benefits in the basic production environment, while different forms of matrix, project and team organizations can support new product development processes with their known strengths (Galbraith, 1971; Hobday, 2000; Liker, 2004; Smedlund, 2009). Interaction and openness, intra- and inter-organizational, are important levers to gain innovations in today’s systemic, networked, and fast-paced world (Chesbrough, 2003; Johannessen, 2009). If a matrix is launched to support this, also adjusting and reframing the innovation process is a necessary task for successful activities and to gain the maximum benefit from it.

Based on an extensive search of current literature, there is a certain research gap in focused studies interconnecting the innovation process and adoption of a MO. Moreover, some recent studies drawing on matrix structure findings have suggested more research to be done on management interlinked to groups that steer and control innovation activities based on interaction (see e.g. Artto, Kulvik, Poskela, & Turkulainen, 2011). The general interest in innovation and organization design research is increasingly heading towards complex interrelationships in dynamic contexts. In practice, managers are trying to merge processes and organizational structures in turbulent business environments. Studies rarely examine the facilitation and focus on innovation activities when firms are adopting a MO. The current study aims to address this research gap. The research question is: How to reframe innovation activities when adopting a MO?

The paper is structured as follows. Based on the theories of innovation processes and organizational designs, we build a case study using several research tools. This paper discusses interaction mechanisms of innovation and organization as well as analyzes the innovation process in a recently adopted MO. We describe the dynamic nature of the innovation process and organizational constructs. We also make visible the organizational challenges in the sub-phases of the innovation process. Finally, this paper concludes our research, its theoretical contribution and gives some managerial suggestions for changing the organization design and developing processes aiming to build an innovative organization.

**Literature Review**

**Innovation and Organizational Design**

Organizations’ ability to continuously generate innovations is one of the key capabilities in today’s business environment (Alegre & Chiva, 2008; Bessant, 2003; Ellonen, Blomqvist, & Puunmalainen, 2008), and organizational designs are important part of enabling successful innovation activities (Miles, Snow, Fjeldstad, & Miles, 2010). Organizational innovations are seen to enable innovation capabilities for better firm performance (Camisón & Villar- López, 2014), and research on the organization of innovation projects suggests that project flexibility is a common reaction to technological turbulence (Candi, Van den Ende, & Gemser, 2013). Flexible and consistently adjusting organizations are seen to outperform others especially in unstable and turbulent environments (Haveman, 1994). The overall practical implication based on Prajogo and Ahmed (2006) is that to achieve high innovation performance, organizations first need to develop the behavioral and cultural context and practices for innovation. According to Prajogo and Ahmed, only within such conducive environments is it possible for organizations to develop innovative capacity to deliver innovation outcomes and performance more effectively. However, it still needs to be further studied how this could be simultaneously connected to practical development of innovation processes and continuously changing future adaptive organizations.

According to Van der Panne et al. (2003), empirical studies show that successful innovative firms are loosely structured in the early phase of the innovation process and develop more formal structures in the later stages of the development process, and organically organized firms develop essential capabilities needed in innovation activities. Zaltman, Duncan, and Holbek (1973) also de-
scribe how an organic structure is appropriate for the initiation stage and a mechanistic structure is appropriate for implementation. However, it seems that the literature cannot fully cover the challenges of such dynamics related to innovation structures and interaction with the continuous organization design changes that are commonly present in the current business world. Miles et al. (2010) write that traditional organizational designs (U-form, M-Form, Matrix, Multi-firm Network) will not be able to respond effectively to the opportunities and challenges faced by the 21st century. New organizational designs that can mobilize large sets of actors who have the ability to self-organize and collaborate are needed. Fjeldstad, Snow, Miles, and Lettl (2012, p. 739) propose that these “new successful organization designs are based on an actor-oriented architectural scheme composed of three main elements: (1) actors who have the capabilities and values to self-organize, (2) commons where the actors accumulate and share resources, and (3) protocols, processes, and infrastructures that enable multi-actor collaboration.” It is seen that the locus of control and coordination is the organizational actors themselves and their dynamically evolving networks and interdependencies related. According to Dougherty (2008, p. 430), “Social constraints are necessary because the work must be orchestrated, shaped, defined, and guided so that people can come together readily even if they do not know each other, can share key assets with others effectively, and can deal with the inevitable institutional pressures from regulators, competitors, and other social forces. Social actions are also necessary because innovation problems are unpredictable: people must improvise together in the situation since they cannot be told what to do ahead of time. Managers cannot force action and they cannot avoid constraint, so they need to constrain the organization to enable action.” The aspects above are relevant when developing structures and processes that the firm uses to arrange tangible and intangible resources for intra and inter-organizational collaboration.

Artto et al. (2011) found that the organizational arrangements for innovations tend to rely on organic and embedded matrix structures and especially on the front end of innovation, emphasizing a wider set of embedded organizational arrangements than mere development groups – including personalized and value-based interactions between the executives and the staff, innovation processes and idea management, and innovation software systems. Another interesting finding was that innovation groups can be formal or informal organizational bodies in a matrix structure, circulating part-time representatives from lines in their roles, and with organic and ever-changing procedures (Artto et al., 2011). They also found there to be a clear distinction between the group roles for fostering and generating new ideas (often called innovation groups, consisting of staff members) and groups for selecting and transforming ideas into innovations (often called development groups or boards, consisting of middle managers). Based on their empirical study about the front end of innovation, Artto et al. see that innovation development groups should have representatives from “line” organization units when selecting, processing and advancing company-wide innovation projects. In this way, a sort of a matrix structure in an innovation group ensures the involvement of all units through evaluation, decision making, and resourcing as well as information distribution in an organization. Some successful innovation processes, such as the DARPA (Defense Advanced Research Projects Agency) model, lean on a strong project manager in the organization, his vision and motives, given resources, and prior social networks while communication and control structures are evolving based on project progression (Carleton, 2010). Tushman, Smith, Woody, Westermanz, and O’Reilly (2010) found in their research that ambidextrous organization designs (coupling high structural differentiation with targeted structural linkage and senior team integration) are relatively more effective in executing innovation streams than functional, cross-functional, and spinout designs. They also point out the role of senior team integration with capabilities simultaneously explore and exploit in innovation activities.

Most of the existing innovation literature can be broadly classified as a technically oriented “process” approach and an organizational design oriented “structural” approach, although recently the cultural aspects of organizations supporting innovation strategies and the enhancing of
Innovative capabilities have received more attention. Structural arrangements and process designs are considered rational approaches to integrate organizational systems and members, but often they are claimed to be ineffective because these changes are not synchronized with the existing values, attitudes and interests (Muthusamy, 2009; Nesheim, 2011; Porter, Lawler, & Hackman, 1975). As addressed in books related to organization design, some sort of hierarchy and structures are always present, and often some sort of grouping as well. Grouping is often done based on skills (knowledge), process and function, time, output (products), markets (client) or place to be able to coordinate work in organizations (Mintzberg, 1983). Mintzberg (1983) also describes the decision making power in vertical and horizontal decentralization: “By using matrix structure, the organization avoids choosing one basis of grouping over another, instead it chooses both. It is dual authority structure which sacrifices the principle of unity command.” Thus, a matrix can be seen as one possible solution for an organizational design challenge when aiming to adjust innovation activities for survival in turbulent environments.

**Matrix Organization**

The term matrix refers to a cross-functional organization that brings people together from separated organizational areas to undertake tasks on a relatively permanent basis compared to rather temporal project teams (Ford & Randolph, 1992). Hobday (2000) delivers the matrix partition also into functional, balanced, and project matrices in project-based organizations. Nesheim (2011) approaches the matrix from a horizontal process management aspect with hierarchical line organizations. The MO grows out of the organizational choice between project and functional forms (Galbraith, 1971; Mee, 1964). Matrix management can provide “horizontal” coordination over “vertical” functional departments (Burns & Wholey, 1993). The matrix is a hybrid structure with two or more distinct hierarchies, often seen as customer-facing units obtaining resources from a functional dimension (Fjeldstad et al., 2012). A matrix assembles skills and resources across as well as up and down the hierarchy with coordination and control built in. A matrix design seeks to capture both the efficiency and specialization of the U-form (unitary) and the customer focus and flexibility of the M-Form (multi-divisional) (see Miles et al., 2010). There are various forms of matrix structures among other organizational arrangements. Hobday (2000) describes the different types while presenting the alternatives, from functional forms to project organizations and matrix forms associated with and between them.

It is claimed that a matrix improves communication and can handle increased information loads when compared to the more traditional functional structures. Forced contacts and communication over departments are improving decisions making and response time, which translates into an organization that can quickly and flexibly adapt to a dynamic situation. It is, however, also recognized that split or shared authority and responsibility between boundaries creates conflicts in resources, interests and assets (Davis & Lawrence, 1977; Ford & Randolph, 1992).

Ford and Randolph (1992) write that an organization cannot plug a matrix into its existing structures and expect success, and Davis and Lawrence (1977) warn that a successful matrix must be grown instead of installed. Burns and Wholey (1993) studied the adoption and abandonment of matrix management in organizations from organizational information processing (in terms of information that must be gathered, interpreted, synthesized, and coordinated in the context of decision making) and inter-organizational network basis. According to them implementing a matrix structure constitutes a shift from vertical- functional authority toward a hybrid, function-by-project organization. Matrix structures are seen as team-oriented arrangements that promote coordinated, multidisciplinary activity across functional areas, broad participation in decisions, and the sharing of knowledge. Burns and Wholey (1993) also point out that research on the adoption of matrix management may improve understanding of factors favoring structures that promote product innovation and quality management (like continues improvements). Their research results
also suggest that “organizational networks influence the diffusion of administrative innovations in much the same way that they influence the spread of technological innovations” (Burns & Wholey, 1993, p. 130). Saunila, Mäkimattila, and Salminen (2014) state that a matrix structure alone cannot solve all the challenges related to innovation activities, and the transformation towards a matrix structure requires time, employee commitment, and management.

Research Design

Starting from MO literature supplemented with innovation studies, we searched for a case that could provide us empirical evidence on a practical level. An organization with several units and strong customer and production dimensions in a turbulent environment was found in the media business.

The Case Organization in Fuzzy Media Markets

Media is one of the most challenging and rapidly changing business areas today (Campos, 2009; WAN-IFRA, 2009). The environment has been affected by globalization, and new technological innovations and user demands need to be taken into account in new media services. The development of IT, internet, social media, etc., has changed the whole operation field, the media, customer, and audience relationships. To respond to the change and future needs, news media companies must shift their organizations to focus on their audiences, not on the old ways of producing and doing business inside specific silos (Campos, 2009). Media used to be driven by a very traditional functional process of producing daily news on paper for committed consumers of a chosen publication. Its daily routines and organization were formed for that purpose, but the world changed around and new needs emerged that needed to be satisfied. The challenge of interconnected media and consumer habits demands new approaches, daily renewal of products, and services and organizational forms answering to these needs. The new agile product development process is shifting structures towards matrix and project organizations, as mentioned in many previous studies (Hobday, 2000). A media firm’s organization and innovation process has to be able to answer in different lengths of cycles of innovating daily content for consumers (readers and listeners) and customers such as advertisers, and a bit longer cycle of new innovative service platforms and products developed for survival over a longer time frame. The pace and interval are different within these cycles, which also challenges the leadership of innovation and resource management (Halbesleben, Novicevic, Harvey, & Buckley, 2003; Pérez-Nordtvedt, Payne, Short, & Kedia, 2008).

Media firms are traditionally seen to be operating in oligopolistic and monopolistic markets — with lower levels of competition than found in many other industries — and some managers do not have an experience or knowledge base of how to operate in rapidly changing markets (Picard, 2004). Media companies have been adjusting strategies while trying to compete with other firms and innovations launched by them. There exist links between changes and business opportunities, suggesting systemic interplay within innovation activities. “Management theory dictates that organization must follow firm’s strategy - and strategy depends on vision of the company, its capabilities and resources, the markets and the competition – so the organizational model should be the best suitable for company’s purposes” (Campos, 2009).

The data used in this case study was collected from a private organization specializing in various areas of media business. The case organization was a media company located in southern Finland, regionally seen as a very important actor. It has several business units that have different roles in the organization with shared and their own functions. This includes several printed papers, internet services, radio, and traditional supportive units such as printing, distribution, and functions such as IT and administration. Altogether there are around 270 employees in the organization. This organization, like its competitors in the media business, is balancing between traditional and
Interaction and Innovation - Reframing Innovation Activities for a Matrix Organization

new media and struggles with the common challenges in the rapidly changing business environment. They have understood that innovations are needed for renewal and future business success while cutting costs is not enough for survival and profit making. Previously there have been some attempts to develop innovation activities, such as the use of an IT-based idea gathering system, but the results were considered inadequate and the system implemented did not achieve a satisfactory level of use. Units partly competing with each other did not fully support positive interaction for idea refining and execution of innovations. The firm’s collaboration goal with university was to utilize practice-based innovation by increasing theoretical innovation knowledge in the organization and to simultaneously harness the hidden innovation potential for business with precise analysis and implemented designs for a recently released supportive MO. During 2009-2011, collaborative actions (Figure 1) took place to describe how ideas need to be managed to become beneficial innovations and how to prepare the organization to utilize external innovation better – in other words, the organization needs to be internally open so that it can also be externally open for innovation activities.

Research Methods

The methods used in this study are a combination of action oriented research (Coughlan & Coghlan, 2002) and case study research methods (Eisenhardt, 1989; Flyvbjerg 2006; Voss, Tsikritsis, & Frohlich, 2002; Yin, 1994). According to Coughlan and Coghlan (2002), action research uses a scientific approach to study important social or organizational issues together with those who experience these issues directly. Action research always has two goals – making the action happen and reflecting on what happens – in order to contribute to the theory. This process involves collaboration between the researchers and members of the organizational system. Action researchers are not just observing change; they are actively working to make it happen (Coughlan & Coghlan, 2002). An action research project provides the context of this study, see Figure 1. A visible result was an innovation handbook, describing the routes and actors involved from idea refining to innovation in a fresh MO (see Salminen, Saunila, & Mäkimattila, 2011 for further details). The concept is about enabling actors, commons, and protocols to self-organize better and having updated descriptions for senior / top management about the innovation process itself and a window to support idea gathering and the progression of innovations. The method and tools used are not limited to a MO, and the whole handbook development process can be seen as data acquisition and analysis of organization design and related challenges.

![Figure 1. Action oriented research tasks related to development activities](image-url)
innovation studies (Teece, 1996; Teece, Pisano & Shuen, 1997) focusing on the level of organizational actions also pay attention to the roles of individuals and industry specific issues. This study approaches the combination of organizational design and the innovation process as an interlinked entity which requires a deep understanding of individuals, the organization, and industry specific details. Complex relationships require several data acquisition methods, a rather long surveillance period, and close collaboration with the organization under analysis.

A single case study was chosen to achieve a deep understanding of a multi-unit organization under dynamic change and organizational response over borders. Several methods of data collection and multiple researchers were used to gain triangulation and ensure results (Eisenhardt, 1989; Flyvbjerg, 2006; Pålshaugen, 2009; Voss et al., 2002; Yin, 1994). The research included five main phases of information gathering and was made simultaneously with the strategic development process in corporation. Those five stages were the following: 1) a web-questionnaire for everyone in the organization, 2) interviews of chosen employees, 3) a diagnosis session with managers and key persons, 4) Innovation handbook workshops, and 5) a final interview with the firm’s key personnel participating in the development process, see Table 1. The study was carried out in 2009-2011 by four researchers gathering and analyzing data. The findings are a result of the shared interpretations of researchers based on information achieved with the various data collections methods presented here.

<table>
<thead>
<tr>
<th>Data</th>
<th>Number of people involved</th>
<th>Purpose</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey (13 questions based on innovation literature)</td>
<td>All employees of the case company 147 (out of 270) responses</td>
<td>Diagnosing the current state in innovation activities related to personal and organizational levels</td>
<td>The questionnaire showed a clear gap between felt importance and realized actions taken in several fields</td>
</tr>
<tr>
<td>Interview (semi-structured, recorded and transcribed)</td>
<td>15 senior managers and innovation agents</td>
<td>Diagnosing the current state of the innovation process and related activities</td>
<td>Need for a clearly structured and described innovation process, challenges in organization design for innovation activities</td>
</tr>
<tr>
<td>Diagnosis session; (summary memo)</td>
<td>15 senior managers and innovation agents 5 researchers</td>
<td>Further developing the output of the questionnaire and interviews.</td>
<td>Development targets of the innovation process and related activities</td>
</tr>
<tr>
<td>7 workshops, (documented with photos, memos and summaries)</td>
<td>3-6 innovation agents 2-4 researchers</td>
<td>Creating an adaptive “innovation process handbook”, a systematic procedure to search and select ideas, accelerate and launch them and also a description of roles and resources involved and links to management</td>
<td>Description of the innovation process in the fresh matrix structure (self-organization in a manageable manner)</td>
</tr>
<tr>
<td>Closing interviews, (semi-structured, taped and transcribed)</td>
<td>6 innovation agents</td>
<td>Clarifying the results and benefits of the process done and current activities going on to carry outcomes further in practice in the MO</td>
<td>Issues in the current organizational design and development targets for the future</td>
</tr>
</tbody>
</table>

1) A questionnaire related to the innovation process was targeted to all employees. 13 questions were formulated based on innovation literature (see the Appendix). The questionnaire aimed to
gain understanding on the current state of the chosen topics related to personal and organizational levels by asking both the perceived importance of the topics and their current situation in the organization. The results of the 147 responses were summarized and used as part of the diagnosis session. The questionnaire showed a clear gap between the felt importance and realized actions taken in several fields. The questionnaire was also analyzed to understand the form of innovation management in the case company for development activities and to create a basis for further, more detailed interviews.

2) Interviews were conducted with senior managers and key professionals. The interviewees included persons in every operation of the matrix, held responsible for innovation activities in their own area. The interviewed senior managers acted as their supervisors. 15 interviews in total were conducted, transcribed, and analyzed. Managers and key professionals were asked semi-structured questions but also given ample space to provide their own perceptions on the topics. Typically such open-ended interviews lasted a bit over one to two hours and were conducted in a timeframe of one month, during a corresponding stage of process and organizational change in the case company. The frame of the semi-structured interview was built on a) personal role in innovation activities, b) practical collaboration in the organization, c) innovation structures and processes, d) leadership and management-related innovation activities, e) customer and other external information in networked innovation, f) efficiency and measurement of innovation activities in the organization. Each theme had 5-10 preplanned supportive assisting questions which were used according to the flow of the interviews as they progressed.

3) A diagnosis session was used as a method of interpreting previously gathered information (1-2) with the chosen employees and managers of the case company to add and complement current common knowledge with available information for future use. The majority of the participants also took part in the interviews. The target was to share information and findings within the organization and to enhance essential information by participating. A summary memorandum was written based on the findings in stages 1-3 to be used as a basis for future innovation workshops. Furthermore, the findings presented in the memorandum were circulated and approved by the participating researchers and the target organization’s key persons.

4) Innovation workshops were organized as thematically oriented sessions, based on data gathered and analyzed earlier (1-3). Five main themes were covered in the sessions: a) innovation management and roles in the organization, b) the innovation process – from opportunity recognition to idea refinement and solutions, c) developing innovation activities, d) personal innovation capabilities, e) measurement of innovation activities and continuous innovation system evaluation. The participants were chosen by the case company with the criteria of “development-minded key persons from different units”. The meetings were structured and scheduled within a timeframe of one year in the form of 7 half-day workshops (described in more detail in Salminen et al., 2011). The aim of the workshops was to create “an innovation process handbook”, a description of roles and resources interlinked to the systematic process to search and select ideas and develop them to innovations. The Innovation Handbook was designed to be used during the development project to document outcomes and communicate the results also to the upper management to gain their simultaneous acceptance. Later it will be updated according to future needs by the “innovation agent” group. It is important to note that one main aim was to create a collaborative platform for interaction over unit borders. Action-oriented research was conducted during this process and all sessions were documented.

5) Finally, workshop participants were interviewed again in spring 2011 to clarify the results and benefits of the process done and current activities going on to carry outcomes further in practice in a MO. A semi-structured frame was built on the following themes: a) the “innovation handbook” process and the interactive platform used for its creation, b) organization structure
changes, c) innovation knowledge and capability development, d) development action benefits and inertial issues.

Analysis and Findings

We found several main issues to focus on when developing innovation activities and orchestrating them in the fresh MO. The main findings (in research phases 1-5 and their analysis) are presented and integrated under the following topics from all the phases of the research and analysis: (1) Sharing resources and managing them, (2) A visible innovation process and clear channels for ideas to evolve, and (3) Internal and external brokerage, breaking boundaries with key individuals.

