MANAGING CONSTANT CHANGE IN INNOVATION NETWORKS

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Abstract

This paper explores how dynamics manifest in innovation networks and how it can be managed during the innovation process. The paper identifies different types of dynamics in networks for innovation, and examines how network management aids in coping with dynamics. This is achieved through a longitudinal, multi-case study that was conducted in the field of technical business-to-business services. An abductive research strategy is applied to create new understanding of network dynamics and its management. The findings show that network dynamics is an integral part of the innovation process in networks, and dynamics takes specific forms. Network dynamics further manifest in multiple ways during the innovation process. Network management provides important means to manage the innovation process despite constant changes. Research has so far paid scarce attention to dynamics in innovation networks and to possibilities to manage dynamics. This paper thus considerably adds to current understanding in this field.

Introduction

Innovations are increasingly pursued in networks as knowledge and other resources that are needed for innovations are nowadays typically dispersed among a variety of firms and other organizations (Möller & Svahn, 2003; Oerlemans, Meeus, & Boekema, 1998; van de Ven, 2005). However, gaining benefits from networks is demanding (Möller & Svahn, 2003) and academics recognize the significant role of network management when the aim is to innovate in networks (Pittaway, Robertson, Munir, Denyer, & Neely, 2004). But at the same time they state that management of networks can be highly complicated since networks may consist of various relationships (Möller, Rajala, & Svahn, 2005) and as networks are dynamic (Dhanaraj & Parkhe, 2006). Still, innovation networks should be effective and achieve the set targets. Similarly, they should be efficient providing sufficient benefits for all the members involved (Jarillo, 1988).

Despite academics recognize the need to manage the innovation networks, current research has paid scant attention to the topic (Ritala, Hurmelinna-Laukkanen, & Nätti, 2012). Extant research lacks knowledge on the innovation process in networks in general (Cantù, Corsaro, & Snehota, 2012; Russo-Spena & Mele, 2012) which has allowed only a restricted view on network management (e.g., Gardet & Mothe, 2011; Gardet & Fraiha, 2012; Landsperger & Spieth, 2011). Similarly, the dynamics of innovation networks has reached little consideration in research. The need to study the network dynamics together with the means to manage innovation networks has been recently expressed, for example, by Ritala *et al.* (2012).

This study answers these calls by focusing on the following research questions: How does the dynamics manifest in the networks for innovation? How can dynamics be managed during the innovation process? This is achieved by studying the innovation process in five innovation networks from the partner search until the commercialization of a technical service solution or package.

As the theoretical foundation of the research, this paper seeks insights from strategic network view (e.g., Jarillo, 1988; Möller et al., 2005) and innovation networks literature (e.g., Perks & Jeffery, 2006; Ritala et al., 2012). Strategic network literature provides theoretical understanding on purposefully established networks and their management for this study. Innovation networks literature provides insights into peculiarities of innovation networks, such as network dynamics. It further aids in gaining understanding on relevant issues in managing innovation networks.

This research contributes to innovation networks and network management literature by providing new understanding on dynamics in innovation networks and means to manage innovating in dynamic networks. The paper identifies different types of dynamics in innovation networks and shows how they manifest in the innovation process. The paper further suggest means to cope with network dynamics during the innovation process through network management.

This paper is structured as follows. The research method is described after the introduction. This is followed by the literature review and a tentative framework for network dynamics and network management. Next the results of the empirical cases are discussed. The paper concludes with the discussion section.

Keywords

network management, innovation, dynamics

Method

This research employed a qualitative multi case study (Stake, 2008, 123) with five innovation projects that took place in networks. The qualitative case study research allowed studying both the innovation processes and their outcomes (Silverman, 2006, 349) within a real-life context (Scholz & Tietje, 2002, 9; Yin, 2009, 2).