Sharing Resources and Managing Them

One major challenge during the change period from a functional organization to a MO needs to be stressed. In the diagnosis session, there was a debate about existing development resources, such as money and workforce, and the owner of the idea for future actions. There was an argument over whether the needed resources are already allocated on a unit, profit center, or corporate level, because the organization was also changed to a matrix recently. The corporate level opinion was that development budgets are in units. It was interesting that business units said that the R&D money was only for previously known projects in the budget and there was no money for corporate level innovation activities. There were no resources seen to be allocated for shared innovation projects. This was actually a quite natural outcome of an issue related to shared resources, but one that is very important to notice during a change period. Our case firm handled this discussion in a very innovative and positive manner, even having some great ideas of rewarding risk takers willing to allocate resources for common projects in the future.

It is very easy to describe the general level of how the information flows in a matrix, but when asked which persons are needed to participate and make decisions in the organization, it was seen that the routes were not clear and they had to be clarified. Common practice was that to push ideas forward, you go talk to top management with power to make things happen. It was also mentioned that decision making was distributed between different isles, and it was seen to be only partially optimal when orders were given. An interesting outcome was that instead of breaking silos, people felt that transferring to a matrix could actually force boundaries and build new walls in new directions. A practical forum for collecting ideas was missing, and the plans were seen too abstract or missing for real interaction to take place. The matrix structure was also easily seen to disturb the daily work and to cause confusion.

“When you adopt a matrix organization, everyone would like to be developers of functions, but no one wants to focus on the daily operative routines. It is very nice to present ideas about everything, as long as you don’t have to participate in executing those,” said one manager in the organization.

The conclusion was that people were trying to perform the daily tasks without being able to gain the real benefit from the matrix structure. Learning takes time, and there is always inertia present when adopting new ways. The problem of “free riding” was also mentioned several times. Units are not willing to put efforts and resources into development activities if they think someone else in the organization will do those anyway soon enough. It is a way of saving one’s own resources for other issues with a quicker pay back, better profit, or projects including less risk. The organization will be slower to respond to challenges and even sometimes miss the opportunity window for business.

To be able to utilize the benefits of a matrix, a group of Innovation Agents was formed. Their task is to update the documented descriptions of processes and resources related to innovation activi-
ties in the organization. They also catalyze and support related actions and form an integrative forum over operational unit borders in the matrix. This group helps to choose the right ideas for refinement and acts like a godparent for innovation, ensuring its resources and progress. The agents’ role is not to be project managers, but instead they build fertile ground for ideas to mature and link innovations to strategy and support management. Firm strategy should have an impact on the ideas and innovations generated, but strategy should also be updated based on good innovations. One major issue is to share the knowledge that innovation activities are based on and build trust between actors to enable innovations.

In the interviews, intellectual property issues were not mentioned to cause problems, except complicated copyright laws in the media field, especially in multimedia content production. Despite this, a major issue was that people were worried about other departments and units stealing ideas from the original inventor. This concern was more related to competition between units than between persons. The outcomes are related to the current economic pressure to make arrangements to cut costs in weakly performing units and functions. People were motivated to see their own ideas develop into something concrete; other rewards were seen more as something extra. The conclusion was that clear rules for departmental IP actions inside the corporation are essential to avoid this cause of inertia and to increase openness. There was also a recognized need to build trust through interaction and shared resources. Building up trust requires time and action (Blomqvist, 2002; Ellonen et al., 2008). “Earlier units wanted to keep their own issues and ideas to themselves. And we did not tell those to others… I think we have been able to get rid of that kind of attitude”, it was said.

Enabling fast decisions and agile management is crucial for today’s business. It is important that decisions are done routinely on a suitable level to avoid jamming the top level or finding unofficial routes to proceed. Everything being brought to the top is a phenomenon that seems to occur easily in a fresh matrix. The decision making process has to fit the needs of the organization and it cannot cause inertia and temporal problems. During the research period, it was noticed that the discussion focused first on the firm’s matrix structure and later it changed towards building internal capabilities to utilize external resources in an efficient manner. The matrix was left out of the discussion as the development project proceeded and became focused on “the right people in interaction”.

A Visible Innovation Process and Clear Channels for Ideas to Evolve

“Often you hear the question of where to present this idea and to whom...” “Sometimes ideas are processed until the final stage in units, without thinking what it means to others” “...as described in the handbook, we really need systematic project management and professionals... if it is done as a side job, the results are what they are.”

Creating ideas and accelerating and launching them require a systematic process and paths to take information forward and to make decisions. Decisions without real life resources and commitment are a waste of time; this is a major issue especially in matrix operations. There has to be certain interplay and respiration throughout the processes and the internal MO, and also out of the corporation to gain new inputs for future innovations. Insight and action inertia matters in different phases of the innovation process (Godkin, 2010). A certain level of continuous change is desirable to avoid lock-ins and silos in the organization. Focused resources are essential for a clear process, and ownership of innovation is important.

The creation of the handbook was seen as a successful way to find time for development and take concrete issues forward and make them visible. “It can be clearly seen what everyone’s role is in every stage, where they can get support, where to address issues and who is deciding and what.
Generally the guidelines and documents for positioning issues in the organization are a very important aspect. How to bring things forward in the organization... how to coordinate these, it is big thing...” It was also mentioned that “all groups have not understood their responsibilities and roles in innovation activities and the need to serve the whole matrix, they are still working like they did in the past, and they are not able to gain the benefit from the matrix structure...” In sum, the description of the innovation process in the matrix was seen as important.

“I think that it helped to simply have different clear phases described. Planning projects is much easier and I know in which stage we are going. I can define how ready the issues have to be in every stage”.

The description of the innovation process over the unit limits in the corporation was seen as very useful. The “handbook” mapped how the information flows and resources are involved. Too many times there are attempts to solve these issues with implementation of IT systems and thinking that they will solve the problem. Our study suggests that they might be good support, but enabling interaction and clarifying the information flows related to actions are keys to success. It is very important to have a common understanding in the organization regarding which activities are worth of lifting to the corporate level and which are continuous improvements in units (Figure 2). There is a difference between knowledge sharing and building – some best practices can be transferred but some have to be developed together. We found out that the matrix is expected to take care of this issue, but it seems that the matrix is simply one of the enablers when the innovation process and its relationships are described well. A clear description of the process and its acceptance by top management prevents internal arguments over responsibilities. It is clearly a commonly shared model of how to proceed with things.

Figure 2. A collaboratively agreed process to get senior management and employees pursue innovation – description of the process and actors in the Handbook of Innovation

“I think it is clear that we have the godparent for an idea, the owner of the idea, or not maybe the owner but someone responsible for carrying the idea further... a responsible person to keep up with the development and schedules, I think it ensures that something happens”.

“I think nowadays different aspects, like marketing, are better noticed and considered. I do not know if it is about the handbook and process development or purely due to the matrix or other reasons, but the interaction is better than before”.

There was a clear demand for a forum and for members to represent different units and functions to develop the innovation process and evaluate the ideas into a concept for projects (see Figure 2).
Interaction and Innovation - Reframing Innovation Activities for a Matrix Organization

The innovation agents took this position in our case company. They built up the capabilities for innovation actions by actively participating in the fuzzy front end of the innovation process. Informal ways appearing for information flows are good indicators of process success and of the existence of an organization map. It indicates whether routing or resourcing should be updated to a certain extent or if implementation and learning of new arrangements need more attention. One of the interviewed persons had a rather expecting opinion of the implementation: “process development was good, but the real change is still waiting…”

In most industrial firms, R&D processes are described (e.g., Cooper, 1990, 1993) due to quality certifications and company policies, but the process reaches the fuzzy front end of innovation surprisingly seldom. In other fields, such as the media, the focus has been in processes of delivering news and development processes are rarely clear. Even if the firms have created some sort of clear path for innovation processing or systematic use of interpretative methods, it is very seldom updated when the organization form is changed or if the firm is facing a merger or acquisition. A clear description is also very useful when new employees are orientated for their tasks in order to be part of creating the firm’s future success through innovations. Based on workshops with our case firm, we also had a clear need for description improvements in the fuzzy front end of innovation, and also in describing the process and resources for innovation execution activities. The firm’s prior process focus was mainly on producing daily news inside units.

**Internal and External Brokerage, Breaking Boundaries with Key Individuals**

Internal and external brokerage (Burt, 2004; Parjanen, Harmaakorpi, & Frantsi, 2010) was needed to support development activities. External brokerage supported internal communication, made visible the need of internal interaction platforms and brokerage, as well as showed the potential of external sources of innovation and the need of internal capability development to utilize those. In interviews it was pointed out that during development activities an external broker can undress the command chain and hierarchy to enable information flows over existing vertical and horizontal borders.

“If the unit director says that today we develop the process together, in reality it means that the direction of discussion goes by his goals and thoughts, and then starts the blocking, etc. Outsider attendance gives fresh thoughts and questions, sort of external views and releases the thoughts of the group, because they do not have to be responsible for their thoughts to their boss who is sitting nearby… We can direct opinions to an outsider and say why it can be done like this or like that.”

The importance of linking theory and practice was mentioned several times as very useful. “It was very important that a third party was framing and supporting the development work; the process model would not have formed internally… theoretical background gives more insight…” Also finding time for development was easier with planned external meetings: “…in our daily rush we do not have time to think about these issues, but with preplanned external meetings in the calendar we were able to use the time to think and develop the process, and we found lot of good points. Especially the role of the Innovation Agent -group was clarified, what it is and should be…” “Actual collaborative doing and developing was welding this group together”.

As a result of the diagnosis and interviews, it was easy to agree that the case firm could benefit from an internal team supporting the innovation process in the organization. The team was focusing on describing the innovation process in a new MO, updating it and supporting the fuzzy front end of innovation activities with agreed tasks. External brokerage reduced inertia while developing the innovation process and knowledge sharing. The process description was a theory-based learning process for the participants about the relationships and interplay in innovation, not only
to produce a road map or flow chart for the Innovation Handbook. Team members were chosen from different units and with the right active development attitude. These innovation agents were first to break the silos through interaction and build up the common interest of innovation activities with the support of the innovation director. Internal agents are in a key role and their task in the innovation process has to be clearly defined, and management commitment is crucial.

**Discussion**

Based on our study, we are convinced that different phases of the innovation process have different characteristics and needs regarding the organization. The early phase should be supported by exploring future oriented information (Uotila, Mäkimattila, Harmaakorpi, & Melkas, 2011), idea generation handled with a fuzzy and not too forced manner, the concept phase should be driven by the organization seeing alternatives and the common goal, and the project development phase should have clear execution steps and resources (see Candi et al., 2013; Cooper, 1990). The management has different expectations and needs in different phases. Because of today’s efficiency pressure, it is easy to focus only on visible actions and quick rewards, which easily cuts other efforts than clearly targeted and measured. The organization should be able to use resources also in the early phase of innovation and to have the flexibility to find the right individuals with interest and knowledge (Chesbrough, 2003; Fjeldstad et al., 2012; Huston & Sakkab, 2006). The challenge is to let the organization adjust based on developed innovation and adapt to the needs of current stages. This should be done simultaneously while sharing resources with the daily operational challenge of business activities – creating income for the firm to finance innovations to become future “milked cash cows”. The impression based on the results is that if the organization is purely focused on functions and current products, it can mainly develop incremental innovations (see Tidd, Bessant & Pavitt, 2005) of current products and processes. If the organization is closer to a project form, radical innovations (see Augsdörfer, Bessant, Möselin, Stamm, & Piller, 2013, pp. 17-20) emerge easier but development activities focus on certain projects and challenge the enduring elements of the organization. The matrix tries to combine the good features but has the pitfall of unclear responsibilities. The challenge is to find out how to ensure the flexibility and time for sourcing and refining ideas within a matrix while simultaneously having the internal and external pressure of efficiency. While the idea matures into a development project, the challenge changes to the capability to carry tasks and investments to a goal without dominating and stealing resources from other projects. This has to be done so efficiently that the opportunity window still exists for the product launched. We see these findings to be in line with previous exploration and exploitation studies and their management balance discussion (March, 1991; Miles et al., 2010).

Organizational challenges in the different phases of the process are summarized in Table 2 to demonstrate practical implications to be considered in an organization’s design and process development actions.
### Table 2. Main outcomes: the innovation process phase and MO challenges

<table>
<thead>
<tr>
<th>Phase of innovation process</th>
<th>Challenge in the organization, previously or due to the change</th>
<th>Action in MO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signals and opportunity recognition</td>
<td>Passive, only some active and focusing on own field of expertise, not seen as a part of everyone job</td>
<td>Interaction platforms and training for absorptive capacity – every one jobs to acquire and share cross functional information</td>
</tr>
<tr>
<td>Idea generation</td>
<td>Employee participation and motivation on an average level. Ideas not shared due to competition between units.</td>
<td>A common platform for common good, all units participating in idea refinement, motivation and a supportive culture</td>
</tr>
<tr>
<td>Idea evaluation</td>
<td>No clear forum internally and the customer aspect biased</td>
<td>Done systematically in a cross functional team and linked to strategy aspects and total customer needs</td>
</tr>
<tr>
<td>Refining to Concepts</td>
<td>Partial picture of needs due lack of communication</td>
<td>Customer oriented products and services supplementing each other and every unit, platforms for refining</td>
</tr>
<tr>
<td>Decision to develop further</td>
<td>Previously go / no go too early, the available resources seen mainly internally in a unit. Change to the matrix has confused decision paths and authorities.</td>
<td>A collaborative view of benefits and available resources between units and functions – also the possibility / alternative to do only in a unit, with partners or a suitable time period later</td>
</tr>
<tr>
<td>Starting project</td>
<td>Starting if / when resources available and often based on a personal hunch</td>
<td>As soon as it looks profitable by using internal or external resources and costs considered</td>
</tr>
<tr>
<td>Running R&amp;D project</td>
<td>Often on the side of an operational rush in a unit – or totally externally with loose control and management due to internal know-how</td>
<td>Utilizing internal and external resources better, clearly lead by a strong PM in the matrix and a follow up (time and costs)</td>
</tr>
<tr>
<td>Testing</td>
<td>A partial view, function or unit</td>
<td>The customer in focus, feedback in the matrix</td>
</tr>
<tr>
<td>Implementing</td>
<td>A unit or function aspect, daily operational priorities often first</td>
<td>Entirety, attention to in-house communication and internal sales before external actions</td>
</tr>
<tr>
<td>Measuring innovation process</td>
<td>No clear indicators, projects controlled with varying methods</td>
<td>Defined indicators and monitoring, tracked through the process</td>
</tr>
<tr>
<td>Learning</td>
<td>Poor loop, hard to learn when processes are hardly repeatable and no clear description and documentation</td>
<td>Innovation agents and an updateable process description enables learning, the focus also on documentation. The innovation director with senior managers ensuring the corporate aspect.</td>
</tr>
</tbody>
</table>

Our study suggested that firms should come to terms with very practical matters to reinforce their innovation activities and utilize capabilities. This means going back to the very basics, like having social interaction platforms to combine information and build trust over unit boundaries and knowing who makes the real decisions about the resources available for agile actions for common good. These findings are in line with Nesheim’s (2011) paper, as well as with his notion that “The ability to develop arenas between process owners and the operative organization is vital.” When
previous information channels and decision making are rerouted for the matrix, it is very useful to have discussion platforms with visual descriptions of innovation paths in the organization. When old structures disappear, it is very easy to end up in a situation where workers lack the interest of pushing ideas through unclear paths while daily working and operational challenges are enough in the new organization form. The aimed benefits of a MO might be overruled not only because of the internal political games usually blamed, but also because of unclear routes for real life information and operational decisions. There have to be efficient ways of connecting senior level managers (as in a matrix) with their formal authority to make decisions and support planned actions (see Artto et al., 2011; Nesheim, 2011). Allowing personnel (from different vertical and horizontal positions) to describe flexible and updateable processes including linkages to the senior/top management for total business optimization might be one solution. Such an “innovation agent group” could combine people and their activities in a matrix, develop the innovation process, foster and generate new ideas, select and transform ideas into innovations – instead of doing these within separate teams (see e.g., Artto et al., 2011). The group is able, to some extent, to circulate individuals and also utilize their social networks inside and outside the organization to advance innovation activities. The above mentioned aspects also support the behavioral and cultural context to achieve high innovation performance (Prajogo & Ahmed, 2006).

Our study confirms the result of Artto et al. (2011) that the natural development path of an innovation organization begins with emphasizing diagnostic and boundary systems, followed by a more intense focus on interaction to find a common meaning and justification for the shared innovation activities. Based on our study, we can say that if the firm can really describe together over its unit boundaries how idea generation is catalyzed, innovations developed, and actions taken in projects, it is on the correct path. These findings are well in line with the recent study of Artto et al. (2011), stating that there are several integrated management control mechanisms for innovation activities embedded in organization structures. Our case also provides evidence for the argument of Artto et al. (2011, p. 416) that IT systems are often used to store information, but without any other interaction they are more likely to increase the social distance between individuals than facilitate innovation collaboration in the organization. Interaction is needed to build common interest and motivation to gain resources to push innovation forward. One of the challenges is to define what the difference between daily continuous improvements and innovations in units is and which ideas have to be lifted to a shared platform with other units (see Figure 2). Employee driven innovation can be seen as much more than employees just having ideas (Kesting & Ulhøi, 2010; Salminen et al., 2011). This is a key issue in order to achieve the necessary agility and decisions and to avoid internal inertia. To be able to play on a field of systemic innovation, practical shop floor knowledge that is usually seen as a source of incremental innovations has to be connected to information often claimed to be in decentralized R&D units and leading towards radical innovations. We agree that today’s challenge is to connect all available information and transform it into practical agile actions with situational awareness (Sonnenwald & Pierce, 2000) provided in collaborative networks of actors from all organizational levels (Fjeldstad et al., 2012). Fjeldstad et al. (2012) have also aptly described organizations’ aims towards capable actors that self-organize and share resources with processes enabling multi-actor collaboration. In today’s business, external and internal change is constant, so rather than find ultimate stationary solutions, we should find out how to predictably enable change and gain relative benefits from dynamics. This also fits the design of innovative organizations, especially in the world of discontinuous and disruptive innovations (see Augsdörfer et al., 2013). Due to the systemic nature of innovations, they also have a counter-impact on the organizations from which they originate – creating a need for re-adjustments of the organization and triggering new innovations into the ecosystems. This is evident especially in media companies trying to adapt and innovate to survive.
To summarize, an important theoretical contribution of our research lies in the distinction made between organizational flexibility especially in the early stages and conceptualization of innovation, and in the later stages when focusing on performance and clear execution processes of evolving solutions. These findings include similarities with old organization studies related to innovation (e.g., Zaltman et al., 1973) as well as recent technological innovation studies (e.g., Candi et al., 2013) discussing internal and external turbulence interlinked to planning and specification flexibility. We would also like to highlight that the things required from the organization change during the innovation refinement from an idea to a product or service – an organization has to be able to meet both endogenous and exogenous innovation challenges. These issues are important when developing matrix or alternative organization structures to manage and support parallel innovation activities in different phases of multiple innovations. The second main contribution of our study is the need to foster interaction. Instead of focusing purely on the innovation process or matrix structure, there could be efficient action platforms combining both and simultaneously increasing interaction needed in current and future innovation activities – like in our case the innovation agent group bringing people together from different units. Often presented IT solutions can be good aid, but they alone cannot solve management challenges related to human activities. The third main point in this study is allowing and supporting the change. Organization design and processes should be able to adapt to the internal and external change demands in an efficient and profitable manner. The essence lies in the fact that the change is constant in both processes and the organization, and continued compatibility should be assured. The main point is that people with the right information have to be connected to the process at the right time to share their knowledge and they have to be able to make decisions about the tasks and resources to achieve the set goals together. From today’s innovation perspective, we agree with the old wisdom (Davis & Lawrence, 1977; Ford & Randolph, 1992; Porter et al., 1975) that a matrix cannot be just “shifted” to an existing organizational setting. Development activities with real interaction are needed to manage resources and processes in organizations. In this paper we have also presented a way to develop and reframe innovation activities by using an innovation handbook and an innovation agent group to facilitate the change. Researchers and firms having similar challenges can further refine this approach for their tailored development activities – single case studies create value for those with similar interests (Pålshaugen, 2009).

Limitations and Future Research Implications

We note some limitations, which in turn offer opportunities for additional work. First, our results are based on a single case study on a firm having its own culture and prior structures for innovation, and thus more research is needed to ensure the generalization of the results. Moreover, some of our simplifications take a rather linear process departure to highlight the outcomes in certain stages (e.g., Table 2), but in reality the innovation process is a complex intertwined entity with multiple cycles and connections – innovations are built on innovations (Berkhout, Hartmann, Van der Duin, & Ortt, 2006). Our research also points out the challenge of studying continuously changing matters, such as organization structures and innovation activities related to dynamic impacts of the business environment. We assume that we have managed the challenge well with a combination of various methods of data acquisition, but more can be learned with later observation and evaluation of development effects and organic change in the case organization and their relationship with unpredictable business environment change. There is an opportunity for future research to study the longitudinal managerial role of an innovation agent group and how it can develop matrix-like integration over unit borders. Another interesting aspect is how product and process innovations have an impact on organizational designs and organizational innovations in collaborative organizations and how they trigger new innovations for customers.

Interaction and Innovation - Reframing Innovation Activities for a Matrix Organization
Conclusions

Rapidly developing technologies and customer demands are forcing organizations towards constant change. The pressure of competition will force firms to focus on how they trim and integrate their networked innovation process and knowledge refinement according to the constant change. The temporal fit of the organizational structure and the paths for information processing have to match. Regardless of whether the organizational structure is the result of a clear management strategy or a given space for organic formation, the routes of fostering ideas to finished products or services have to be clear, efficient and seamless paths fitting the current form and operational activities of an organization. Firms would benefit if they had a general description of the innovation process and supportive functions, like they have in many quality related issues demanded by related standards and policies. They should also focus on the fuzzy front end of innovation and not only on R&D pipes or production, as is usually the case. These descriptions should be updated to support real life actions for the current status and accepted across the organization. Assuming information flows and affecting actions is not enough, but a too stiff description is not the purpose. A compatible organizational structure and the innovation process have to be agile and adjustable based on the needs of the changing business environment.

References


Interaction and Innovation - Reframing Innovation Activities for a Matrix Organization


Mäkimattila, Saunila, & Salminen


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Appendix. Questionnaire Design

Questionnaire was constructed for the themes related to organizational innovation activities. Based on literature review, 55 initial items were operationalized (see Kallio, Kujansivu & Par- janen, 2012; Saunila, Mäkimattila & Salminen, 2014, for further details). The items were re- viewed and revised with a group of researchers in order to ensure the appropriateness of each item. This process resulted in 42 items being eliminated, and 13 remained for the final version of the questionnaire. The selected items and their background are presented in table below. For each of the 13 items utilized, the respondents were asked to indicate their opinion on a Likert-type scale ranging from 1 to 5 about the seen importance for organization and current situation in or- ganization.

<table>
<thead>
<tr>
<th>Theme and questions</th>
<th>Meaning for innovation activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INNOVATION STRUCTURES</strong></td>
<td></td>
</tr>
<tr>
<td>1 Ideas are systematically collected in our unit</td>
<td>Innovation should be supported by sufficient tools, processes and systems</td>
</tr>
<tr>
<td>2 We have a clear way of how ideas are processed and implemented</td>
<td>Effective further development of ideas is necessary for the success of the innovation process</td>
</tr>
<tr>
<td>3 I get feedback for my ideas</td>
<td>Feedback should be given concerning improvement suggestions for innovation</td>
</tr>
<tr>
<td><strong>ORGANIZATIONAL CULTURE</strong></td>
<td></td>
</tr>
<tr>
<td>4 We ensure that the reasons for problems are investigated and eliminated</td>
<td>It is important to modify systems and processes fairly quickly</td>
</tr>
<tr>
<td>5 Different opinions are appreciated in our organization</td>
<td>An organization should tolerate individuals who do things in a different way</td>
</tr>
<tr>
<td>6 Cooperation between units works well</td>
<td>An organization should have an effective environment for collaboration within and between departments</td>
</tr>
<tr>
<td><strong>LEADERSHIP</strong></td>
<td></td>
</tr>
<tr>
<td>7 I have the courage to try new things despite the possibility of failure</td>
<td>Individuals should be encouraged to try new ideas without fear of failure and its consequences</td>
</tr>
<tr>
<td>8 My ideas have an effect on our actions</td>
<td>Managers should increase the personnel’s opportunities to participate in development activities</td>
</tr>
<tr>
<td><strong>EXPLOITATION OF EXTERNAL KNOWLEDGE</strong></td>
<td></td>
</tr>
<tr>
<td>9 I apply ideas from other fields of industry to my work</td>
<td>Good ideas emerge by applying information from outside an organization</td>
</tr>
<tr>
<td>10 I interact with customers in my work</td>
<td>Interaction with customers can provide missing inputs into the learning process which the organization itself cannot provide</td>
</tr>
<tr>
<td>11 Customers’ ideas are exploited in our unit</td>
<td>The ability to exploit external knowledge is a critical component of innovative capability</td>
</tr>
<tr>
<td><strong>INDIVIDUAL CREATIVITY</strong></td>
<td></td>
</tr>
<tr>
<td>12 I enjoy my work</td>
<td>Internal motivation includes for example deep interest and involvement in one’s work</td>
</tr>
<tr>
<td>13 I participate actively in development</td>
<td>Individuals should have an opportunity to affect the outcome of their work</td>
</tr>
</tbody>
</table>
Biographies

Martti Mäkimattila, M.Sc. (Tech.), M.Sc (Econ. & Bus. Adm.) is a PhD student and Researcher at Lahti School of Innovation, Lappeenranta University of Technology (LUT), Finland. His research focuses on systemic innovations. Prior to joining the academic community he has gathered profound management experience in international business and R&D contexts.

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Systemic Innovation in Complex Business Portfolios – A Case Study

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Systemic innovation in complex business portfolios – a case study

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Abstract: This paper presents the interaction of different systemic elements in innovation activities in complex business portfolios. The interaction of innovation and portfolio transformation is highlighted based on two empirical case studies. Systemic challenges with different drivers and external impacts are presented. The managerial implication is to focus on dynamism present in continuous change. This study contributes to innovation and portfolio business literature by creating a linkage between the two fields of study and by making the multiple interlinked systems visible. This paper extends the innovation discussion towards portfolio businesses.

Keywords: innovation; systemic innovation; business portfolios; case study.


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1 Introduction

Innovation and entrepreneurship are important elements of business and also in a central role of the EU 2020-plan to power growth in the European Union (EU). Innovation dynamics highlight the role of complex innovation systems (Coenen and Díaz López, 2010) and organising for systemic innovation (Chesbrough and Teece, 1996). In this paper, we focus on systemic innovation within complex portfolio businesses.

The phenomenon of systemic innovation has gained increased interest during the last few years (Nieminen et al., 2011; Johannessen, 2009). Even though the discussion on systemic innovations has dealt with the role of different contexts for innovation, the research has largely overlooked the dense portfolio business systems defined by ownership ties. The innovation discussion is generally heading towards an analysis of the systemic nature of innovation (Trott and Hartmann, 2009; Berkhout et al., 2010; Geels, 2005; Geels and Schot, 2007). The prior research has been focusing on different innovation models, such as closed and open models (Chesbrough, 2003) as well as the different systems approaches to innovation and technological change (Coenen and Díaz López, 2010; Markard and Truffer, 2008; Nieminen et al., 2011). Innovation is often considered to take place and analysed within the borders of a firm, like in traditional closed innovation principles or in a ‘funnel’ describing open innovation and IPR tools leveraging it (Chesbrough, 2003). Many of the systemic elements in the innovations stem from their context. As such, prior research has focused on the complexity of multi-unit corporate challenges as well as firm networks and also studies about business groups with habitual entrepreneurs and teams (Galunic and Eisenhardt, 2001; Huston and Sakkab, 2006; Belenzon and Berkovitz, 2010; Iacobucci and Rosa, 2010; Huovinen and Tihula, 2008). Mäkimattila et al. (2013) have pointed out that entrepreneurs are using their position as owners in several businesses to build dynamic platforms to grow new innovations and Iacobucci and Rosa (2010) recommend that future research should focus on complementary theories related to portfolio entrepreneurship and business groups. Also EU currently points out the importance of the research related systemic innovation, e.g., in context of business portfolios and ecosystems supporting entrepreneurial activities (EU). It seems that we know relatively little about the character of systemic innovation within business portfolios and our paper focuses on this research gap. It is clear that innovation and entrepreneurially oriented portfolio research have developed in different tracks and it would be beneficial to combine these perspectives to further understanding of the systemic innovation dynamics.

This study focuses on innovation in complex business systems. Our research question is ‘How do systemic innovations develop within complex business portfolios?’ With this research question we extend the understanding of the complex environments of systemic innovation. The aim of this paper is to show the multifaceted systemic nature of innovation and to present the interconnection between innovation drivers found in business portfolios. The interplay of different drivers, endogenous and exogenous, has an impact on the formulation and outcomes of innovation. Beside drivers emanating from the business context, other drivers such as individual and social drivers are also contributing to the portfolio change, simultaneously having constant systemic interplay with innovations.
2 Theoretical background

2.1 Systemic innovation

Innovation can be defined as a “...process of turning opportunity into new ideas and of putting these into widely used practice” [Tidd et al., (2005), p.66]. Tidd et al. (2005) also refer to Drucker’s (1985) view that innovation is seen as the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for different businesses. Generally innovation is seen as successful exploitation of new ideas, including both new technologies and new ways of doing things.

Prior research has partly neglected dynamism and systemic interplay of innovations, although interaction and firms facing the challenge of working beyond their boundaries has been widely acknowledged in innovation studies (Johannessen, 2009; Trott and Hartmann, 2009; Chesbrough, 2003; Huston and Sakkab, 2006; Rothwell, 1994). There is no clear fixed point of origin in innovations, as Trott and Hartmann (2009) state in their call for modern innovation models. Also Berkhout et al. (2010) criticised the linear pipeline descriptions dominating the current innovation literature and they suggested that the system of dynamic processes could be seen as a circle of change. “Innovation may start anywhere on the circle and previous innovations will inspire new ones: innovations build on innovations” [Berkhout et al., (2010), p.487]. This could also cover a mosaic of different categories of innovations. The concept of systemic innovation is also used in the literature of innovation management as a category of innovations requiring specialised complementary assets for successful commercialisation of the innovation in question (Teece, 1986) and extended to innovations from which “benefits can be realized only in conjunction with related, complementary innovations” (Chesbrough and Teece, 1996; Maula et al., 2006).

There are various system approaches to innovation. Frameworks of technological innovation systems, socio-technical systems and sectoral systems of innovation are commonly used approaches (Markard and Truffer, 2008; Coenen and Díaz López, 2010; Nieminen et al., 2011; Geels, 2004) as well as departures from self-renewal and the point of closed, open and dynamical systems (Ståhle, 2009). The dynamic framework seems to be part of a wider tendency in the innovation system literature to focus not only on changes in the system but also changes of the system (Bergek et al., 2008; Coenen and Díaz López, 2010). The prior discussion has also covered family firms and business portfolios as open systems from the owner perspective (Pieper and Klein, 2007; Rautiainen et al., 2012).

Every system of innovation is situated within a certain context. While all these above presented innovation system aspects are also meaningful, it is important to understand the system and its environment and it would be misleading to purely isolate the system from its environment (Asheim and Coenen, 2005). Defining the boundaries of the innovation system is crucial to the study of factors and drivers for innovation. It is necessary to distinguish the drivers belonging to the system of innovation from the exogenous, outside, drivers of innovation (Coenen and Díaz López, 2010). Liu and White (2001) discuss about primary and secondary actors. Primary actors directly perform innovation activities and secondary actors affect the behaviour or interaction between primary actors. According to Edquist (1997), a system of innovation is constituted of the components of the system and the relations among the components, such as organisations and institutions. The phenomenon of business portfolios also raises the question of where the
innovative organisation starts and ends. In that sense, the organisational boundaries (e.g., Santos and Eisenhardt, 2005) are likely to denote other characteristics than legal. It is conceivable, that businesses within a portfolio together constitute an effective innovation system with the required critical mass for innovative processes or that the portfolio organisations would be expected to take part in an innovation process because of their joint ownership background.

2.2 Portfolio business system

Existing studies about the processes involved in the innovation and development of portfolio business are limited. Portfolio entrepreneurs are defined to be individuals who found, own, manage and control more than one business at a time (Westhead and Wright, 1998; Carter and Ram, 2003; Carter, 2001; Ucbasaran et al., 2001). While observing portfolio entrepreneurs, several advantages have been found that affect business success. Entrepreneurial experience supports new business success (Huovinen and Tihula, 2008; Alsos and Carter, 2006). Portfolio entrepreneurs have been found to have better business success than single business entrepreneurs (Flores-Romero and Blackburn, 2005). Portfolio entrepreneurs are able to leverage high-discretion slack resources, positive legitimacy spill-overs and learning effects and experimentation across a loosely coupled business setting.

Diversified business groups, e.g., business portfolios consisting of legally independent firms operating across diverse industries, are an interesting research subject. Business groups, collections of firms, are bound together in formal and/or informal ways (Granovetter, 1995). The interest for business group research has gained attention among several researchers. The definition of business groups (Granovetter, 1995; Yiu et al., 2005) as well the characteristics of business groups (Goto, 1982; Khanna and Rivkin, 2001) challenges researchers. Yiu et al. (2007) developed a model which classifies business groups into four business group organisational archetypes. They concluded that there are different forms of business groups depending on the environment in which they operate. Innovation and business group research shows that group affiliates are more innovative than standalones (Belenzon and Berkovitz, 2010; Chang et al., 2006) as well as groups also discourage innovation by creating entry barriers (Mahmood et al., 2013).

A business portfolio is a company’s set of investments, holdings, products, businesses and brands. There can be a number of possible reasons to congregate different businesses under a group structure. Portfolio business entails making strategic and financial choices, e.g., which companies the entrepreneurs will invest in and which new products and development projects they will choose (Carter, 1998; Almeida and Wolfenzon, 2006) and it also involves resource allocation, e.g., how the entrepreneur will spend his or her resources (Alsos and Carter, 2006; Iacobucci and Rosa, 2010). Portfolio transformation can also be seen as an organisation system searching for stability and balance between efficiency, power, competence and identity within the interaction of innovations, ensuring the existence of a profitable portfolio.

A portfolio structure composed of interdependent firms forms an organisation that can have collective goals beside the goals related to individual companies. The underlying reasons for organisational change in a portfolio can be multiple. Organisations create and combine units and processes to address new opportunities and pressures, thus altering their orientations to the environment as the environment changes (Fjeldstad et al.,
In order to seize emerging opportunities, the portfolio structure and its boundaries are likely to be in constant change.

Santos and Eisenhardt (2005) defined the organisational boundary as the demarcation between the organisation and its environment, taking place through four different boundary conceptions: efficiency, power, competence and identity. When we look at the notion of organisation boundaries in a portfolio structure, we can identify the same elements. Business portfolios support the sharing of resources (monetary and human) over formal units, e.g., firms as separate legal units. A portfolio structure also handles some of the transaction costs with a different perspective than ‘formal’ firm networks – and this supports some innovation activities, as decisions do not always have to be reasonable and justified at first hand. To reflect on the main variables that have an impact on the particular area under study, it is important to define the boundaries of the portfolio business system.

### 2.3 Conceptual background of different drivers

Businesses are in constant change because of the changing endogenous and exogenous circumstances of the business. Endogenously the businesses receive these inputs and outputs internally from within. In a portfolio, the actors collectively identify and develop capabilities and transfer and renew those capabilities under changing circumstances. The inner dynamics of the business portfolio create opportunities inside the system where different firms in the system generate new innovations and businesses. Innovations are created by people in the process of trying to solve a problem or to find new and better ways of doing things and innovation is therefore a social process.

Figure 1 describes how external impacts create pressure towards firm portfolios (circle) and trigger new innovations through three main drivers; individual, social and business drivers. Individual drivers refer to development needs arising from the personal needs of the owners or the managers to adjust the business. The social drivers refer to development needs that are mainly related to the social expectations directed towards the entrepreneurs. Such expectations would emerge from the family, for instance. Finally, the business drivers refer to development needs that emerge from the competitive situation and environment of the distinct businesses or the whole portfolio.

Exogenously the business receives inputs from and returns outputs to its business environment. For a portfolio of businesses, the environment forms an overwhelming complexity. That is, each of the businesses in the portfolio deals with their ‘own business environments’ and receives information on ideas, needs, pressures, resources, financing, etc. At the same time, each of the portfolio businesses faces the need to adjust their operations to the environmental circumstances. Together, as a portfolio, the exogenous pressures may take the form of institutional forces in the form of, e.g., changes in legislation, taxation or ownership.

Figure 1 illustrates the business portfolio and the different internal and external pressures affecting the development of the portfolio. The innovations reflected in the system may cover different combinations of paradigmatic changes within the portfolio. At the same time, the business system is likely to contain incremental, radical and disruptive innovation processes. The systemic innovation may take forms such as new start-ups, diversification or structural transformation of the businesses or the whole portfolio.
In Figure 1, the firms are legal entities (boxes) where ideas (dots) are maturing (process funnel) to innovations, or relocated (arrows) to better fitting constructions of evolving innovations in other firms – regardless of the formal borderlines of firm. The business prospective is forming the portfolio while it is searching for the optimum and this is triggering new innovations through drivers.

The continuous systemic interplay of innovations and transformation is a never-ending process where the portfolio is used as a platform to enable profitable innovation activities. As mentioned by Lakhani and Tushman (2012), the capability of continuously shifting boundaries to suit the strategic, technical and competitive needs is seen as an advantage in competition. In business portfolios, different main drivers are guiding the innovation activities inside firms, combining rational and emotional issues, searching for a temporal compromise to fit into the larger scope of profitable business. In other words, this means that the boundaries (Santos and Eisenhardt, 2005) between businesses within the portfolio as well the boundaries of the portfolio as a whole are in constant change.

3 Methodological approach and design

In this section we describe our empirical study. We present findings from two explorative in-depth case studies. Such studies are the most appropriate for understanding and uncovering a phenomenon that one does not know much about. Our study is aimed at
producing an understanding of the context of the systemic innovation in portfolio business.

To reveal how systemic innovations develop within business portfolios, it is necessary to find longitudinal empirical cases where these elements are visible. Eisenhardt (1989) states that in order to fully grasp the ‘dynamics present in single settings’, a longitudinal approach to case study research is specifically recommended. Following this, we apply a case study approach and the empirical part builds on a case analysis and snapshot pictures of two family business portfolios. We use family business case because of its unique characteristics, e.g., family, business, owner defined by Tagiuri and Davis (1996) and also because of the dynamics and interdependencies among the subsystems can be captured (Rautiainen, 2012). The unique systemic innovation development can be captured through an analysis of the business portfolio development.

We concentrated our research on two different family businesses which meet the criteria of portfolio business. As the criteria for selection, we used the following rules:

1. the case was supposed to contain a wealth of separate businesses to meet the idea of complexity
2. the case was supposed to have developed for a long time, at least for 20 years, to be able to reflect the longitudinal aspects of systemic innovation.

The first business case, Flowergarden Ltd., has existed for 55 years and there have been about 30 different companies involved. The second case, John Nurminen Ltd., has existed for over 140 years and there have been about a hundred different companies involved.

3.1 Data collection and analysis

The bulk of the data was collected through semi-structured interviews with the family members. The data consists of interviews with main owners, managing directors and board members. Several types of data were collected:

1. interviews with key individuals (six main owners, two managing directors and four board members)
2. publicly available data, e.g., historical material, which was collected primarily from the companies’ histories
3. internal data.

The case study method is eminently justifiable under certain conditions: where the case represents a critical test of an existing theory, where the case is a rare or unique event or where the case serves a revelatory purpose (Eisenhardt, 1989; Yin, 2003). Although case study methods remain a controversial approach to data collection, this study method enables a close examination of the data within a specific context. In this study, the case study method revealed complicated systems that require multiple levels of analysis to produce new knowledge about the phenomenon. The empirical case study data is used to reconceptualise and extend the existing theory.

While reviewing this material, we started to develop constructs for both cases. According to Danneels (2002), the data analysis points to relevant concepts and theories in the literature and at the same time the literature provides conceptual frameworks to support data interpretation. To study how systemic innovation interacts in portfolio
business, we examine the business stages in two phases. This analysis was supported with the model developed to describe the conceptual framework of systemic interplay of innovation and transformation (see Figure 1). Eventually the iteration between the cases and literature allowed us to identify a more integrated approach.