This study applied the instrumental case study approach where particular cases provided an insight into the research question with the aim of forming general understanding of the phenomenon (Stake, 1995, 3). Generalizations made in the study are analytical, based on finding similarities within studied cases (Dubois & Araujo, 2007). Multiple cases enabled building more robust, generalizable, and parsimonious theory (Eisenhardt & Graebner, 2007). In this research, each case was chosen for theory-building reasons – that is, to illuminate the focal phenomenon and fill theoretical categories that enhance generalizability (Hallen & Eisenhardt, 2012). Therefore the study applied an abductive, theory development approach (Dubois & Gadde, 2002).

The empirical cases dealt with the development of innovative technical business-to-business service solutions and service packages (portfolios) in inter-organizational and intra-firm collaboration. Technical services were chosen for the study since they are typically delivered in cooperation with other goods and services providers and, as empirical research has shown, technical services firms are likely to engage in collaborative arrangements for innovation (Tether & Hipp, 2002). In addition, in the academic service literature, technical services have received scant attention (Schilling & Werr, 2009, 44).

The first case is about the resource management system development at Alfa, a construction, maintenance and professional services provider within energy, telecom and industry sectors. Alfa's aim was to be a pioneering and agile firm in its business field. This necessitated new kind of mindset in managing company resources. For this purpose Alfa decided to build a resource management system. With the help of the system Alfa wanted to develop and intensify the traditional way of performing work in the company. Six IT business solution firms formed a development network with the IT department of Alfa. The system was developed between 2008–2012.

Two cases deal with wind power service portfolio development, one at Alfa and the other at Delta, an engineering and consultancy firm. The peculiar characteristic of these cases is that they describe an emergent business field. Most of the actors were new in the field and many actors had been only lately founded. Alfa developed a modular service portfolio for the entire life-cycle of a wind turbine both in intra-organizational team and with customers, suppliers, consultants and university students between 2008–2012. Delta's aim was to provide large engineering and consulting service entities to the customers in the wind power field. Delta formed a development team inside the firm for this purpose in 2010. They hired also some university students for the development project. In 2012 Delta widened the cooperation to sister companies abroad.

The fourth case is about foundation solution development for wind turbine towers. The focal firm is a fastening technology firm serving customers around the world. Apart from manufacturing, the firm invests heavily in R&D functions. It made a strategic decision to start development work in wind power business in 2009. The representatives of the company had noticed that current wind turbine foundations could be substituted through a new foundation innovation that could be provided as a service concept to customers in the wind power field. They found Delta to innovate and design the foundation with them. Later Alfa joined the project as a pilot customer.

The fifth case is about new automation solutions in mechanical engineering industry. A technical trading firm Gamma wanted to help their customers improve their competitiveness through a new innovation, a robotics solution. They concluded a partnership with a robotics firm in 2009 to develop the solution. The robotics solution was launched in 2011. During the development process they got an invitation to tender from a large steelworks that needed a comprehensive sample production solution. As the solution included various systems, Gamma and the robotics firm joined their forces with a laser-technology firm to offer the new to the world system to the customer. The sample production solution was taken in use in the spring 2013.

This study applied process research when studying the cases. Process research is defined as "research concerning a process that exists between two points in time (--)" (Quintens & Matthyssens, 2010). Thereby process research is able to describe how and why some temporally evolving phenomenon (Bizzi & Langley, 2012; Pettigrew, 1997) comes into being (Halinen, Medlin, & Törnroos, 2012), develops and changes over time (Pettigrew, 1997). In this study, innovation processes were followed both retrospectively and in real time (Bizzi & Langley, 2012).

Qualitative interviewing was used as the primary data collection method (Warren, 2002). The first round of interviews was conducted among the directors and project managers of the innovation projects at Alfa, Delta and Gamma in January–September 2010. The second round of interviews was conducted among the directors and project managers of the three focal firms and firms that participated with them in the innovation networks. The second round of interviews took place in November 2011–December 2012 (see Table 1). Altogether 33 interviews were conducted in the five innovation projects. Interviews were audio recorded and transcribed verbatim.