3.2 Case 1: Flowergarden

This case focusing on flower trading consists of a core business and a set of related businesses. The data collection deals with business development between years 1952 and 2007. Figure 2 presents snapshot pictures from two different phases; the initial stage in 1952 and the re-organised structure in 2007.

In 1952, three brothers built a greenhouse and began growing roses. At the time, they had equal stakes in the business, but the plan was to build a separate company for each of the brothers. After ten years, in 1962, one of the brothers carried out the initial intention of having an own company and withdrew from the family business. The remaining two brothers restructured the company, organising it into two segments, both owning half of the company. In 1977, the brothers had disagreements about the business and the second brother withdrew from the family company and started his own business. At this point the remaining brother brought his family into the business and the ownership was shared with his wife and four children. Between years 1980 and 2000, several different business acquisitions, start-ups and joint ventures were conducted. During these years the family also made several ownership transactions because of the forthcoming succession process. Three children were bought out and two of them started their own new businesses. Also one business was established for the grandchildren. In 2000, the succession was complete and there were only three owners. Again, many disagreements emerged about the management and growth plans between the owners, so one child withdrew from the family business and started her own new business as well as made a joint venture with her husband. At this stage, the core business had two owners, one with a 90% ownership and one with a 10% ownership. The development of the portfolio business at
Flowergarden Ltd. has taken some 55 years. During this process, there have been about 20 different companies involved and the number of start-ups, acquisitions and buy-outs was 19. In its present configuration, the core corporation includes the parent company and three subsidiaries as well as a real estate business.

3.3 Case 2: John Nurminen

This case has had around two hundred different operations, start-ups, acquisitions, joint ventures and buy-outs. Data collection has been retrospective, including operations between years 1871 and 2010. However, our analysis from this case covers only the latest stages of portfolio development, since the most significant change has happened between these stages. Figure 3 presents snapshot pictures from two different phases; the holding level in 2000 and the organised structure in 2010.

Figure 3  Case 2: portfolio development observed in two stages

At the beginning of 2000, the company had a corporate structure which was divided into three different business areas, e.g., shipping, logistics and small, specialised businesses. Between years 2000 and 2006, the development was rapid and John Nurminen Ltd. was a leading player in Scandinavia. Some business sectors changed drastically so several modifications had to be done. The family wanted to enter a new field where the aim was to build a nationwide chain. However, at the same time some businesses also had to be cut. Due to the long history with several business areas, the family was reluctant to sell them to third parties and instead they moved these businesses under direct family ownership which enabled the business to continue under family control. By the year 2008, the company’s portfolio had grown too difficult to handle; they had a unit, automotive logistics, which demanded too much in the way of investments and there was a need to stabilise the portfolio. Nurminen wanted to continue as a family business, so they were looking for partners at the unit level, partners able to support the business area. Negotiations with an investment company led the family to list the company on the stock
exchange. This took place through the purchase of a new company which had already been listed.

A few months later, the board of John Nurminen Ltd. clarified the policy; the core idea of the strategy was that John Nurminen Ltd. would be divided into two different groups: a group with a listed company as the core and a group with the private family company as the core. The key business functions were moved to the public corporation, which was focused on high-quality logistics services, such as railway transport, terminal services, forwarding and special and heavy transports. The family business group’s associated companies engaged in specialty areas such as logistics, vehicle logistics and maritime transport. The family business group also works as an independent private equity investor, focusing on the growing need for financing in small and medium-sized enterprises.

4 Findings

The first case describes situations from the start-up (founder) to the situation in the third generation. In the long run, this family has kept its business going via individual businesses and shared businesses. The reason for this comes mainly from family relations and shared ownership between several family owners. The second case describes a situation where the fifth generation is re-organising the portfolio structure based on a situation where the business portfolio was too difficult to handle. Some units were demanding investments and others were attached to the family. The difference between the cases is the lack of conflicts in the second case; the ownership is concentrated mainly in the hands of one main owner.

Both cases show the fast development of several businesses (see Figure 4). New businesses were established, joint ventures and acquisitions complemented structures and the distinct businesses in both cases were evolving. All these actions affect innovation within the portfolio, creating a systemic entity. The dynamic aspects of different drivers shaped the portfolio structure. We can identify three different drivers which are significantly affecting the system – the individual, social and business – thus changing the portfolio structure. Both cases can be thought of as following a broadly similar pattern in the system. In the first case, the business has been changed a number of times because of reasons originating from social factors from the owners’ side rather than the business itself. Also from this point of view, at least four times the business ownership of the core business has been changed due to poor family relationships. The second case illustrates better how the individual drivers are affecting to the reason for establishing individual companies. In some point the reasons were economical, but mostly the reasons based on the personal interest for a certain industry. In addition, an endogenous driver affected the individuals and thus the family members have been able to carry out their personal ventures. Changes in family relationships, individual interests, rising conflicts and internal competition might reshape the portfolios and trick new innovations. ‘The weight of history’ and the fear of losing the family’s shared wealth and gained property might also limit the activities and new investments. The conflicts might sometimes also support innovativeness and force to renew (Sharma, 2004).

Business drivers have affected the portfolio structure the most. In the first case, there were changes in the businesses for several reasons; the entrepreneurs saw new opportunities in the field, the environment changed (e.g., tax regulations compelled them
to divide the business into two different companies) or the owners were motivated by value creation to buy other companies and rationalise their business focus by selling branches that were unprofitable or not closely linked to the core business. The portfolio restructuring in the second case could be seen as a way for the owner to respond to the need to control the challenges in the business environment – the public company would thus be more visible and responsive to the public eye while the private company would secure the continuation of the family values. The restructuring also created new possibilities for collecting resources to the portfolio: the listing of the public company introduced the business to a wide range of new owners and thus new capital. The case further shows how the distinct businesses have grown in their roles in the portfolio: the portfolio has contained companies that have not grown, but also some important companies, industry leaders where growth has been rapid. These companies have developed growth by buying smaller rival firms or by establishing new ones that are later merged. Both cases maximised different opportunities to use power over crucial external forces; likewise both cases maximised the value of the firm’s resource portfolio.

Figure 4 Illustration of the emergent systemic driver in the research cases

From the perspective of systemic innovation, the Nurminen case provides interesting insights. First of all, the case shows clearly how the innovation process unfolds simultaneously at different levels. The identified changes in the case include, e.g., start-ups, portfolio restructuring, ownership changes and new perspectives on synergy. The changes are constantly seeking for compatibility within the system where the distinct businesses are evolving, the business portfolio is changing and the important stakeholders are directing their expectations on the businesses. When monitoring the long-term effects of systemic drivers, it was noticed that the role of the systemic drives grows out of the complexity of the business portfolio and its context. That is, while the complexity of the portfolio increases, it leads to growing needs in internal system development.
Time is the decisive element in the concept of portfolio business. A longitudinal approach is required to capture changes and development in the portfolio. The nature of systemic innovation in these cases evolved when the portfolio business system was developed on a certain level. With a longitudinal approach we were able to identify the systemic driver. Interaction between system components can emerge in an unplanned and unintentional manner through drivers and not always as a result of designed actions. This challenges the adaption of the system, but also creates new possibilities and triggers new innovations as solutions. Tensions and conflicts are part of the creative renewal of system and its components. The system and its components are continuously searching for the optimum to find answers to the needs of individual, family and business interests in a manageable manner.

5 Discussion

In a business portfolio, the questions of complementarities of different businesses or complementarities of the different trajectories of development within the systems become interesting. Even if the business system is constantly evolving along with the changes in the environment, the compatibility with the environment or between the different subsystems within the business portfolio is not evident. On the contrary, drivers guiding the systemic innovation within a business portfolio are shaping the pace, direction and the methods of portfolio development. Therefore the changes in different drivers are causing portfolio structure adaption and also creating new alternatives for answering to those temporal needs rising from interests and resources available through social relations and firm ownerships. As such the portfolio level analysis with drivers and their development over time are interesting from entrepreneurial aspects as pointed out by Zellweger et al. (2011), but also from innovation approach closely linked to entrepreneurial behaviour.

Risk-taking capability is often seen as one of the important aspects of successful innovation activities among resources and knowledge. Business portfolios can support this in various ways, but also hinder willingness to renew. As mentioned in earlier studies, social ties, e.g., family ties, can also cause inertia in renewal and innovation activities, such as traditions and avoidance of conflicts (Hausman, 2005; Grundström et al., 2012). Portfolio thinking can support innovation due to shared assets and their risk management – compared to a one-company structure. Portfolios are also changed and treated as strategy tools to reach new goals, based on ideas turning into commercialised business innovations needing released and reallocated resources in order for them to take place and portfolios are rematched with new targets. This creates a systemic entity of complementary innovations enabling each other as well as a platform for future profitable ideas (Chesbrough and Teece, 1996; Maula et al., 2006).

It seems that innovation and the business portfolio are related phenomena. Generally, there is no clear beginning or end in linear innovation (Berkhout et al., 2010; Trott and Hartmann, 2009) or separate business portfolio formation. Instead, there is a systemic interplay of different elements. The ideas to be transformed into profitable business and the business portfolio to enable these multidisciplinary activities as regime transformation are complementary systemic innovations.

The analysis suggests that the system itself causes needs for the internal development (see Figure 5). The internal complexity, heterogeneity, dynamism, differing time frames of the distinct businesses and the varying expectations toward different businesses may
lead to the emergence of a systemic driver. That is, once the business system grows large enough, it will create a constant need to develop it further. At the same time, there is a tendency for the business to shift towards multifaceted development of diversified portfolios with individually and socially driven innovation. On the other hand, in some parts of the portfolio the innovation activities may be more related to large organisations’ dynamic capabilities related to innovation and the family’s board activities. Also Liang et al. (2012) pointed out the possible differences in operational management and board directors’ impacts on innovation activities. Moreover, with successful business, some of the innovation activities can take steps towards financing new innovations, e.g., external start-ups. Then the future question is whether this funded business will end up being part of the business portfolio.

**Figure 5** Illustrating the drivers and complex organisational boundaries related to innovation activities (see online version for colours)

This analysis extends our learning about innovation activities in a systemic context. In this study, we uncovered systemic aspects of complementary innovations in a portfolio structure. The transformation processes of business portfolios play an important role in innovation activities and are actually part of systemic innovations themselves (Chesbrough and Teece, 1996; Maula et al., 2006).

### 6 Conclusions and implications

This study analysed how innovations and business portfolios interact and how their systemic interplay proceeds in a dynamic manner. The results of this paper suggest that
the identification of the innovation process in a business portfolio system requires a broader research view than previous research has offered so far. This study contributes to innovation and portfolio business literature by creating a theoretical linkage between the two fields of study and by showing how portfolio business systems can function as contexts for systemic innovation. By analysing the case and the literature of systemic innovation and portfolio business, we came to the following conclusions.

First, innovation and the business portfolio have a systemic connection. Second, this system is in constant change based on development needs in businesses and in relation to business issues, individual issues and social system issues. Third, the system itself causes needs for internal development, which leads to a need to consider the interaction from the system perspective. We also noticed that some of the prior contradictory results of innovation research might be due to ignoring portfolio aspects and the systemic entity. Studies focusing on enterprise innovativeness or development activities from idea to product or service inside firm boundaries can sometimes deliver only a partial picture of the results of innovation activities.

The practical dimension of this paper emphasises that while conducting innovation research, researchers has to be aware of invisible interlinking elements and continuous dynamic change. Organisational boundaries are complex arrays of efficiency, power, competence and identity, taking different forms to support the aims as social constructions, e.g., delivering the innovation based on different drivers. Systemic innovations can be interconnected sets of organisational, architectural, process and product innovations and so on, supporting each other and guided by the managerial actions in the organisation. Incremental, radical and even disruptive innovations are created to achieve the goals and to solve unexpected managerial problems in practice. More managerial challenges appear when the complexity and systemic interdependencies increase. Due to the evolving entity, also hidden interconnections challenge the management, while changes in different drivers cannot always be predicted and changing one part has an impact on others.

Our study is not without its limitations. Rather than generalising the results of the case studies, this research aimed to focus on multifaceted issues of interlinked activities while developing innovations and transforming supportive structures to enable new business. The analysis was conducted in a family business context, but also to build ground for future research examining, for instance, portfolios as learning innovation networks as well as their role in innovation ecosystems. This innovation approach could include aspects from dynamic capabilities in the family business portfolio context. Future research could also focus on the temporal fit of different drivers presented in this study, innovation processes during dynamic weight shifts of the drivers and open innovation (such as IPR issues) in a dynamic portfolio context.

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DEVELOPING COLLABORATION STRUCTURES FOR
UNIVERSITY–INDUSTRY INTERACTION AND INNOVATIONS

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ABSTRACT

Purpose – This paper examines the doing, using, and interacting (DUI) of Universities of Applied Sciences (UAS) while developing intra- and inter-collaboration with industry. It also reviews recent literature related to the roles of absorptive capacity (AC) and social capital (SC) in interaction.

Design/methodology/approach – A qualitative case research on developing collaborations between UAS and small and medium-sized enterprises (SMEs) for innovation activities.

Findings – Prior knowledge and contacts vary in organisations, and interaction should be supported while aiming to maximize benefits of internal and external resources available for innovation. This paper contributes by pointing out the importance of the interconnection of DUI, AC, and SC while developing collaboration.

Originality/value – This paper describes issues challenging the collaborative innovation activities and directions to focus on structural development to support interaction with parties having different backgrounds, goals, and strengths. The study highlights the importance of knowledge exchange with several universities and firms, and the different learning modes related to innovation.

Keywords: Innovation, DUI, Absorptive capacity, Social capital, University-industry
1. INTRODUCTION

This paper examines learning through doing, using, and interacting (DUI) in Universities of Applied Sciences (UAS) for developing structures for small and medium-sized enterprise (SME) collaboration. It also reviews recent literature related to the roles of absorptive capacity (AC) and social capital (SC) in DUI. The paper focuses on the interconnection of DUI, AC and SC in development of innovation activities. Findings of the study can be used to enhance UAS as organisations transferring knowledge and technology among SMEs – assuring a close link between education and innovation. By better understanding the roles of AC and SC in unidirectional knowledge exchange the University City-Region actors can further develop their interaction.

Universities (science and applied sciences) are seen as important parts of knowledge exchange activities for innovation, and they have their own interests in networking with firms (Perkmann et al., 2011; Perkmann & Walsh, 2007; Peças & Henriques, 2006). Firms are forced to participate in new alliances and use open-innovation tools to gain knowledge due to the increasing complexity and pace of technological change – this to respond to the business dynamics and to compete (Rothwell, 1994; Chesbrough, 2003).

Jensen et al. (2007) presented two different modes of learning in innovation activities: the science, technology, and innovation (STI) mode based on the production and use of codified scientific and technical knowledge, and an experienced-based mode of learning based on DUI. Firms combining these modes are more likely to create new products or services than those relying primarily on one mode (Jensen et al., 2007). To enable DUI and STI learning, SC and AC play important roles in the interactions of networked organisations and individuals (Kallio, 2012; Kallio et al., 2010). This is the case especially in the innovation context, where front-end activities often lean on prior informal networks of actors and knowledge gained in earlier activities (Lehenkari, 2006; Cohen & Levinthal, 1990). SC and the theory of AC, describing the ability to recognize, acquire, assimilate, transform, and exploit external knowledge, are linked to DUI and STI modes (Jensen et al., 2007) in the UAS–SME innovation context. The aim of this paper is to examine the DUI learning in UAS when they develop structures for SME collaboration. The research question is: how are DUI, AC, and SC interconnected within UAS–SME innovation collaboration and structure development?

The paper is structured as follows. First, the combination of the theories of DUI, SC, and AC are presented concerning University–SME innovation activities. The empirical part of the paper presents the data and its analysis in the context of UAS–SME collaboration structures. The characteristics of UAS and SMEs as well as those of innovation collaboration are discussed. The implications and future research avenues are also presented.
2. LITERATURE REVIEW

2.1 INTERACTION, KNOWLEDGE, AND INNOVATION

The present discussion emphasizes the non-linear nature of the innovation processes, and the importance of interactive learning in organisations. Whereas the linear model focuses on explicit knowledge, the interactive model stresses systemic relations between actors and processes. It is the emphasis on a variety of knowledge types and the links between them, which is regarded as the most valuable resource in the interactive model, and interactive learning is regarded as the most important process (Lundvall, 1992; Johannessen, 2009).

The interactive innovation model highlights the connection between organisational, technological, and environmental factors. The model presupposes that innovation processes vary from organisation to organisation and that the interlinking patterns of these interactive processes are important. In the interactive model, R&D activities are not seen as the primary process generating innovations, but rather as part of systemic relations among various elements: markets, finance, internal and external knowledge, management, company culture, networked activities, and the regional and national innovation system. (Johanessen, 2009; Kautonen, 2012)

Major and Cordey-Hayes (2000) state that effective innovation requires the transfer of knowledge. To combine the information gained through social interaction, the different parties must have some overlap in knowledge or someone must support the transform of knowledge so that it becomes relevant to the others (Dyer & Singh, 1998; Parjanen et al., 2010). Brokers can transfer disconnected pools of information to new contexts and establish necessary ties between actors (Burt 2004; Parjanen et al., 2010; Tura & Harmaakorpi, 2005). They can also bridge and bond the SC needed in these actions (Ibid.). The capability of an actor to benefit the structural holes in social networks is closely linked to SC and overlapping knowledge related to AC. An open communicative environment and a free flow of information are seen to promote innovation processes in and between organisations. The link between theory and practice will be established more easily to support the organisation as a whole, and interaction between several types of expertise have space to transform into innovations (Johanessen, 2009; Fjelstad et al., 2012).

Today complex networks of firms, universities, and government offices are critical features of many industries, especially in technological and environmental industries. Various forms of inter-organisational partnerships and virtual networks are core competencies in the R&D of new technology and business. Networks of sources of knowledge are widely distributed and orchestrated by various actors. Universities and UAS are seen increasingly as important sources of knowledge, innovation, and economic growth, because firms increasingly source innovation by forming alliances with universities and UAS (Powell & Grodal, 2005; Kautonen, 2012; Huston & Sakkab, 2006; Chesbrough, 2003; Isaksen & Karlsen, 2012).

Motivations for firms to engage in alliances with universities and UAS vary. While often SMEs are aiming to solve problem that have occurred in R&D projects, the interests of large corporations are also towards sourcing new ideas and concepts for the future. Although firms’ perceptions of benefits in these alliances are different, and vary
according to size and other issues, there exist some main reasons for collaboration with universities and UAS. Firms, for example, seek to leverage their R&D funding (Grimaldi & von Tunzelman, 2002) or want to access novel scientific knowledge or improve their problem-solving capability. In addition, collaboration with universities and UAS provides opportunities for companies to seek potential recruits (e.g. Perkmann et al., 2011). Firms have also started to collaborate with universities in many informal alliances, or in development projects, where the aim is not so clear in the beginning of the project. In these alliances, reasons for firms to participate may be, for example, to gain more SC and to strengthen their AC.

External and novel knowledge can be gained from the universities and UAS in different parts of the world. However, sourcing of knowledge is easier to organise with partners found in the same region than with distant partners (Isaksen & Karlsen, 2010). It is acknowledged that geographical distance has an influence on the sources of knowledge available to firms (Bishop et al., 2011; Isaksen & Karlsen, 2010). Therefore, some firms benefit from being located within a close geographical distance to universities or UAS.

For universities and UAS, reasons to collaborate are based mainly in their given roles and educational tasks. Universities and UAS are challenged to engage more in their regions to underpin collaboratively firm’s innovation and development activities to ensure that the knowledge they produce is useful to regional industry. We assume that drivers behind collaboration are often financial and lacking the bi-directional benefits of knowledge co-creation and structures needed. However, this area has not been well studied, previously, and, therefore it is one research gap we are seeking more understanding of in this paper.

### 2.2 DUI AND STI MODES IN INNOVATION ACTIVITIES

Although the learning processes vary based on the organisation and collaboration structures in innovation activities, there is large amount of research literature on the topic (e.g., Alegre & Chiva, 2008; Jensen et al., 2007; Lampela, 2012; Lane & Lubatkin, 1998). We focus on two ideal model descriptions, DUI and STI, to give the frame for analysis of innovation activities in the UAS–SME context. Jensen et al. (2007) contrast two different modes of learning in innovation, based on different types of knowledge production. Technology and innovation (STI) mode is based on the production and use of codified scientific and technical knowledge. The DUI mode relies on informal processes of learning and experience-based know-how. The formal and informal knowledge elements and processes are discussed in context of ‘know-what, know-why, know-how, know-who’ previously presented by Lundvall and Johnson (1994). The DUI mode of learning refers to know-how and know-who, which are often tacit. Although such learning may occur as an unintended by-product of the firm’s design, production, and marketing activities, Jensen et al emphasize that the DUI mode can be intentionally fostered by building structures and relationships which enhance and utilise learning by doing, using, and interacting (Jensen et al., 2007). Jensen et al. (2007) conclude that firms combining the two modes are more likely to create new products or services than those relying primarily on one mode or the other. They also find that their research results are beneficial to innovations systems and policies (Jensen et al., 2007).

Harmaakorpi and Melkas continue the DUI/STI discussion to support innovation research and analysis from a knowledge perspective in practical contexts, such as DUI-
related intellectual cross-fertilization, e.g., creative sessions where scientific and practical experience are combined for innovation, and issues that often become more visible slowly, such as the heterogeneous development of organisations to support innovation. They also present and describe innovation policy types and modes (in Table 22.1, p. 447). STI are linked to universities, and DUI is linked to UAS, but not excluding each other. Harmaakorpi and Melkas also point out the role of information quality in these activities (Harmaakorpi & Melkas, 2012).

2.3 ABSORPTIVE CAPACITY AND SOCIAL CAPITAL IN INNOVATION ACTIVITIES

Instead of linear technology related processes, innovations are seen to emerge as nonlinear processes embedded in social and economic activities. Innovation as a process of interactive learning between organisations and their environment highlights the role of AC and SC (Lundvall, 1992; Johannessen, 2009; Cohen & Levinthal, 1990; Tura & Harmaakorpi 2005; Godkin, 2010).

AC is originally defined by Cohen and Levinthal (1990) as an organisation’s ability to value, assimilate, and apply new knowledge. Zahra and George (2002) developed the concept further by distinguishing between two different types of AC: potential absorptive capacity that is important in acquiring and assimilating external knowledge, and realised absorptive capacity, which refers to the functions of transformation and exploitation of the knowledge. They also suggested that there is a need for special social interaction mechanism between assimilation and transformation processes. Dyer and Singh (1998) see partner-specific AC as a function of ‘1) the extent to which partners have developed overlapping knowledge bases and (2) the extent to which partners have developed interaction routines that maximize the frequency and intensity of sociotechnical interactions’. The AC reification construct presented in Lane et al. (2006, p. 856, Figure 4) is slightly more mechanistic in nature, but they also point out the roles of external and internal drivers related AC. Lichtenhaler (2009) highlights AC-context issues related to exploratory, transformative, and exploitative learning in using external knowledge. Organisations should keep assimilated knowledge alive by maintaining and reactivating it. Sometimes assimilated knowledge has to be maintained for years until it can finally be utilised and applied in new products. The transformative learning has an essential role in this. Exploratory, transformative, and exploitative learning have complementary positive effects on profiting from external knowledge (Lichtenhaler, 2009). Although AC involves individuals, groups, and organisational levels linked to knowledge flows, several mechanisms can influence it, such as internal networks, cross-functional interfaces, and interactive learning (see also Volberda et al., 2010, p. 934, Table 1.) Organisation AC can been seen as being dependant on the links across a mosaic of individual capabilities (Cohen & Levinthal, 1990), formal and informal networks related and influenced strongly by cognitive processes of the managerial levels (Volberda et al., 2010). Cohen and Levinthal (1990, p. 131) see interaction between individuals as relevant antecedents: ‘An organization’s absorptive capacity will depend on the absorptive capacities of its individual members. To this extent, the development of an organization’s absorptive capacity will build on the prior investment in the development of its constituent, individual absorptive capacities.’ Because of the natural changes of actors and inbuilt AC (personal learning and education), AC and SC are assumed to play important roles in this interaction dynamics related to DUI and STI innovation activities.
Characterizing innovation as social, nonlinear, and as an interactive learning process raises the question of the role of sociocultural structures in innovation processes (Tura & Harmaakorpi, 2005). For studying nonlinear innovation processes SC offers a conceptual framework and tool to theoretically handle the importance of networks and strategic alliances in the modern business environment (Tura & Harmaakorpi, 2005; Perez-Luno et al., 2011). According to Tura and Harmaakorpi (2005), SC refers to the possession of social relationships and membership in collectives, and to the resources that derive from these relationships and memberships. Nahapiet and Ghosal (1998, p. 243) see SC as ‘the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships’. Social capital is also seen to inhere in the structure of relationships of human capital and economic capital (Portes, 1998). It is generally agreed that social capital plays an important role while developing organisational and regional innovation capability. The term capability refers to the ability of the innovation networks to exploit and renew existing resource configurations in order to create a sustainable competitive advantage in a dynamic innovation environment. It is seen that through SC, an actor can mobilize other actors and their resources embedded in social structures. SC also supports networks to share information efficiently, by reducing transaction costs and allowing the adaptability of system. It facilitates creative interaction and collective learning processes by encouraging and supporting cooperative behaviour. Building SC is strongly connected to actions. Moreover, the impact of the social, structural, and cultural environment is widely accepted in innovation activities (Tura & Harmaakorpi, 2005; Smedlund, 2008).

SC has been classified in various ways and into subcategories (Alguezaui & Filieri, 2010; Landry et al., 2002; Perez-Luno et al., 2011) to better understand its nature, but we follow three main dimensions presented by Tura and Harmaakorpi (2005): (1) the structural dimension; the impersonal configuration of linkages between actors, such as ‘how to reach who’; (2) the relational dimension, the personal relationships between the members of the network, e.g., reputation, respect, and friendship; and (3) the cognitive dimension, referring to the social assets, such as systems of meanings and shared representations, values, and interpretations. All of them are facilitating the actions of individuals within the social innovation structure. Usually, these things are linked to positive aspects in innovation activities, but it is important to remember also the possible negative impacts. Owing to the previously presented issues, SC can also been seen as limiting some actions and possibilities in networks in all three dimension, e.g., bad reputation, missing link, etc. SC can also support some sorts of closure in community, and it restricts its sensitivity to new information and alternative ways of doing things (Nahapiet & Ghosal, 1998; Tura & Harmaakorpi, 2005; Pihkala et al., 2007; Alguezaui & Filieri, 2010).

SC is about the causal action capabilities of the (individual or collective) actors, where trust also has a certain role. It is also important to notice that there are situations where an actor’s SC is ‘worthless’. This context-dependence is known as the ‘field-specificity of social capital’. Tura and Harmaakorpi present a well-fitting example:

A simple example of this is a distinguished scholar who has high social capital within the scientific community. This status does not, however, automatically give his/her social capital outside that community, in fields such as the business environment where both the respected actors and the rules of the field differ significantly from those of the university. (2005, p. 1117)
2.4 SUMMARY OF LITERATURE REVIEW

Organisations create new knowledge and build enabling AC and SC in their context and drivers based on their purposes. Educational and business organisations have their own goals, but those goals are interlinked with each other’s. Knowledge exploration and exploitation networks in innovation activities are also different in nature (Smedlund, 2008; Walter et al., 2007; March, 1991). SC and AC are developed based on internal activities and interaction with external parties. DUI and AC play important parts in this internal and external learning related to innovation, and as mentioned in Lane et al. (2006; based on Cohen & Levinthal, 1990), AC also allows traditional firms to learn to do something more and quite different, than ‘learning by doing’, which allows organisations to get better at what they already do. According to the literature, SMEs are often challenged in STI activities because of their limited resources and capabilities and, therefore, they search for support to R&D from universities. However, literature also occasionally points out that the high-technology based SMEs often spin off from universities, requiring DUI, SC, and AC for developing innovation and for its commercialization.

In our study, we have used the broader interpretation of AC, SC, and DUI in the R&D context found in the literature, and not limited to firms’ formal codified R&D activities (AC applicable to the education organisations participating in networked innovation activities). We are also aware of the complex conceptualization of partly overlapping terms and issues, but see it as fruitful starting point for this study focusing in practical development of interaction structures for innovation.

![Figure 1. Illustrating synthesis of AC, SC, and DUI interconnection.](image-url)
3. CASE DESCRIPTION

The research is based on a project in the southern part of Finland financed by the European Union’s (EU) European Regional Development Fund. The project was focused on developing collaborative processes and structures in Universities of Applied Sciences for supporting the innovation activities and internalization of Finnish metal industry firms. The project was conducted from 1 November 2009 to 30 April 2013, and participants included six UAS, one University of Technology, and 40 SMEs in Southern Finland.

The aim of the project was to create tools and operations models for SME–university collaboration for innovation activities and internalization. Research focuses on developing enabling structures, models, and methods supporting cooperation and interaction in these actions and relationships.

3.1 UNIVERSITIES OF APPLIED SCIENCES, AND THEIR ROLE IN FINLAND

The higher education system of Finland consists of two different levels: Universities of Sciences and Universities of Applied Sciences\(^1\). The mission of the universities is to conduct scientific research and provide higher education based on the research. UAS educate professionals for the labour market and perform applied R&D, which supports education and promotes regional development (OKM, 2012). Anyhow, compared to the rather old University tradition, UAS became part of the Finnish education system as late as in the 1990s, and only in 2003, research and innovation activities were formally added to their tasks that earlier included only education (Vestala et al., 2010). According to a Finnish evaluation, UAS seem to have had a remarkable role in developing innovation systems (Harmaakorpi et al., 2010; Vestala et al., 2010). Due to the large amount and extended role of UAS, regions are still in the process of developing collaboration structures, and the roles of various actors are evolving. A committee of Ministry of Education (Vestala et al., 2010) noted that in the structure development of the higher education institutions, measures should be taken to consolidate cooperation between UAS, universities, research institutes and other parties so that these form a regionally operating entity. Further research on this field is also vital. As presented above, in education, the tasks of UAS have been described as applied research and R&D services related to that, whereas Universities of Sciences have been directed at basic research and production of scientific knowledge.

3.2 SME IN THE INTERNATIONAL BUSINESS ENVIRONMENT

Multinational enterprises are often thought to dominate businesses, but more than 99% of all European businesses are SMEs. ‘They provide two out of three of the private sector jobs and contribute to more than half of the total value-added created by businesses in the EU. Moreover, SMEs are the true back-bone of the European economy, being primarily responsible for wealth and economic growth, next to their key role in


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innovation and R&D’ (EU)² SMEs are a crucial part of the business networks, e.g., large firm’s value adding R&D, production, and service networks. They are often seen as a main source of innovations, and this is often linked to entrepreneurial attitude among the skills and expertise of their personnel. However, often SMEs lack the resources and time to look beyond their immediate short-term needs (Major & Gordey-Hayes, 2000; Mäkimattila et al., 2012).

Firms engaged in this project were SMEs with various sizes and backgrounds, and located around Southern Finland. They presented multiple aspects of the networked metal industry. Some firms could be classified as traditional suppliers for larger firms, and some were Science University spin offs presenting high-tech services for industry; therefore, the size, age, and experience in international business were very different, which affects the innovation principles and processes as well as partner networks in these activities.

4. RESEARCH METHODOLOGY AND DATA

An action-oriented R&D project provides the context of this study. The methodology is a combination of action-oriented research and case-study research methods. According to Coughlan and Coghlan (2002), action research uses a scientific approach to study important social or organisational issues together with those who experience these issues directly. Action research always has two goals: making the action happen and reflecting on what happens, in order to contribute to the theory. Action researchers are not just observing change; they are actively working to make it happen (Coughlan & Coghlan 2002).

Case-study research method is usually used to contribute to our knowledge of individual, group, organisational, social, economic, and political phenomena. In Voss et al. (2002, p. 197), the strengths of case research are summarized based on Meredith (1998) and Benbasat et al (1987): ‘The phenomenon can be studied in its natural setting and meaningful, relevant theory generated from the understanding gained through observing actual practice. The case method allows the questions of why, what and how, to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon.’ The case-study method has been often misunderstood and criticized, but now it is better accepted as a tool for capturing important findings in complex systems. According to Yin (2009), the rigor of the case study has been one of the greatest concerns among biased views influencing the direction of the findings and conclusions. Case studies typically combine data collection methods, such as archives, interviews, questionnaires, and observations. Using quantitative and qualitative research methods in combination produce the best results in research (Yin, 2009; Eisenhardt, 1989; Voss et al., 2002; Flyvbjerg, 2006).

In order to enhance understanding about the UAS collaboration, an initial questionnaire was developed in 2009; 11 workshops were observed during 2010–2013; 12 semi-structured interviews were conducted during spring 2011; a closing survey was conducted in spring 2012, and finally a concluding workshop was held in 2013. Data were gathered in a collaborative manner, and several researchers participated in these


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activities from different regions. Surveys and interview questions were planned based on innovation theories in the literature. Research was operationalised so that the terms AC and SC were not used directly. Innovation, AC, and SC literature theory language was converted to practical terms so that they would easily understand in e.g., questionnaires directed to firms and workshop collaboration.

Figure 2. Data collection and analysis: Action-oriented research during development activities.
Table 1. Summary of the data acquisition in this study

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Data Acquisition / Method</th>
<th>Participators / Organisations</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studying the current state of innovation activities in SMEs.</td>
<td>Survey, an electric questionnaire sent to SMEs</td>
<td>65 persons in all organisational levels in various SMEs in Southern Finland</td>
<td>The questionnaire identified the SMEs’ general focus in innovation activities with UAS</td>
</tr>
<tr>
<td>Studying the current state of innovation processes in SMEs and interaction related with UAS</td>
<td>Interviews, structured questions about innovation topics based on innovation literature</td>
<td>12 managers in different SMEs having some prior contact with UAS of various regions</td>
<td>Very different capability levels of SME–UAS network activities, indications of SC, and AC challenges</td>
</tr>
<tr>
<td>Further developing the output of the questionnaire and interviews</td>
<td>Diagnosis workshop; presentations and memos</td>
<td>6 researchers and 3 project managers from UAS and Science Universities</td>
<td>Development targets of networked innovation structures and related activities in UAS</td>
</tr>
<tr>
<td>Developing activities, while benchmarking others, and discussing ongoing development actions</td>
<td>10 workshops; presentations and memos</td>
<td>Total of 14 researchers from UAS and science universities</td>
<td>Development targets, ongoing actions, and focused research topics</td>
</tr>
<tr>
<td>Fulfilling development and research needs Understanding the cap between felt importance of topics and realised outcomes of UAS as seen from both UAS and SME aspects</td>
<td>Survey, based on innovation literature and prior studies Electric questionnaire with background questions and similar question sets for UAS and SME in two-dimensional squares: felt importance and realised outcome under 9 main topics related to innovation and internalization, with free text space given to feedback included about the topics and in general</td>
<td>110 persons answered, in all organisational levels, from SMEs (35) and UAS (75) Each of the 6 UAS was asked to send this survey at least to: 10 persons in a UAS 10 SMEs with which they are collaborating 10 SMEs that have not started / rejected UAS cooperation in some form earlier</td>
<td>Complementary information for research and future development</td>
</tr>
<tr>
<td>Clarifying the results and benefits of the process done and current activities going on to carry outcomes further in practice</td>
<td>Closing workshop, summary table, and memo</td>
<td>8 researchers from UAS and science universities</td>
<td>Research and development targets for the future, and implementation of developed solutions</td>
</tr>
</tbody>
</table>
Researcher triangulation was used to validate the interpretations made out of data gathered with various methods. Three researchers analysed data and workshop observations, and made interpretations. Then, the researchers discussed their findings and searched for mutual understanding and differences in interpretations. Outcomes were reflected and combined with those of other researchers participating UAS. The analysis results were compared to the literature presented in the theory section.

5. ANALYSIS AND FINDINGS

Based on workshops in different premises, we identified three different main combinations affecting the interaction structures between technology-oriented universities and industry: Areas having (1) only UAS; (2) UAS and regional units from science universities; and (3) UAS and the main campus of Science University. In the end of the observation period, one of the UAS and one science university were located in same premises, but they were not merged in an administrative manner. Moreover, it was noted that politically established regional technology centres had important impact on roles and structural constructions of actions. Interaction between the parties was formulated through those constructions, activities and the personal relationships of the actors.

Based on our second survey, the main reasons to start UAS–SME collaboration were (1) personal relationships; (2) contacts; and (3) projects (often related to funding). In the UAS workshop, it was said that often the relational SC forces to participate and possible funding are often seen as the driver. It was also noted that it really matters is who you know, when alliances are formed and participants are chosen. Free comments (SME) in the second survey highlighted the same issues, e.g., ‘We have not been working with UAS while we have no known contacts there, we would like to, but as a small actor, we do not have time to search possible routes and structures to collaboration . . .’ or ‘. . . we have only worked with science universities (Technology)’. It was seen that especially with limited resources, focus and partners are chosen with SC in different forms thus playing an important role, not only in SMEs but also in UAS. It was also mentioned that regional aspects and possible future projects are guiding convention formation (also the probability of future project funding), especially in UAS and universities. Limited resources as well as internalization aims were mentioned as the reasons why SMEs search for partners for R&D activities. In the second survey, the reasons why SMEs quit collaboration were identified as follows: (1) nothing or natural project ending; (2) schedules and bureaucracy; (3) business/economic cycle. Interviews and workshops had similar implications, pointing out that collaboration is natural when the benefits are probable and a time fit exists.
<table>
<thead>
<tr>
<th>FINDINGS</th>
<th>DUI</th>
<th>SC</th>
<th>AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey 1</td>
<td>SME DUI orientation with customers and suppliers – as main innovation source. UAS should better share projects with other research institutes (other UAS, universities, etc. – also the STI connection)</td>
<td>SMEs’ prior contacts build on student training periods and final thesis – in addition, research collaboration and prior personal contacts mentioned. Because of the SMEs’ internalization aims, contact networks are valued as important. Defined/allocated collaboration conventions and contact persons required.</td>
<td>Research partner should understand well the goals and context-related information. SMEs’ difficulties in understanding and valuing research outcomes (transformation among acquisition)</td>
</tr>
<tr>
<td>Interviews</td>
<td>SMEs have practical aims in interaction. Limited resources and time in both (SMEs and UAS). SMEs wish that universities would specialize with certain profiles in university networks.</td>
<td>How to reach who, clear contacts (bridging). Flexibility to avoid bureaucracy (bonding). Dynamic nature of SC. SC important to source future oriented information.</td>
<td>Regional roles of actors and cumulative AC related to role. Development conventions and common understanding through collaborative doing – building overlapping knowledge base. Future orientation and knowledge-transformation challenge.</td>
</tr>
<tr>
<td>Diagnosis workshop</td>
<td>Interaction structures vs. UAS service offering. Open-innovation dimension. Variety of SMEs, all individual and strongly related personnel.</td>
<td>Field-specificity of social capital – e.g., enterprises and universities, UAS, and science universities. Entirety of student, personnel, and organisation SC – internal SC among external dimensions.</td>
<td>AC is based on interest and prior knowledge, in UAS and SME. Dynamic nature of AC.</td>
</tr>
<tr>
<td>Workshops (development)</td>
<td>How to enable DUI, bi/multidirectional platforms needed. DUI in networks of universities and firms among other actors and knowledge sources. DUI in ‘formal’ and informal conventions and networks. Action needed to build SC and AC, both needed to start action -&gt; DUI</td>
<td>UAS challenged to reach SMEs, often based on prior personal contacts. The role of students, bridging SC, also international dimensions. University and firm labour personal contacts (work and free time as well as prior contacts in both).</td>
<td>Importance of education for long-term AC development in SMEs. Acquisition; how-to-reach information needed. How to know what is available – loop to SC. How-to-value knowledge with limited resources. AC in different fields in universities.</td>
</tr>
<tr>
<td>Survey 2</td>
<td>The role of UAS for SMEs – participants and roles, DUI and STI. Interconnection of DUI and STI.</td>
<td>Difficulties in finding the right contacts and activities rather with previously known parties especially in risky cases.</td>
<td>Very different level of prior AC in SMEs – context-related SMEs are unique in skills and learning orientation.</td>
</tr>
<tr>
<td>Closing workshop</td>
<td>Different needs, different platforms – DUI development can be done when SC and AC roles are identified.</td>
<td>SC: bridging and bonding – focus on entirety and all network resources.</td>
<td>AC: acquisition, assimilation, transformation, and exploitation – focused development activities.</td>
</tr>
</tbody>
</table>
UAS saw their capabilities and structures, as well as action challenges, rather similarly, based on our surveys and interviews. In the questionnaire directed to the UAS and the SMEs, both were asked similarly about the felt importance of interaction-related topics and realised outcomes. UAS and SMEs had similar interpretations of the importance of those issues, but UAS saw their impact slightly more positively. Only in regards to intellectual property and normative topics did SMEs indicate that the UAS performed better in support than the UAS saw themselves having performed.