Table 1: Interviews conducted in the companies collaborating for service innovation

Case	*Company*	*Position of the interviewee*	*Date of interview*	*Number of interviews per case Total n=33*
Resource management system	Construction, maintenance and professional services provider (Alfa)	Business development director/head project manager	15.2.2010 12.12.2011	6
	IT business solutions firm A	Business area director	28.2.2012	
	IT business solutions firm B	Project manager	25.1.2012	
	IT business solutions firm C	Project manager	13.1.2012	
	IT business solutions firm D	Project manager	16.1.2012	
Service portfolio for wind power industry at Alfa	Construction, maintenance and professional services provider (Alfa)	Business area director, wind power	19.2.2010 25.11.2011*) 11.12.2012*)	6
	Alfa	Sales manager	4.9.2012	
	Engineering firm B	Divisional director	24.1.2012	
	Wind power producer	CEO	24.1.2012*)	
Foundation solutions for wind turbine towers	Engineering firm A (Delta)	Project manager	20.9.2010*) 12.12.2011*)	6
	Technology firm	Business development and technology director	30.1.2012	
	Construction, maintenance and professional services provider (Alfa)	Business area director, wind power	19.2.2010*) 25.11.2011*) 11.12.2012*)	
Automation solutions for mechanical engineering industry	Technical trading firm (Gamma)	Group president CEO Business area director	11.2.2010 11.2.2010 20.8.2010 2.12.2011	9
	Robotics systems firm	Senior Vice President	16.12.2011	
	Robotics systems firm	Project manager	3.12.2012	
	Laser technology firm (later production systems firm)	Divisional director	1.2.2012 13.12.2012	
	Production systems firm	Project manager	1.2.2012	
Service portfolio for wind power industry at Delta	Engineering firm (Delta)	Unit director	30.1.2012	6
	Delta	Team coordinator	1.2.2012	
	Delta	Project manager	20.9.2010*) 12.12.2011*)	
	Delta	Wind power specialist	3.9.2012	
	Wind power producer	CEO	24.1.2012*)	

*) Same person interviewed for two projects in a single interview

The retrospective and real-time interviews with managers of various organizations that were directly involved in innovating projects, enabled the researcher to write down the innovation processes from the beginning into a point where the service solution or package was launched. This was followed by the cross-case data analysis. Preliminary research questions and the related literature provided the

guidelines for the data analysis (Marshall & Rossman, 2006, 153, 156). A tentative framework that was constructed on the basis of the literature (see picture 1) provided the starting point in analyzing the dynamics in the case networks.

The analysis began with exploring the changes in the network structure of the networks during the innovation process. Then the reasons for those changes were analyzed. After that other types of changes in the innovation process in networks were sought for according to the guidelines of the tentative framework (picture 1), and the reasons for the changes were analyzed. On the basis of these findings the managerial actions connected to network dynamics were analyzed. The theory-building process occurred via recursive cycling among the case data, emerging theory, and extant literature (Eisenhardt & Graebner, 2007).

Literature review

Network dynamics and management of networks

Network and innovation research often take a linear and static view on networks and collaborative innovation (Baraldi & Strömsten, 2009; Nooteboom & Gilsing, 2013) in terms of structures and processes. Current research provides a view where the formation of innovation networks takes place in the beginning of the innovation process and the network configuration remains static after that (e.g., Ring, Doz, & Olk, 2005). Research typically emphasizes established, long-term relationships between the network actors as they are most probable to help in preserving stability (Freytag & Ritter, 2005; Landsperger & Spieth, 2011). Similarly, innovation literature pays attention predominantly to predictable elements in the innovation process (Essén, 2009). Striving for stability has generated research on how to design, manage and control networks in order to avoid all kinds of instability. And as the research has focused on stability, our knowledge on network dynamics has remained scarce (Provan, Fish, & Sydow, 2007).

Still, innovation research recognizes also the existence of network dynamics. Pittaway *et al.* (2004), Ojasalo (2008) and Ritala *et al.* (2012) state that innovation networks evolve over time. Network dynamics takes place when actors, relationships, needs, problems, capabilities, and resources change in the network (Ojasalo, 2008). Such dynamic networks require constant adaptations (Landsperger & Spieth, 2011). Similarly, some observations indicate that innovation processes can be cyclical instead of linear. And they may involve unexpected interactions between factors at the individual, organizational and societal level (Essén, 2009). In fact, Freytag and Ritter (2005) maintain that networks can be stable only if they face various changes. The important question should thus not be how to achieve stability but how to cope with network dynamics, that is, how to manage innovation networks.