Internal UAS development of structures was seen natural and important in enabling the interactions with external ‘business’ partners. UAS are often focusing on developing laboratory and offering related services (e.g., rapid prototyping), and communication and IT tools and updated courses for students to achieve the necessary levels of skills and complementary education for firm personnel. UAS have also further developed and applied collaborative DUI-supporting frameworks, such as LCCE (Learning and Competence Creating Ecosystem), LbD (Learning by Developing), and CDIO (Conceive-Design-Implement-Operate) for interaction with firms. AC and SC aspects were often embedded and not directly focused in structure development in the mentioned topics.

Common challenges were the temporal fit of combining educational and business schedules, and the slightly different drivers behind the collaboration in UAS–SME alliances. It was seen that SC and AC are built through actions. In addition, it was mentioned that this could sometimes happen in organisation slots and levels, where it is not directly benefitting innovation activities. A noticed issue was that mostly firms are purposely sourcing precise information or service where it is available, and they are not willing to allocate their limited resources for long-term relationships, ‘running idle’. UAS might sometimes aim to long-term collaboration mostly for political reasons and strategic decisions. In firms, communication channels are opened when needed, and closed after accomplishment of an objective. Sometimes there is a SME demand that is not visible outside, but activated because of suitable offer from the UAS. There was indication that the UAS would like to collaborate mainly in terms of course tasks, but available resources limited the possibilities of guiding individual student works in firms. Moreover, firms are waiting for real results out of the works because of the time used and other transaction costs. SC had an important role in all of the three dimensions.

Prior personal contacts were seen as a major issue for firms seeking collaboration and other universities for cooperation in networked projects. There was no major difference in how firms and UAS themselves saw the UAS as an innovation partner for SMEs. However, finding the ‘right persons’ with the ‘right knowledge’ was mentioned, in both directions, in early phases of collaboration activities. There is clear demand of projects such as this case to develop personal and organisational networks (SC) between UAS, science universities and firms. There has been much discussion on the field of UAS–SME networks, but practical UAS–UAS innovation network activities could be reinforced to utilise the different strengths of the UAS and to connect suitable science universities to UAS–SME networks thru UAS. EU and Finnish funds (such as the European Regional Development Fund, ERDF) can support the interaction needed, as in this project, to build AC and SC for DUI activities nationally and internationally.

In the analysis, we recognized that there is cooperation between UAS in several fields, but often, the SC is built on different levels than directly benefitting practical innovation collaboration with other universities and SMEs. In large organisations, internal SC also
plays an important role in networked innovation activities with external parties. We have indications that SC is more important if the other party’s AC is limited. Brokering and SC are then needed to link actors over structural holes, but also to cover AC problems.

An internalization-related finding was that while building DUI, it is important to notice that in different countries organizations might have slightly different roles. It was said in the workshop: ‘To start to do anything in China, you have to go there and be active. Prior contacts are important, as well as the combination of the university, firm, and political actors participating – like sister cities used in the Mayer model’. Universities, UAS, public intermediate organisations, cities, and firms might have different positions in activities – this might also influence the AC and SC that are supposed to be present in parties’ activities. In addition, the personal connections and SC-related issues might have different value in different countries. In China and Russia, SC-related issues seem to be important for successful innovation activities to take place.

**6. DISCUSSION**

In this paper, our goal was to integrate learning approaches and innovation by testing established theoretical concepts of DUI/STI (Jensen et al., 2007), AC (Cohen & Levinthal, 1990), and SC, with empirical findings in a UAS context. Issues found are linked to a very practical approach of SMEs, aiming to do straightforward business with universities having simultaneously diverse goals.

Although innovation now has an increasingly systemic nature, the complex combination of technological and market knowledge challenges innovation networks (Johannessen, 2009). This highlights that AC, SC, and interaction are used to combine firms’ knowledge with available information. We see that this information transformation occurs when SMEs, UAS, and science universities together process available information. In these activities, some overlapping knowledge base is necessary. Speeding up information transition processes is not enough; intervention to add and combine complementary information is crucial, as is the linking of these processes in different organisations. In knowledge transfer, integration, and collaborative knowledge creation, formal and informal governance are also important (Hong & Olander, 2010). Personal relationships and trust among formal contracts have significant roles, especially if the university and industry in alliance are in the same field of research and have deep prior core knowledge (Hong & Olander, 2010). The fear of later rising competition, instead of successful collaboration or cooperation might limit the DUI and STI activities, and this has been mentioned earlier in other studies (Lehenkari, 2006). SC is a key issue while information is being shared in the early phases of innovation.

It is widely agreed that social interactions enhance the innovation performance, and the optimal structures of social networks that support innovation have also been widely studied and the outcomes have been presented (Alguezaui & Filieri, 2010; Smedlund, 2008). In structures there seems to be development possibilities for UAS to use each other’s networks and to specialize in certain areas of services for firms. Often UAS are seen to serve local firms regionally, but seldom as working as collaborative channels for regional SMEs to combining resources from other UAS and science universities. Moreover, the brokering in such activities (Burt, 2004; Parjanen et al., 2010, 2011) as well as long-term development to support information transformation to knowledge collaboration with firms could be enforced. SMEs are easily trapped in exploitation
(Mäkimattila et al., 2012) and those existing contacts, to explore information from the same sources. Shared information transformation platforms and new contacts could support innovation activities and renewal of firms and UAS.

AC of the organisations enables technology-transfer between universities and the firms, and allows intermediaries to work for that purpose. Both the intermediary function and the AC are important to facilitate the transfer of tacit knowledge for innovations (Kodama, 2008). Long-term R&D collaboration and personal education builds AC in both organisations. We also would like to highlight the collaborative knowledge creation including the AC and SC combination in this – although interactive innovation is largely based on DUI (Jensen et al., 2007), but not forgetting the important role of the STI mode and the interplay of both of these modes as competitive edge.

As pointed out by Gray (2006), policy makers should reappraise the role of technical and vocational education to support the development of AC in SMEs. AC needs both general and very specific knowledge on the field, and cannot be built only on ‘basic general codified knowledge’ to enable DUI innovation. Certain prior-knowledge bases support firm–university interaction, and geographical proximity facilitates the exchange of tacit and context-specific knowledge; Bishop et al. (2011) support this finding. However, UAS could also focus on internal AC to enable knowledge acquisition and transformation from science universities and firms, and from other UAS.

Firms and UAS should focus on the diversity of their contacts in the current complex world demanding external collaboration for innovation activities. SC, especially relational, makes tacit knowledge more valuable for radical innovations (Perez-Luno et al., 2011). Tight structural and relational SC in organisations might limit firms and UAS by narrowing the networks of innovation and creative solutions. As also discussed earlier, inter-firm linkages and university–industry linkages lead to different outcomes (Kodama, 2008).

SC is giving fast access to the right arenas for sharing information and participating in DUI. Especially, if the profiting potential is not directly visible, SC supports brokers in their actions. AC instead could be linked to important long-term development and learning, to overlap prior knowledge to create new combinations of meaningful information. This brings the combination of AC and SC into the core of innovation activities. We see the interactive DUI loop sourcing from rather linear STI processes, with crucial support of SC and AC. Often the DUI loop triggers new a STI path, having a systemic interplay with the innovation and the related actors. STI can be a rather linear analytic process requiring AC, but the early stage and end are strongly linked to DUI processes leaning on SC. However, SC and AC are also built thru DUI, requiring time and action.
UAS are often supposed to transfer science university STI knowledge to the organisations, and firms are seen as knowledge users (Figure 3, left side). In practice, there seems to be some challenges (Figure 3, right side). The knowledge producers and users should be seen as simultaneous actors in the collaborative work of interpreting the information based on their context (Figure 3, SC and AC). Currently, the practical mechanism needs development to interlink DUI and STI activities – Figure 3 illustrates university and firm actors and their DUI and STI drivers. Focus should be in structural, relational and cognitive dimensions in SC as well as in potential and realised AC with different types of information and networks (see also Smedlund, 2008). However, we would like to remind that networks are dynamic in nature – developing based on actions and related SC elements (individuals, network structure, norms, beliefs, and trust) and have different natures in different phases of innovation proceeding. Moreover, the size of the organisation affects the roles of structural, relational, and cognitive SC dimensions in intra- and interorganisational networks.

We agree with Tidd (Tidd, 2001, p. 173; Tidd & Bodley, 2002, p. 128): ‘Much research on the management of innovation attempts to identify some ‘best-practice’. . . However, there is unlikely to be ‘one best way’ to manage and organise product development as industries differ in terms of sources of innovation and the technological and market opportunity, and organisation-specific characteristics are likely to undermine the notion of universal formula for successful innovation.’ Besides the mentioned industry dynamics, we would also like to point out the differences in collaboration based on regional combination of existing science universities and UAS, and the combination of these with other intermediates such as technology centres and those related to dynamics. Based on our study, it seems that best practises and innovation processes are linked to deeper structures of regional entities. However, UAS could fill the important role of sharing best practises and innovation-related knowledge, building AC and SC to enable learning to utilise DUI and STI modes with firms.
We also see DUI, AC, and SC as having important roles in radical innovations in the future. Radical innovation requires deep knowledge of the respective technological domains, and it develops within a trusting context since it involves more risky investments. Developing radical innovation needs shared frames of reference with partners, and common repertoires of communication to solve various problems (Alguezaui & Filieri, 2010). Instead of linking DUI only to incremental innovations (Isaksen & Karlsen, 2010 and many others), we see the role as merging actors and STI processes in systemic contexts. When different knowledge bases of different firms (SMEs and large multinational corporations) and universities (Science and UAS) are combined with well-covering individual networks, the radical systemic innovations have the power to appear and reach markets.

The findings of the study advance the prior wide range of research related to AC, SC, DUI and STI, by making their roles and interconnections visible in the UAS context (Table 2). Organisations can develop their collaboration structures better when the different theories discussed above are paid attention to. The theories support practical work by focusing on AC and SC as innovation enablers, but also recognizing the inertial forces related, as well as by understanding the different aspects of DUI and STI. In their interaction, UAS, Universities and firms can develop their internal focus and contribute to active regions, where developed structures truly support collaboration and coopetition instead of pure competition. As such, strengths of different universities and firms, like knowledge and networks, can be utilized both regionally and globally. In the era of globalization actors in regions should harness each other’s networks and different knowledge production modes to compete with, access and produce value for other University City-regions having different strengths. Implications presented in this paper might also benefit current studies related to regional industrial changes and new business ecosystems rising in certain fields. This is a hot topic also in many other areas than the Finnish forest and telecom industry regions that are undergoing tremendous change that has impacts on the whole society.

### 7. Limitations and Future Research

This study focuses on extending the understanding of issues related UAS–SME innovation collaboration, linking it to the DUI theory. The aspect was to connect theory and practice by combining questionnaires, interviews, and workshop observations in Southern Finland, following the educational actors and structures involved in this area.

Future research should examine in more depth, the tools helping networked UAS together with science universities to integrate available information for innovation activities with SMEs. Further, research should include deeper analysis of the practical mechanisms linking UAS, science universities, and firms. The roles are rather clear in the normative approach, but during the research it became rather obvious that practical routes are not polished between different universities, knowledge transfer methods, and firms searching available information from different sources. Although recently shared strategy work for specialization of different Universities has begun, this opens the window for observing the change and implementation results, also from a smart-specialization perspective. Moreover, the different drivers behind DUI activities and the roles of different intra- and inter-organisational loops should be analysed in the practical context of knowledge co-creation.
8. CONCLUSIONS

In this paper, we examined learning approaches and innovation by testing the established theoretical concepts of DUI/STI (Jensen et al., 2007), AC (Cohen & Levinthal, 1990), and SC, with empirical findings in a UAS context. The paper makes a contribution by pointing out the interconnection of DUI, STI, AC and SC in innovation activities. The study highlights the importance of knowledge exchange with different types of universities and firms, and the different learning modes related to innovation. Prior knowledge and contacts vary in organisations, and interaction should be supported to utilize external resources of different organisational and individual backgrounds. The issues found are linked to a very practical approach of SMEs aiming to do straightforward business with universities having simultaneously diverse goals, and this brings also the AC and SC into the core of today’s networked innovation.

UAS are focusing to fulfil the politically given task of education and regional supportive actions to serve firms with other public organisations. The education actions and publicly financed projects are often measured on criteria other than those directly linked to innovation collaboration with other UAS, science universities, and SMEs. Activities might have been on a level where the where gained SC is not directly promoting actual innovation activities between different universities and firms. Hence, SC and AC are rooted in individuals. Moreover, innovation structures to support DUI and STI are linked to organisations’ capabilities to utilise both individual and organisational dimensions. Formal and informal interaction support building SC and AC, and all of them are needed in the current complex, interlinked innovation activities with other parties. Interaction is needed to build overlapping knowledge bases and for brokerage to bridge actors from different contexts. Current DUI loops are rather homogenous and local, including some STI connections, instead of utilising larger heterogeneous resources and idea pools for a longer-term perspective of combining both modes. This study pointed out that UAS should also focus on SC and AC while enhancing structures and networks with other actors. Easily, the regional focus is on the in individual UAS offerings, such as education and laboratory services for SMEs, instead of enabling the larger heterogeneous resource-pool usage needed in current global competition. In particular, the SMEs emphasised the idea that UAS and universities should focus on internal network development, and clarify the roles and focus they aim to offer to SMEs: This covers the international dimensions to access abroad. In addition, the diversity of SMEs, their needs and capabilities are significant – there is likely not one recipe or process that could fit for everyone’s needs. Therefore, the access to participatory activities is strongly related to prior SC and AC, as well as to the future collaboration in parallel development of these achieved during interaction. During this study, both the UAS and SMEs highlighted the importance of concrete doing and interacting in target-oriented collaboration projects.
REFERENCES


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Redesign of Home Care Service Delivery – A Systemic Approach to IT Innovations

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“Redesign of Home Care Service Delivery –
A Systemic Approach to IT-Innovations”

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Abstract

Objectives: This paper delivers how systemic innovations co-evolve with organizations in the context of home care. It describes the dynamics in shared innovation activities while developing information technology (IT) systems for home care service delivery. It also presents a timely relevant practical case concerning how applying IT can support service delivery planning, task-related information sharing and reporting.

Methods: An in-depth single case study takes the systemic approach to innovations. Interaction and interpretation of a development project are observed longitudinally. Innovation literature is presented from the system perspective to emphasize other than pure technology focuses for successful projects in complex environments. The theory is carried on to the empirical part containing a single case study and analysis in the home care context in Finland. The data were collected in 2010–2014 within a large innovation project in a mid-sized city. The phenomenon and complexity of developing innovative IT solutions in the systemic context is discussed.

Results: Systemic innovations are results of collaborative actions. The complexity requires knowledge and skills from different fields – which no-one alone has. Secondly, it demands shared activities to make the change from the current dominant system take place. The multi-level dynamics challenges the management alternatives that focus either on larger development platforms for transitions, or product-based diffusion – then facing later obstacles related to fragmented solutions when merging IT systems and processes.

Conclusion: This study contributes by pointing out the complexity of developing innovative solutions with actors having different focuses, interests and interdependencies under dynamic conditions.

Keywords: Systemic, Innovation, Innovation systems, Home care, Healthcare, Service, IT, Information, Case Study, Finland
1 Introduction

In Finland much debate has been going on about public healthcare IT-projects, where fragmented IT solutions are created instead of utilizing larger platforms to support healthcare and welfare services. At the same time innovation discussion has discovered that a lot of public funding is used for the benefit of incremental innovations supporting separate products instead of creating radical and systemic innovations. Recent international innovation studies have also pointed out the difference between innovation and transition policy in complex innovation environments [1]. Simultaneously, at the practical level, many information technology professionals are frustrated with unclear specifications and changing project scopes – these challenges are often tried to be solved at the process level by synchronizing parallel projects and by developing project and specification management tools (e.g., updated state-gate models [2] and agile software methods).

Despite such challenges – also in other countries than Finland – there are few studies covering issues from early phases to implementation from the systemic innovation perspective. Some steps are taken in national health and welfare sector studies, for instance, from perspectives of management [3] and co-developing information systems in healthcare [4, 5]. Bessant and Mahrer [6] noted that most radical innovations are taking place around the public sector, where traditional linear development approaches are reaching their limits. They also proposed alternative studies of approaches for service innovation “co-creation” for public sector healthcare [6]. Our study addresses this above-mentioned research gap. It focuses on system level challenges from an organizational perspective – it observes the actors, resources and activities in an IT-related project, based on a longitudinal single case study.

This study brings forth new information about innovation taking place in complex home care systems. Home care is provided by municipalities in Finland to support elderly and disabled persons living at home in their basic needs. With the research question “How do systemic innovations evolve in the home care context?” we extend our understanding with an in-depth case study on an
innovation project in a mid-sized Finnish city. The purpose of this paper is to analyse the dynamics related to projects, and present the interconnection between innovation drivers and obstacles to reach system level changes. This paper advances the discussion about new ways of delivering home care services and points out the collaboration needed for successful actions.

The paper is structured as follows. First the concepts of systemic innovation, innovation systems socio-technical transitions are presented. The discussion is carried on to dynamic environment of actors, resources and activities (the ARA framework) – highlighting interaction with fuzzy boundaries of organizations and business sectors. The empirical part of the paper presents the data and its analysis with an in-depth case study in the home care context. The findings show the co-evolving nature of interconnected innovations and organizations, and finally some future research avenues are presented.

2 The dynamic approach to interconnected innovations and actors

Innovation has been defined as “...process of turning opportunity into new ideas and of putting these into widely used practice” [7, p. 66]. Innovations can be in generally categorized as independent “autonomous” or interdependent “systemic” innovations which “benefits can be realized only in conjunction with related, complementary innovations” [8, 9]. Systemic innovations are defined in this study as “an interconnected set of innovations, where each influences the other in the system and in the ways in which they are interconnected with the actors and the environment”. These interlinked innovations are often characterised under such terms as product, process, service and organizational innovations, or based on novelty; incremental, radical, discontinuous or disruptive innovations [7, 10]. Some research stems are interested in converging technologies, while some focus more on sociotechnical aspects and some are interested in interaction between actors.
2.1 The various approaches to innovation systems

Innovation is nowadays seen as collective activity, which takes place within a wider system context, often discussed as an “innovation system”. The concept of the innovation system stresses the flow of information between multiple actors with their resources and activities to turn an idea into innovation on the market [11, 12, 13, 14, 15, 16, 17]. There are several innovation system approaches. The National Innovation System (NIS) places a major emphasis on country-specific factors influencing the innovation. By using national boundaries, actors sharing a common culture, history, language, social and political institutions are identified [18]. The focus of NIS is to identify the importance of interactions among many agents within a single country and the way in which they support learning which promotes innovation [19]. In the Regional Innovation Systems (RIS) approach, the basic idea is similar to that of the NIS approach, but the unit of analysis is a region [20, 21, 22, 19]. Sectoral Innovation Systems (SIS) are defined [23, p.131] as follows: “...the system (group) of firms developing and making a sector’s products and generating and utilising a sector’s technologies...”. Technological Innovation Systems (TIS) enable studying the characteristics of the system associated with a specific emerging technology, to analyse its strengths and weaknesses as well as its dynamics [15, 13, 14, 16]. Since the focus of the TIS lies on a specific technology, it reduces the complexity of the system analysed, but partly misses the “socio-technical” aspect.

The Socio-Technical System (ST) literature is mainly interested in how new configurations around large socio-technical systems emerge and are retained in the society – interlinking innovations, transitions and system changes [24, 25, 26, 27, 28, 29, 30, 31]. Niche-innovations, sociotechnical regimes and sociotechnical landscape are used to describe the interplay of different levels related to transitions [24, 25, 26, 27, 28, 29, 30, 31]. Berkhout et al. [33] have presented the Cyclic Innovation Model (CIM), where they highlight that in the future, many innovations will be the result of combining technical capabilities and customer needs from different sectors (trans-sectorial innovations) – for example, innovations in the healthcare sector that will be made possible by new
developments in information and communication technology. CIM has a systems view of the cyclical change processes – and their interactions – as they take place in a successful innovation arena crossing traditional boundaries: “hard” and “soft” sciences as well as engineering and commercialisation are brought together into a cohesive system of creative processes forming an arena of opportunity [33, 34].

2.2 Organizing for shared activities; actors with dynamic resources and fuzzy boundaries

Recent studies focusing on emerging organization designs for such collaborative arenas have discovered similar aspects as those presented above. Inter alia, Fjeldstad et al. [35] proposed that future organizations are based on actor-oriented architectural schemes composed of three main elements: “1) actors who have the capabilities and values to self-organize; 2) commons where the actors accumulate and share resources; and 3) protocols, processes, and infrastructures that enable multi-actor collaboration.”. A large amount of studies also focus on the linkages between different actors (e.g., based on Granovetter’s [36] prior works) and on how such links can be created and utilized for innovation activities – like different types of distances and brokering in structural holes [37, 38]. Faems et al. [39] state that firms using the strategy of heterogeneous inter-organizational network of collaborative partners perform well in innovation. Huston & Sakkab [40] have also stressed the same conclusion and shown the need of developing internal capabilities when utilizing external resources.

Teece et al. [41 p. 516] define dynamic capabilities as “ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments”; and Leonard-Barton [42] refers to dynamic core capabilities as “a set of differentiated skills, complementary assets, and routines that provide the basis for a firm’s competitive capacities and sustainable advantage in a particular business” based on Teece [43]. Leonard-Barton [42, 44] studied the dynamic interaction of projects and firm capabilities and stressed the related managerial
paradox within innovation activities. As core capabilities are collections of knowledge sets, they are distributed and constantly enhanced from multiple sources [42]. Rothaermel & Hess [45] stress the roles of individual-, firm- and network-level effects on dynamic capabilities, whereas Powell & Grodal’s [46] and Chesbrough’s [47, 48] findings show that within complex knowledge constructions the locus of innovation lies within a network of learning composed of incumbent firms, new entrants and research institutions, instead of individual firm boundaries. Dynamic capabilities can be seen as “extension” of resource-based theories [49, 50, 41, 42], based on learning from individual, organizational and network level activities. From the current innovation perspective, some of the earlier literature is challenged due to the fact that it is very difficult to define the core competence or core business due to overlapping technologies and services offered in a dynamic context, e.g., IT present in different services that converge. Actually, in many systemic innovations, it is very difficult to specify the field of business or industry due to the trans-sectorial activities.

Organizational boundaries are a central phenomenon in collaboration, defining actors with their resources and links for shared activities, but research is mainly dominated by transaction cost economics and related exchange-efficiency perspectives. Santos and Eisenhardt [51 p. 502] have offered wider aspects that can better describe boundary conceptions in these shared activities from a dynamic perspective. They are called efficiency, power, competence, and identity; “The efficiency conception adopts a legal view in which boundaries are determined by the efficient locus of transactions. The power conception adopts a permeable view whereby boundaries are conceptualized in terms of the sphere of influence over other organizations and institutions. The competence conception is a dynamic view whereby boundaries are seen in terms of the resource portfolio that coevolves with the environment. The identity conception takes a holistic view, such that boundaries are the often unconscious mind-set that organizational members use to gain cognitive and emotional coherence about “who we are.” When analyzing activities around systemic innovation projects it is important to understand the dynamics and relationships of the actors. The project is one sort of evolving organization itself (see Figure 3), with individuals participating from
several organizations, like firms, funders and public organizations, e.g., city health care; universities, national technology funders, research centers and regional intermediary organizations. Individuals are tied with social capital, also having dynamic aspects in its different forms for innovation activities intra- and inter-organizationally [21, 52]. Both the organizational and social dimensions impact the power consumption to steer the project scope based on organizational and personal interests and interpretations.

2.3 ARA Framework – actors, resources and activities

The ARA framework usefully contains and builds on three elements in networks: activities, actors and resources. Actors could be organizations, like firms or other organizations, such as governmental bodies and other stakeholders, units in an organization or individuals. Actors carry out various activities (communication, development, production, distribution) to create value. In doing so, they need to have access to resources such as knowledge, etc. Ongoing activities lead to more connections between actors, thus larger networks emerge. Developing networks makes it possible to create new activities. Ongoing activities mobilize resources, causing resource networks to emerge, and networks change. According to Axelsson [53], there are two main types of networks. “Alliance networks” constitute networks of co-operating firms that have explicitly decided to join forces as a group with common goals and a shared view of the network. “Emerging networks” are networks, where as a result of ongoing activities, various actors, relationships and network structures evolve. There is thus a web of interlinked connections, but no clearly defined boundaries. Each organization cooperates with a number of other organizations, and it is also possible to distinguish a number of more or less overlapping networks. An organization may be part of many networks, while an individual may be part of various professional networks. This means that there are no clear boundaries of the network that is under constant change, and one actor’s view of the evolving network may differ from the views of other actors. The actors that are also evolving might have
significantly different goals for their network activities. The ARA framework is based on the latter
definition describing networks that are ever-expanding. There are no clear borderlines defining who
is inside and who is left outside. It emphasizes the connectedness and emerging aspects – and thereby
new actors as well as resources may become part of a network. [53, 54, 55, 56]

2.4 Home Care Service as Context for Systemic Innovation

A large amount of research has been done and literature reviewed from the perspectives of health
information technology barriers in organizational management [57], smart homes and home-based
consumer health technologies as a public health intervention for independent aging [58], and
coordination of cooperative home care work [59]. The findings see home care work and IT as
increasingly important due to the ageing populations of Europe, USA and large parts of Asia.
Information technology is seen to be a crucial part to solve resource, efficiency and life quality issues
related to services required by an increasing amount of people needing support for running their daily
routines. These global studies are well in line with Finnish studies related to care arrangements for
aging people supported by innovations and new technologies [60, 61, 62, 63].

Even though studies provide this clear evidence of useful and available technologies, national
reports are simultaneously showing the gap between this potential and wide utilization of these
technologies (except for some pilot and demonstration purposes in certain cities). The Finnish health
care system has indeed been criticized for using large amounts of investments on IT without practical
beneficial results, and developing fragmented tools instead of generally used applications and shared
system interfaces. At the same time, the public aim is to increase home care services instead of care
in institutional living, hospitals and healthcare centres. The purpose is to support people’s wellbeing
and good quality living at home. This requires skilled personnel with proper management and well-
functioning IT systems as well as redesign of processes and services. Changes are needed, as current
resources are not sufficient to serve an increasing amount of customers with changing needs and related tasks included in the home care scope. In this setting, it is very important to provide more knowledge about systemic innovation development in the home care sector. The functioning of the home care services is explained in the context of the case analysis.

3 Methods

3.1 Qualitative Single Case Study

Based on the above, we chose to follow the NIS level in this study, with generally shared evaluation perspectives presented also by Hekkert et al. [13, 14]. The approach is chosen based on the fact that healthcare is often observed at the national level, and defining IT solutions purely in one category of technology might be misleading. The rather stationary approach of NIS with predefined components and boundaries can be problematic. To fully grasp the dynamics present we have to supplement the rather static perspective with dynamic elements. Stacey [64], Ståhle [65] and Anderson [66], for instance, provide interesting insights with a combination of complexity theory and organization science, by pointing out how adaptive systems evolve over time through the entry, exit and transformation of agents – and the shifting patterns of interconnections and self-organizing networks. We focus on interaction, and choose to follow the ARA framework. It considers networks and boundaries as ever-expanding, and emphasizes an emerging aspect. Also Lundberg and Andersen [67] have found that the ARA model is suitable to analyze national level multi-actor collaboration networks, even though it is initially developed for industrial processes and used for analyzing collaboration, e.g., in marketing activities. Therefore, at the core of our analysis are actors, activities and resources.
A qualitative case study is used as a tool to capture essential findings from the complex system consisting of human and technological dimensions. Case-study research is a generally accepted method to contribute to our knowledge on individual, group, organizational, social, economic, and political phenomena. The strength of case research is that the phenomenon can be studied in its natural context through observing actual practice. Single case research on innovation can create value not only through general validity but also due to general interest especially if it is linked to national innovation programs and innovation systems. Many enterprises and innovation systems can benefit from such knowledge based on the similarities in practical processes, and this is also an important aspect when judging the general value of single case innovation studies. Such practical discourse can help understand the challenges of how to organize development and innovation activities in organizations and in complex networks of actors having different backgrounds and practical goals. Rich case studies combine various data collection methods, such as archives, interviews, questionnaires, and observations – and in this study, these different sources are marked with analysis codes for the reader; see Table 1. [68, 69, 70, 71, 72]

3.2 Data acquisition

Data collection was done in 2010-2014 in a mid-sized Finnish city with various methods for triangulation and ensuring rich data (see Table 1). It included; publicly available data, e.g., home care reports and statistics, written data generated during the development project (such as funding applications, steering group meeting memos and project plans, etc.), data from development workshops (focus on customers and employees), and interviews with key individuals (managers from the organizations involved). Altogether about 100 persons were involved (steering group members, customers, employees, managers). The researcher and university had an action research oriented [73] role in the process, which gave access to data. It is also worth of taking into consideration when analyzing and interpreting the data from the case.
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4. Case with Analysis

4.1 Home care case description

Home care services are mainly carried out by the municipalities in Finland. Home care combines services in the home with home nursing. A basic level of service is the norm in home care; this means ensuring medication, nursing, nutrition and hygiene. In recent years, more proactive services that support independence and promote the quality of life and participation in social life have been shifted away from home care, mainly due to financial pressure. The term “home care” is actually open to interpretation; customers receive different levels of home care in different regions. Variations in the content of home care also mean that comparisons are challenging, and statistical data in this area are not comparable nationally. The networking nature of home care implies that collaboration and coordination with other social and healthcare services that help people continue living at home are important (other in-patient and out-patient primary health services, in-patient and out-patient specialized care and rehabilitation), yet often overlooked in practice (e.g., [60]).

The daily work is mainly planned by home care personnel in the defined areas. The accepted care plans as “legally binding care contracts” are saved in databases, and traditionally printed out for trained care personnel for the daily actions. The routing to homes is mainly done without computer aid, based on experience of skilled personnel. In doing so, the personnel also tries to solve numerous daily challenges related to changes in customers’ situations, indispensable care goods (like home keys, diapers, medicines, health care devices etc.), personnel skills and imperative authorizations, available resources, cars and driving licences for transportation, traffic jams or snowy conditions, parking, etc. (DPS, ISM, I1-4)

Our case, the mid-sized Finnish city has been one of the leaders in developing Home Care services, adopting new technologies to gain efficiency and work satisfaction. In tandem, in the city’s strategy, cleantech and environmental issues are targeted as core competences for the future. The
local university campus is a construction of several Finnish Universities focusing on innovation and environmental sustainability, and it collaborates closely with the city. (DPS, ISM, I1-4)

4.2 Planning the development project

Public home care services face the obligation to find savings and cost-efficient solutions due to the overall economic pressure and limited resources available. Finding qualified personnel to work with customers is also challenging. To begin with, the manager in the city’s home care was interested to develop transportation of workers and the goods needed in daily services. She recognized an opportunity for savings in car expenses, and wanted to explore possibilities to use electric cars, which could also fit well to the city’s branding aims. One of the triggers for this thinking was the trend towards less-consuming cars and electric cars as alternative solutions, as part of the intensive global discussion during 2008-2010. With the support of the local university unit, the idea was examined (at the end of 2010) from the overall perspective and funding opportunities. It was found that the idea is good, but it also contains a larger dimension of efficiency and financing opportunities. There was an opportunity for larger savings also by rethinking the routing, parking and other time consuming issues. Indeed, the whole concept of planning the daily services could save time in the home care organization. This was also related to work satisfaction and advancing work planning possibilities with the help of IT-solutions. (DPS, ISM, I1-4)

The amount of elderly people needing home care services will increase rapidly around 2020, while the resources and available personnel will decrease. The methods currently used to deliver services are not able to solve the gap that is continuously growing. In our case organization, in 2010, there were 5 areas with 19 teams with altogether 287 staff members. In 2005, there were 238 417 visits to customers, and by 2010, it had increased to 389 657 visits. Based on an analysis of home care in 2010, only 50.5% of working time was used for actual care of the customers. This was higher than the average percentage in Finland. 14% of the care personnel’s working time was used for trips
between customers’ homes and the office, and 20% for planning the trips and organizing. (DPS, ISM, PFA 1-3, I1-4)

During the planning, based on more detailed information, an analysis of daily activities and time usage was first conducted. The workers keep detailed track of schedules in certain areas of home care services. After this, a joint session for home care was arranged (13.12.2010) with external parties presenting inputs to extend thinking and innovate new solutions for daily challenges of logistics. This session was arranged and facilitated by the university with methods developed earlier. Purposefully distance taking external presentations were used to trigger new insights and ideas for development. Selected home care personnel and managers were participating, as well as some city directors. Certain important findings were made during this thematic session, like how much time is used for trips before and after the actual work, and during lunch time to the office. Some of the challenges of the Finnish winter were also pointed out, like cleaning the snow off the car and heating the cold car, and finding parking slots close to the target. In addition, the different demands for moving labour, goods like diapers and warm meals were pointed out. (ISM, I1-4)

After summarizing the previous data and issues discussed in this session, funding for the actual development project was searched for as well as suitable partners screened. The interesting issue was that while formulating the application, good partners were found based on earlier contacts and experience, but the applicants ran into the problem that the complex systemic issue at hand did not fit clearly to anyone’s desk at the national funding organization, within its ongoing funding programs. With a couple negotiation rounds these problems were solved in a constructive manner (2011-2012), but slightly reformed the coalition and delayed the start. The scope of the project was also slightly redirected during these loops of developing funding applications, but this shared action strengthened the joint social capital for future activities. (PFA 1-3, ISM, I1-4)

After all the preliminary work, the project was focused on developing daily tasking and logistics based on possibilities offered by information technology; utilizing smart phones and networks, GPS-positioning, map services for routing and optimization algorithms, and information in the home care
database (see Figure 1). The development project was planned for the time period between January 2012 and June 2014 and piloted in selected areas of the city in 2013. (PFA 1-3, I1-4)

Figure 1. The basic principle of the IT-solution developed

4.3 Lessons learned during the project

In 2013, there were 534,339 visits to customers’ homes, considerably more than the 389,657 visits in 2010, thus implying shorter average care time per customer. In June 2014, the organization has 8 areas, 287 workers, and has achieved a situation in which over 60% of the workers’ working time is direct customer work (depending however on measurement principles). The IT-system has been piloted with associated complementary innovations, like electric locks and other tools supporting, e.g., diagnosis of elderly people needing doctor’s attention. Utilization of the IT-system
has met several challenges, like opening interfaces; smart phone and IT-system program compatibilities with different updated program versions; finding right optimization parameters for algorithms when sharing daily work efficiently; updating necessary information in databases for optimization; understanding the relationships within the complex entity for development activities; learning to use programs and devices, as well as simply new ways of doing things.

Instead of preplanning the routing, major savings are coming from planning the daily work efficiently. This means less time consumed for planning activities due to computer aid, and probably also better quality of planning. It was also told that (instead of the often discussed resistance towards new technologies by old workers) it seems that recruiting has become easier thanks to the impression of improved “brand” of the work – younger generation values supportive technology in the image of the work. Generally, on a practical level, the new situation can be summarized as follows:

• Creating an IT-based system for home care service delivery does not mean that the teams would be bigger, workers more distant from customers or service quality suffering.

• Instead, customers’ wishes might be better included in the plans; the service could be more homogenous even when care personnel changes, and personal care-takers can be targeted to certain customers.

• Planning and reporting with proper real time documentation can support actions and increase customer safety and satisfaction.

• Also work satisfaction can increase, thanks to better aligned workload between care workers, flattened daily peak spikes and general planning, and less unnecessary extra work.

Anyhow, important notions are that tacit knowledge is difficult to include in databases, and some face-to-face interaction is always needed. Another important caution is that IT-based planning and guidance may create a situation, where workers think less and take less responsibility for their actions. They might just follow the rules and read instructions from the smart phone, and ignore rather obvious insights. (WS, PGM, SGM, II-4, PFR)
There are thus now eight service areas for the teams, which is more than the five at the starting point, and possible outsourcing of services for one area is considered. Other organizational issue is substantial personnel change in home care management (Figure 2), even though management structures remain rather similar. These changes are quite independent from the project, but impact the project and its interpretation. At the beginning, the concerns were the possible changes in the other organizations involved, while home care and the city as an employer have been thought of as very stable and workers permanent. Actually, the persons in the other organizations remain almost the same at the time of writing, and they mainly only changed positions inside their organizations.

(SGM, PGM, I1-5)

Figure 2. Illustrating changes in project organizations and home care management in 2010-2014
5 Findings of the ARA analysis

The discussion above has already reflected the fact that systemic innovations are results of collaborative actions. The complexity requires knowledge and skills from different fields – which no-one alone has. Secondly, it demands shared activities to make the change from the current dominant system take place. As pointed out, theoretically we can observe the dynamics based on actors, resources and activities; the ARA model. Existing innovation literature can be broadly classified in an organizational design oriented “structural” approach and a technically oriented “process” approach, and we use both for our analysis. We will also discuss the findings based on systemic approaches presented in the literature review.

5.1 Actors

When observed from the NIS perspective, the actors were the city’s home care, university, firms, customers, and national technology funding office – consisting of individuals at different levels of each organization. In general, the challenge was to find the right actors with suitable resources for the activities. Finding the right organization does not mean that the information finds the right slot and persons for the activities, as every larger organization has some sort of a grouping to be able to coordinate work [80]. Another challenge observed is that every organization is under change; structures and persons are changing – the tacit knowledge and links to other actors are changing, e.g., in different forms of social capital [21].
In our case, the formation of the coalition was strongly related to the complex project searching for the right slot in the funding organization. The interpretation of the project scope and actors was impacted by the shifts inside the funding organization structures. There were clearly different approaches based on personal opinions and funding structures available when the application was searching for the right slot (PFA 1-3). The second main concern was the changing personnel in the home care organization during the project (Figure 2). The people at all levels changed, and new persons were hired. Naturally, every individual made his or her own interpretation based on available information and documents (codified data) and their own prior knowledge. The result of “what are we doing and aiming at” was strongly impacted by the previous positions in the same or other organizations (ISM, SGM, PGM). The third concern were the changes in the organization delivering the IT-system. The project personnel were balancing between different projects for this and other customers, and the organization was searching for an optimum to share and allocate resources. The firm’s sub-developers seemed to have the same problem. During the handshakes, not only some of
the tacit knowledge was disappearing, but also the interpretation (Figure 3) of what was the aim was changing (SGM, PGM, I1-5).