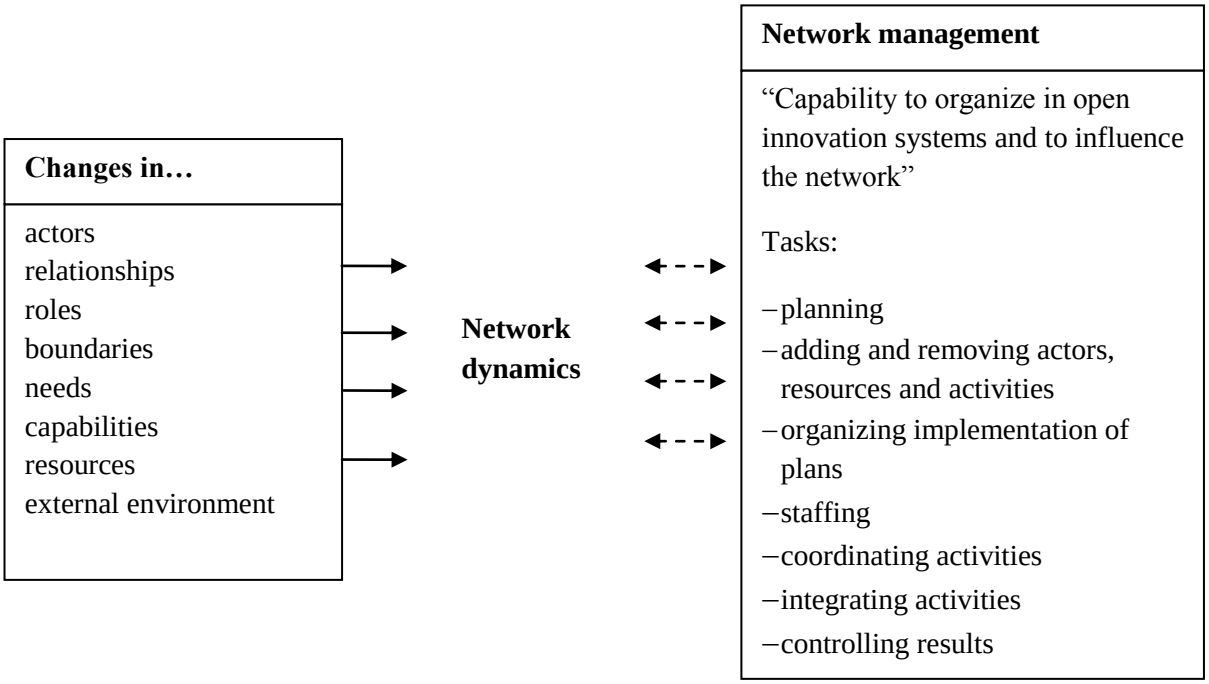
Manageability of networks is a topic that divides the opinions of academics (Möller et al., 2005). Several studies argue that managing networks is not possible (Freytag & Ritter, 2005). For example, IMP Group's Interaction and Network approach posits that networks cannot be managed and especially not by any single company (Håkansson and Ford 2002). Some academics, however, suggest that manageability of a network depends on the characteristics of the network. For example, Möller (2006) argues that intentionally created strategic networks can be managed. These networks consist of specific sets of organizations with jointly agreed goals and roles (Provan et al., 2007). This paper takes the strategic network perspective where a network refers to a group of three or more organizations that are connected in ways that facilitate achievement of a common goal (Möller et al., 2005; Provan et al., 2007). Such networks typically involve a focal firm, suppliers, a pilot customer and consultants and they operate on a temporal basis (Möller & Rajala, 2007).

According to Pittaway *et al.* (2004), management of innovation networks directly affects effectiveness of the network and its capabilities to carry through the innovation process. Network management is thus considered crucial for innovation. Still, research on networks often discuss management issues only implicitly. Academics, however, emphasize the importance of studying network management explicitly because goal-oriented networks generally need management in order to be able to act effectively and efficiently (Provan et al., 2007).

Current innovation research suggests that network management is an important capability in innovation (Heikkinen, Mainela, Still, & Tähtinen, 2007). This capability is necessary if the network organizations want to be able to put a new offering on the market. It can be described as the capability to organize in open innovation systems (den Hertog, van der Aa, & de Jong, 2010) and to influence the network (Heikkinen et al., 2007). This requires managing the collaboration process and the overall innovation process (du Chatenier, Verstegen, Biemans, Mulder, & Omta, 2010). It also includes some type of leadership, or a leader (Dhanaraj & Parkhe, 2006; Möller et al., 2005).

The role of network management is to "define and reach the goals with certain actions as well as possible" (Ojasalo, 2008, 78). Current research identifies tasks that are important in network management. They involve planning (Ojasalo, 2008; Ritter, Wilkinson, & Johnston, 2004) and organizing which refers to implementation of the plans (Ritter et al., 2004). Staffing includes tasks connected to human resources (Möller et al., 2005; Ritter et al., 2004). Network management typically also includes coordinating the activities performed by the network actors (Heikkinen et al., 2007; Möller et al., 2005), integrating those activities (Ritter et al., 2004) and controlling the results (Ojasalo, 2008; Ritter et al., 2004). Network management takes place through managerial action and therefore the behaviors of individual managers influence the network, its activities and resources (Heikkinen et al., 2007). Managing of networks is, however, challenging as there is no optimum toward which a heterogeneous network can strive (Freytag & Ritter, 2005).

Network management literature rarely brings up the structural dynamics of networks for innovation, such as changes in roles, relationships and boundaries, i.e. direction setting, network behavior and conflicts (Busquets, 2010). Järvensivu and Möller (2009) take a dynamic perspective to existing strategic networks, which include typically also innovation networks. They suggest that network management occurs on two levels. Restructuring of the existing network takes place on one level. On the other level, network management is pursued to improve the conditions of collaboration within the existing network structure. Restructuring the existing network refers to adding or removing actors, resources, or activities from the network and changing the ways in which the network relates to its environment. Improving conditions of collaboration, involves various activities to facilitate collaboration between network actors. Picture 1 summarizes the literature that discuss network management and/or network dynamics.



Picture 1: Tentative framework for network dynamics and network management

The tentative framework illustrates various changes that cause network dynamics according to the existing research. Network dynamics refers here to deviations from static circumstances. The relationship between network dynamics and network management varies in current literature. Traditionally research has either ignored network dynamics or argued that it cannot be managed. Management research has emphasized that the role of network management is to prevent any network instability. Lately research has, however, also suggested that coping with network dynamics is a substantial part of network management.

Results

Dynamics in the case networks

In the studied cases, all networks were intentionally formed by the focal actor or actors for innovation. The findings show that the networks that are formed for innovation are not stable. Instead, their structure is in constant change during the innovation process. New actors join the network and some actors leave it. This applies both to organizations as well as to individuals.

First innovation may take place inside an intra-firm team or between two firms, and later other firms or organizations may join it simultaneously or in succession. In such cases the actual network thus forms during the innovation process because more resources are needed for innovation. Alternatively several actors may be involved in innovation already in the beginning. Single firms that are part of the network may at some point of time be actively involved in its actions and at some other time only passively involved or have a minor role in innovation. Actors may also leave the network in different times when their contribution to innovation is completed or they do not have any more prerequisites to continue in the innovation project.

The boundaries of the networks for innovation were not sharp. Although the focal actor had formal contracts with many of the external actors, also parties outside this network could provide resources

for the innovation. For example, in the wind power service portfolio case at Delta the actual development of single services took place outside the development network in professional groups and seminars (see the case description below). Each network firm could also have contracts with their own suppliers and partners during the innovation project for the development of some part of their work. The possible problems with the relationships in such an extended network manifested especially well when the laser technology firm went bankrupt in the automation solutions case (see the case description below).