The notion was that the originally intended larger pools of private and public sector actors delivering services together were not enabled in the first place, and long-term foresight perspectives of planning services were mainly left out of the project scope. The food automat service firm that was defined as an important actor in the early phase of the project was disposed out from the main coalition during the process. The reasons were business and actor related; it was a question of using the city’s own catering unit and price, but also end user related factors were presented for and against the firm. Anyhow, the project also created new connections between partners that had not been previously identified as potential partners, like the various actors around electric locks. The practical and commercial benefits were merging these partners together; alone, it would not have been rational to invest in smart phone operated electric locks. Some new networks and projects are also built on the existing work, like the one searching for national funding for developing IT-services for merging safety and monitoring devices with a control frame/ hub for home care and elderly people. (ISM, PFA1-3, SGM, PGM, I1-5)

Interestingly, it was seen that formation of the collaboration network was largely based on prior dyadic links merged for larger networks through actors involved in the activities. An important finding was that some of the actors carried into the alliance could not satisfy key actors’ requirements and were ruled out due to the personal or organizational interpretation and use of power. They however continued dyadic development relationships with some of their recently introduced contacts, to create and develop new innovation alliances for other activities – spin-off opportunities emerged due to collaboration activities and facilitation. When analyzed, the emergence of opportunities and outcomes, as well as the roles of important actors and activities were afterwards explained and decisions rationalized differently in the different organizations and among different persons. These views impacted the networks and activities as well as the interpretation of organizations’ value for other actors in the future. (ISM, PFA1-3, SGM, PGM, I1-5)
5.2 Resources

The actors on the “innovation arena” had complementary resources, like different types of knowledge. Its sharing was also supported with political agendas in NIS, e.g., in the form of funding structures and institutional infrastructures. Existing resources, tangible and intangible assets, were related to different technology and service sectors having a complementary nature, e.g., smartphones (software and hardware) and wireless networks developed for phones at available radiofrequencies; and GPS chips, software and satellites, with digital maps and routing software. It is important to highlight the dynamic nature of converging technologies and resource assets delivered by individual actors in networks. Like in our case, separate GPS units were not needed as these were embedded in smart phones, and this simultaneous development naturally impacted the actors involved in the activities. Notable is also the ongoing change in the infrastructure (routes and buildings with addresses) that has to be updated in maps used by several sectors. Electric locks and door opening gives keyless access to customers’ homes, making sense when using real time rerouting; all caretakers cannot have keys of all customers. Previous home care IT systems and databases made the optimizing algorithm for planning possible with interfaces compatible information exchange with each other. As shown, systemic innovations in the home care sector have several stakeholders with various technologies intertwined and having complex relationships and path dependencies. To mobilize these actors with their resources for shared activities, the profit and benefits have to be seen. The willingness of firms to join can be observed from two alternative perspectives; having big potential and markets but more uncertainty in reaching the goal, or a clear predefined profitable project with fewer risks. (ISM, PFA1-3, SGM, PGM, II-4)

Two main types of actor changes impacting the activities through resources may be identified; (i) endogenous, individually caused changes or (ii) an actor in the system trying to adapt to the project and other simultaneous activities to optimize resource allocation and profits, causing exogenous
impacts on others. Another exogenous source is when some actors are joining or replaced with better fitting candidates while the project evolves; this is based on interpretation of the target, actors and resources needed for the activities leading to the target. (ISM, PFA1-3, SGM, PGM, I1-5)

5.3 Activities with evolving outcomes

From the process perspective, an innovation process begins with exploring opportunities, which leads to exploitation of certainties [81]. From the interaction perspective, organizations coming from different knowledge bases have certain distances [38], and often need some sort of brokering [37, 38]. In the early phase of this project, brokering and facilitation were an important part that was mainly conducted by the University. Different actors were considered to collaborate, and it was clearly seen that bridging and bonding social capital were needed. These are aspects discussed widely earlier. One interesting finding was that the main challenge for systemic innovation to take place was related to the dynamics of actors joining the process of defining what the project is and what they could offer. Organizational changes (new entrants and exits) impacts interpretation of the project scope and co-evolution of multiple organizations – reforming vision and causing redefining of resources and actors needed. It was clearly seen in the early phase of the innovation project and also at the later stages of actions related to the funded project that when some are mentally opening the process, others might already close the window – when others are exploring, others are trying to exploit (Figure 4). This is important when trying to collaborate, and when brokering the actors and activities. (ISM, SGM, PGM, I1-5)
Figure 4. Process approach to dynamics, illustrating information exchange for activities

Originally the project scope started from the point of home care cost efficiency requirements and utilizing electric cars as part of the city’s cleantech brand, as part of a wider sustainable trend supported also by the national innovation system. The local university was found as a partner for developing the idea, based on earlier organizational and personal collaborations. These activities originated and took place at the mid-level of organizations. The project focus was rethought together, and supplemented with aspects previously familiar from enterprise resource planning and other methods, like simulation tools, from industry. These and the larger system aspects were included in the project scope. Many of the aspects were based on prior experience from different activities in a variety of knowledge intensive technology sectors and home care’s context specific knowledge from the original organization. Individuals had an important role in these activities and mobilizing resources through previously known actors. After opening the process and searching for suitable partners and a funder, the project was impacted by the financial reality. The funding structures filtered and redirected the project towards an alliance with two main actors and an IT-project scope, but prior shared activities impacted the actors included in the sub-activities. Later again, the group
was slightly reformed and the activities focused towards a more traditional IT-project scope. Anyhow, some new actors were joining the network, again based on earlier activities and due to the importance for the project, like a manufacturer of electric locks, emergency services and estate managers. Finally, the project was piloted. (ISM, PFA1-3, SGM, PGM, I1-5)

Much new knowledge was created and delivered based on actual doing and testing, like technology knowledge and information about the organizational obstacles and customer related feedback. Practical results of the project can be summarized from two main perspectives:

1) home care service IT-project for daily resourcing and route planning, combining several different technologies. The green image aspect of utilizing electric cars in home care was concluded.

2) As a reference and access to other cities for the IT-firm that actually has shifted strategically towards home care software and business scope, away from other industry. It should also be noted that the city is evaluating the “outcomes” to be implemented in other sectors of the city’s services.

6 Discussion

The actors had two different views to the evolving project (Figure 5): the operational one of how we survive in practice to get a functional IT-system to support daily tasking, and the more strategic level challenge of the larger (and original) entity of interlinked technology, process, service and organizational innovations – systemic innovations for redesigning the whole service delivery. When analyzing the results afterwards, it can be said that the project fulfilled its targets with piloting a developed IT system and the very first aims to utilize electric cars. The second aspect is that the intended larger collaborative transition platform did not emerge as expected due to several issues, like funding structures, incentives and profits, conflicting interests, path dependency, etc.
This case presents some interesting theory aspects when discussing actors’ capabilities and values to self-organize, commons to share resources, and processes with infrastructures enabling multi-actor collaboration [see, 35, p. 746]. This study delivered how multiparty collaboration on a large scale can identify problems and self-organize around systemic innovation, and how the value can be created in various ways. It also stressed the challenge of different level self-organizing; the focus on the project and the focus on the system that the project belongs to. An important contribution is that politically guided organizations are multilevel interdependent actors as innovation partners. In collaboration, their renewal and co-evolution is partly limited on the basis of clear legally determined tasks and organizational structures. The project and the strategic management levels were visible in the case organization, thus impacted by the changes in interpretation over time. Most interestingly, the system level “self-organization” between regime and landscape level was in very dynamic fluctuation during
the observation period and building pressure for future activities of merging resources and public actors, as cities delivering home care services. There were significant political turns during the project at the national level in Finland; there was an aim to merge 320 municipalities to 100. Finally, it was stated that five main areas are responsible for arranging social and health care services through the current municipalities, but it is still not known what this means in practice and how the boundaries are drawn. This alters private actors, maximizing profits and minimizing risks, to choose methods suitable for collaboration, thus generally having more alternatives to self-organize than public actors. We also made clearly visible – not only the differences mentioned by Alkemade et al. [1] that transition and innovation policies are different, but also – that unclear “transition” policies have tensions impacting on the practical project level of delivering IT-systems. It is often claimed that the health care sector is stable and management unwilling to change and implement IT, but this is not true. The impression based on this study is that middle level management wants to use efficient solutions, but the entirety is challenged by the fact of ending up balancing between rather inertial forces from the daily services and the unclear dynamic organizational environment in larger scale political games. The challenge is completed with the system driving itself into the form where different methods and IT-systems are created and later harmonized, due to the different levels of self-organization searching equilibrium (Figure 5). This is partly due to the phase shifts of different levels of exploration and exploitation (Figure 4).

The study’s main question “How do the systemic innovations evolve in home care context?”, or operationalized more simply as “What is the project scope?” can be observed also from very practical actor-related aspects. In a dynamic context, actors are redefining themselves and their activities. Who are we and what do we do? Who are the partners, what do they know, and what can they do in the future? What are their capabilities and resources for networked activities? What are their true intentions and aims? Not only these organizational level analyses are done based on business prospects, but also the individuals are reflecting upon their opinions. What is my position and power based on activities and emerging links to others; what does this project mean to me and
my work and career? How does it reflect the changing interest over time – the professional aims and personal interests? This summary diagnosis is important to understand organizing for collaboration and time fit for activities linking organizations through persons. Major changes in networks can occur due to persons changing employers, not only due to losing tacit knowledge and rerouted links, but also due to the changing interpretation of the ongoing project.

As a result of our study, we can stress one major issue while developing systemic innovations; every organization has its own culture, organizational structures and processes. This and industry specific characteristics challenge the general shared and synchronized innovation processes. In complex systemic innovations, different types of actors are participating and challenging the organizing for development routines. Different organizations with their given roles (like politically guided public care units, national technology funders, regional intermediary organizations, university units, technology research centers, industry specific firms, etc.) are highlighting the need for interaction and shared platforms – it is challenging to arrange activities with different actors delivering important complementary resources. This paper has stressed also the interesting aspect of the role of project funding in the development path for diffusion. If the focus is on one firm driven technology product, the larger diffusion takes place through a more traditional view; actors compare it to other available solutions – and the decisions are made based on different rationales leading to choose different products or services. Actors, like cities and health care organizations, with their sourcing alliances (Tiera) can support choosing the dominant design, but also the competition laws of EU and sourcing regulations have an impact on these activities. This could again anchor health care organizations to certain products and suppliers with interfaces controlled by them. From other perspectives, like the funding perspective, the same competition rules might impact, if the logic of building dominant design follows a more collaborative activity platform principle, meaning that the focus of the funding structures is on giving resources to support shared activities of multiple actors.

1 Kuntien Tiera Oy, known as Tiera, is owned by more than 200 municipal organizations in Finland, from cities to regional governing bodies. The organization provides IT services, architectures, and solutions to benefit those municipalities, with a vision of reforming public services and processes through collaboration and networking. http://www.tiera.fi/
The development is then not so actor and product oriented, but change oriented. This should be considered at the policy level. The discussion about diffusion of innovations [82, 83] and possibilities to manage systems transitions is natural, but partly controversial, especially in the context of systemic innovations. Loorbach [84] presents transition management and the role of innovations in transitions, including also complex adaptive systems as a background theory for multi-level frameworks. He [84] introduces a cyclical process model as a basis for operational management of multi-level governance. It consists of the following components: 1) problem structuring, establishment of the transition arena and envisioning; 2) developing coalitions and transition agendas (transition images and related transition paths); 3) establishing and carrying out transition experiments and mobilizing the resulting transition networks; 4) monitoring, evaluating and learning lessons from the transition experiments and, based on these, adjusting the vision, agenda and coalitions. In reality, there is no fixed sequence of the steps in transition management, and in practice, transition management activities are carried out in parallel and in a random sequence [84].

(Cf. Figure 5.)

Based on our work we can agree with the Kivisaari et al. [3] findings that “... that realization of system innovation entails linking of developments at multiple levels and interaction between multiple stakeholders. Management of innovation, then, takes place in networks and is collective in its nature. It is about moderating the collaborative process that aims at development, utilization and spreading of system innovation.” Our study also supports their findings of two different types of innovation creation and diffusion: open collaborative co-production type, and more closed transfer oriented innovation – which demands different type of management orientation and political guidance for innovation diffusion in the public health care sector. In our case, there was also a clear indication about the challenge of organizing for such national management. It was brought up in the interviews that each city has its own structures and management position boundaries, which challenge the collaboration between cities (I1). Some cities are forerunners that some other cities and policy-
makers benchmark – this study also contributed by describing some of the roles of cities in transitions [85, 86].

Again, every city makes its own decisions about home care processes, organizational compositions and information technologies used. Anyhow, at the same time, on the Finnish top political agenda, there have been major efforts made to reduce the amount of municipalities from 320 to 100 in the next few years (DPS). This case makes clearly visible the challenge of managing interlinked issues having a dynamic nature at several levels and by several actors. Public actors are focusing on their daily operational challenges within the current borderlines, and top-down decisions are partly overruling the fragmented development activities financed by public funds. Cities are concerned about compatibility of IT-solutions within their own service sectors and within health care alliances between cities. It appears that national leadership and management are partly lacking at the practical level. Firms are focusing on creating successful products for their public and private business customers, and they are supported by national technology funding. Soon again, the operational level professionals in “new larger cities” are struggling to merge IT-systems. As pointed out, some of the challenges can be solved by developing systems in larger coalitions of public and private actors, or alternatively focusing on cities’ sourcing collaboration activities crossing over formal city borders. Anyhow, the management principles of these systemic innovation activities and, on the other hand, diffusion of products and services are quite different, also from the home care end customer’s perspective. The first is driven more by the total service innovation for the customer, and the latter is based on firm-driven “IT-product” diffusion for public organizations.

7 Conclusion and implications

This paper described home care services under pressure to renew their ways of functioning. To serve customers with changing needs, home care organizations with their resources and structures and other actors are delivering different components of knowledge and products, like IT-systems, to
support quality and efficiency. A process of redesign of delivery service system for home care was presented; during the analysis period, a system of computer aided optimization of task composition and delivery routing was developed, simulated and piloted in practice. Several actors (customers, the city – the public service provider, the IT-firm, the university unit, Technical Research Centre of Finland, Finnish Funding Agency for Technology and Innovation) participated in networked development activities. All of them were needed to carry out this interactive innovation process in practice. This study explored how the original idea of an interconnecting set of complementary innovations within collaboration of several actors changed from its original scope and also was changed by the actors involved in those development activities.

The resources available for public services compel politicians and administration to rethink how people are supported to live longer at home. Different services are likely to emerge to fulfil the needs of home care customers and public offering. Collaboration is needed from different authorities in several sectors, as well as private services and efficient systemic solutions for service delivery. Also communities and the third sector (non-governmental organizations) will be harnessed to these activities, and to innovating solutions for new ways of delivering services. The question is how these platforms and ecosystems can be supported by the national innovation system, and how the currently created solutions can become part of future requirements so that we do not end up having new but outdated fragmented solutions for service offerings.

Although this study reveals important aspects of innovations in systemic context, our study is not without limitations. This study is a single case study, and its generalizability takes a different form than in quantitative studies [68, 72]. Future research can be addressed towards forming IT-innovation ecosystems, benefitting customers, public organizations and firms. This study advanced discussion about alternative ways to approach co-operative activities. More research should be done about systemic aspects to support collaborative and coopetitive platforms to harness information technology in complex environments. An important point is that when different IT systems developed are tried to be merged afterwards, it is not only the IT that has to be adjusted. The
problems are related to the whole system compatibility – service delivery processes, resources and their management, and the further development with redefined roles of related actors. These aspects can likely be assessed later in Finland due to the ongoing rearrangement in the healthcare service entity. It still depends on final policy outcomes, however.

Further avenues of future research would be methods and approaches for ex-ante and ex-post impact assessments concerning total costs of the project, vital interfaces between the actors, risks, benefits, etc. The view of total costs, for instance, may be quite different, if only a technology-oriented perspective is taken, as compared to proper assessment of the systemic whole at the very beginning. Partial optimization is prevalent today; it is a question of a “chaining process” in which actors shift their costs to others, and there is no overview of total costs. The customer interface in the era of various digital systems would also be vital to investigate; who takes care of it? Who is the “gatekeeper”? Managing this interface likely becomes particularly central in the future, especially when planning procurement and outsourcing practices.
Author contributions

The first author participated in the action oriented research activities, planned the study and analyzed the case documentation, concluded the interviews and wrote the initial version of the paper. The second and third authors mentored the study throughout and supported to fine tune the paper, and they also participated in researcher triangulation with the other researchers involved in the project.

Competing interests

The authors have no conflicts of interests. Anyhow, as informed in this paper, the first author and the researchers’ university were partly participating in the development activities in a proper manner to get access to rich research data. The first author was invited to the project group meetings, and the home care organization sourced the simulation model and theater-based customer workshops from the university (these were not the core issues of this paper). The university also brokered activities and supported actors without monetary benefits according to its public role in the innovation system.

Acknowledgements

We thank the home care management and care personnel as well as their customers, other participating organizations and the funder of the development project – they made it possible to gather such rich data in collaboration for this study.
Summary points

What was already known on the topic?

- Creating functional IT solutions is a challenging, often cross-sectorial collaborative activity
- There are various “separate/ independent” IT solutions in the Finnish health care system
- There is a large amount of development activities at practical and political level to get functional IT entities into the health care sector
- Home care is one of the rapidly developing sectors to utilize IT in services with a huge potential in utilizing converging technologies

What did this study add to our knowledge?

- Interdependent challenges are tried to be solved separately at different levels, and a systemic perspective is lacking
- Management of innovation takes different paths based on either transition management or IT product based approaches to innovation diffusion, leading to different types of challenges concerning merging actors and activities for managing the entirety
- This study illustrated collaboration characteristics of public and private organizations renewing public service delivery under current dynamic conditions
- This study described an intriguing and timely relevant pilot case as a solution to renew home care service delivery with the aid of converging technologies
References


Appendix 1. The theoretical frame and questions for the semi-structured interviews

The frame for the semi-structured interviews was constructed based on the literature review, and the following supportive questions were formulated. A short introduction to the innovation theme was given from the collaboration perspective, simultaneously presenting figures of the ARA model (Håkansson, 1982) [54] and ST/MLP model (Geels, 2004) [24]. The interviewees were allowed to freely express their impressions around the following topics and generally about the project, its evolution and actors, activities and resources related. The discussion was facilitated based on organizational and process perspectives around these themes.

<table>
<thead>
<tr>
<th>Theme and questions operationalized</th>
<th>Theory background / Literature / Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INDIVIDUALS’ ROLE IN INNOVATION ACTIVITIES</strong></td>
<td>Easy background question for the start; personal work scope documented in transcription.</td>
</tr>
<tr>
<td>What was your role in this project, how could you define it from your perspective?</td>
<td>Personal interpretation of the role and project scope, boundaries etc. See also the theories below.</td>
</tr>
<tr>
<td><strong>DYNAMICS IN INNOVATION SPACE</strong></td>
<td>Socio-Technical transitions, Multi-Level Perspective (Geels, 2004; Geels &amp; Schott, 2007; Loorbach, 2007) [24, 27, 84]</td>
</tr>
<tr>
<td>What kind of general changes led to this project?</td>
<td>Innovation space, Organizational dynamics in systemic innovation context (Tidd et al., 2005) [7]</td>
</tr>
<tr>
<td><strong>ACTORS, RESOURCES AND ACTIVITIES IN INNOVATION SYSTEM</strong></td>
<td>Hekkert et al. (2011; 2007) [13, 14]</td>
</tr>
<tr>
<td>Innovation system – identify in this case from the systemic aspect?</td>
<td>• Actors (private and public organizations contributing in developing and diffusing innovations),</td>
</tr>
<tr>
<td>How could you describe the following topics, roles and their importance to your project scope?</td>
<td>• Institutions (formal and informal constraints related to interaction),</td>
</tr>
<tr>
<td>• Institutions and politics, e.g., regional and national innovation system; laws, norms and regulations?</td>
<td>• Networks</td>
</tr>
<tr>
<td>• Network, its formation and actors involved, who were included, why and how they contributed?</td>
<td>• Technological factors (artifacts and infrastructures)</td>
</tr>
<tr>
<td>• Organizations involved?</td>
<td>Evaluation of innovation systems: 1) entrepreneurial activities,</td>
</tr>
<tr>
<td>• Individuals, their role and changes in it, interests?</td>
<td>2) knowledge development, 3) knowledge exchange, 4) guidance to search, 5) formation of markets, 6) mobilization of resources,</td>
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<tr>
<td>How was the dynamics present in activities in different forms?</td>
<td>countering resistance to change</td>
</tr>
<tr>
<td>Interaction, openness, organizational and technological changes?</td>
<td>ARA model, Håkansson 1982; Axelsson, 2010 [54, 53]</td>
</tr>
<tr>
<td>If you have to define some boundaries based on this project, where would you like to draw those? Were there other interfering systems whose simultaneous engagement caused tensions and challenges to actors?</td>
<td>Complementary innovations, Chesbrough &amp; Teceze 1996; Maula et al., 2006; Chesbrought, 2003; 2010; [8, 9, 47, 48]</td>
</tr>
<tr>
<td><strong>SYSTEMIC AND COMPLEMENTARY INNOVATIONS</strong></td>
<td>Trans-sectorial innovations, Berkhout et al. 2010 [34]</td>
</tr>
<tr>
<td>What kind of complementary innovations were needed for this project?</td>
<td>ST/MLP perspective to niche innovations, regime and landscape changes (Geels, 2004; Geels &amp; Schott, 2007) [24, 27]</td>
</tr>
<tr>
<td>What kind of complementary innovations and trans-sectorial innovations have incarnated due to this project? (Products, Processes, Services, Organizations, please define some examples of such?)</td>
<td>ARA model dynamics, resources and activities (Håkansson, 1982; Axelsson, 2010) [54, 53], Dynamic capabilities (Teceze et al., 1997) [41]</td>
</tr>
<tr>
<td>How has the environment changed based on this project and due to the innovations created?</td>
<td>Insight and Action inertia, Godkin 2010 [87],</td>
</tr>
<tr>
<td>What are the impacts?</td>
<td>Socio-technical inertia, Stiinhilber et al., 2013 [131]</td>
</tr>
<tr>
<td>- On health care sector and home care</td>
<td>ST/MLP perspective to niche innovations, regime and landscape changes (Geels, 2004; Geels &amp; Schott, 2007) [24, 27]</td>
</tr>
<tr>
<td>- On your organization and business</td>
<td>Transition arenas, Loorbach 2007 [84]</td>
</tr>
<tr>
<td>- Have you changed your opinion about the actors and boundaries during the project, and if so, how?</td>
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