The empirical data also clearly showed how the relationships inside the network could change during the innovation process. In some cases the relationship between two firms ended when the contact person left the firm. In other cases the commitment to relationship diminished because of serious problems that the actors faced with each other during the project. Also the strategic plans and decisions that were made in the partner firm could affect the innovation relationship. Sometimes the development relationship became dormant because some events in the environment prevented the possibilities for further development.

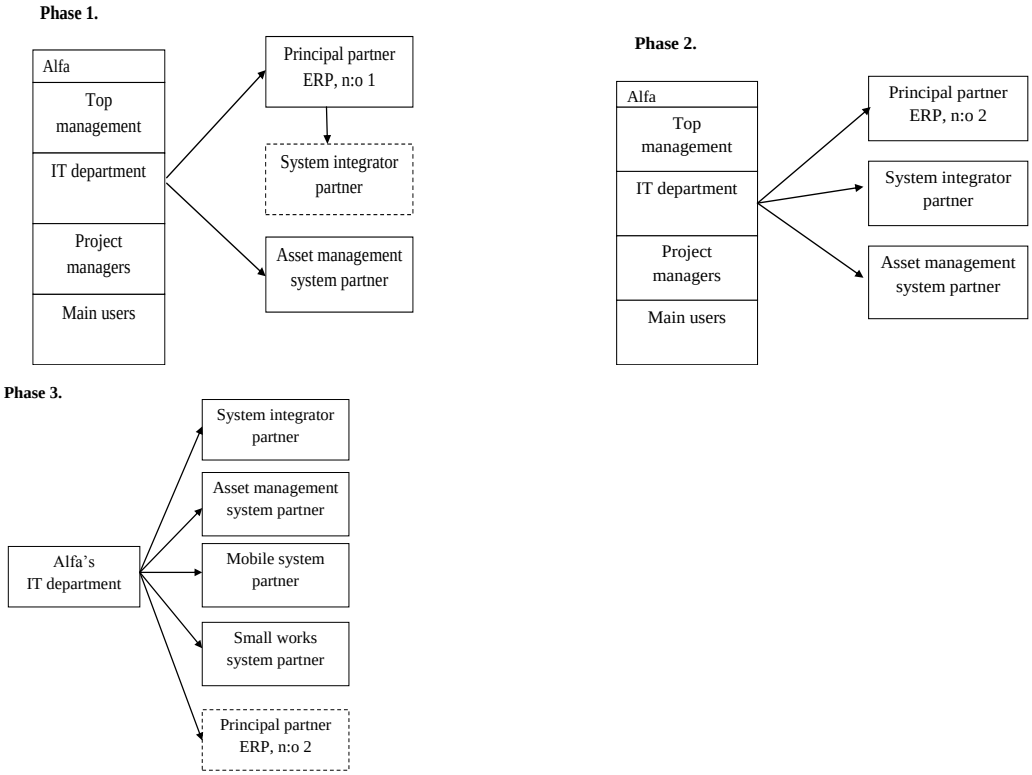
Besides the structural dynamics, innovation networks faced also other kinds of changes. Changes in resources mainly referred to human resources. When people changed, their knowhow and skills and especially their knowledge on the given innovation project typically disappeared. It caused kinds of "black holes" in the innovation process. Typical reasons for changes in human resources were organizational restructuring inside the company and other projects that the company started. Many firms faced also a high turnover of employees. Especially a sudden resign of the project manager could in a critical situation turn out fatal, as in the automation solution case (see the case description below). Employees also participated in the innovation projects often besides their actual work. This meant that their actual work typically dictated when they could be involved in the projects. This again led to delays in time tables and could notably affect the results of the project.

Changes in the needs of the innovation project were also visible in the empirical cases. An example was the sudden crash of the old ERP system at Alfa during the development of the new system (see resource management system case below). This strongly affected the needs of the customer Alfa and thereby the time tables set for development. Similarly, new needs could arise during the innovation project when the customer learnt what the new solution could provide them. In the automation solution case, the innovation partners later learnt that the potential customers needed considerably more services for the robotics solution as they had expected. This resulted in developing a service concept as well.

The following case descriptions illustrate the rich and constant dynamics that took place in the networks for innovation.

Resource management system development at Alfa

Picture 2 illustrates the changes in the network structure during the resource management system development at Alfa. Boxes with dash line illustrate actors that were passively involved in the project at that time. Alfa was the customer and initiator of the development project. Its IT department also chose the actors to the network mainly through competitive bidding. The resource management system development project started in 2008, and the development of the workforce management system still continued in 2012. The system consisted of several sub-systems.



Picture 2: Evolution of the network for resource management system development at Alfa

In the beginning of the development project, the network consisted of Alfa's development and project management organization and three IT companies, each of which developed a partial system for the resource management entity. The ERP development firm acted as the principal partner. At the same time, Alfa was going through extensive organizational changes, and human resources were needed for that project as well. As a result, almost all project personnel that participated in the resource management project at Alfa changed in the first year of the project.

The principal partner had to design a project plan in a very confusing situation. When the plan was introduced, it became clear that it was not realizable. Alfa then decided to change the principal partner and Alfa's project manager and start the project over again.

Unfortunately, only one month after the new principal partner had began to plan the new ERP system, the old system began to crash and the data partly disappeared. The agreed six months project time for the new ERP halved at the request of Alfa. The project was re-scheduled so that the resource planning system development would start straight after the standard ERP system had been launched. When the project was at that point, Alfa had, however, not enough personnel available to continue with the development project. This again led to a situation where the development work had to be realized in four months instead of the scheduled six months.

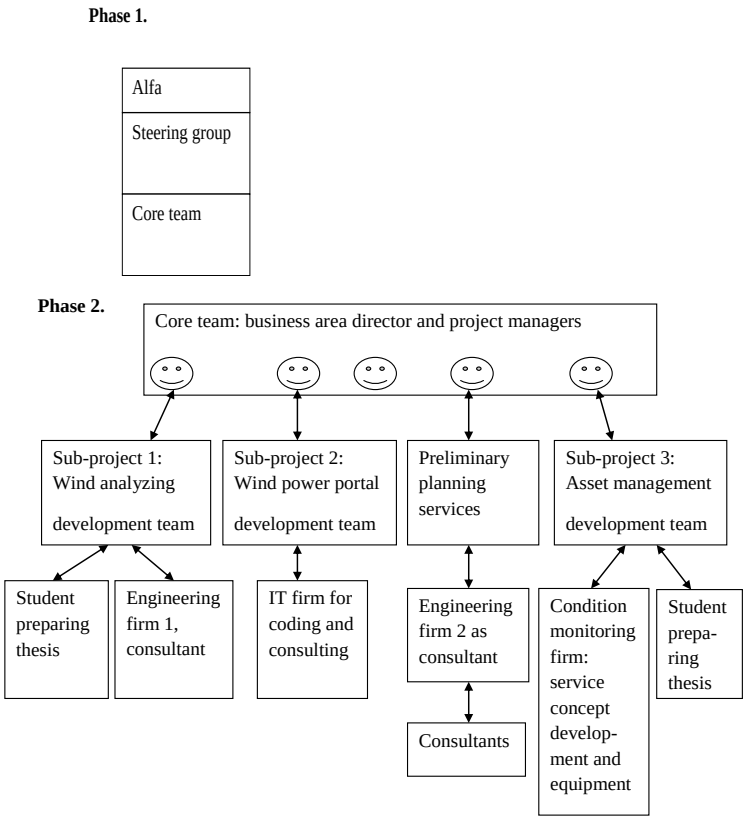
Alfa was not able to do all the needed decisions and testing during the scheduled development period. This meant that only the most urgent things were first developed. New decisions then led to a need to make changes in the system which demanded considerable amount of extra work. And when the system was further developed, new development tasks started to constantly appear. The ERP development phase finally stretched with one year. To speed up the project, Alfa nominated once again a new head project manager.

The mobile system partner and the firm which developed the management system of small works joined the project later when the other systems were enough advanced. Small works system development was not originally part of the resource management system project. It was added later on the initiative of one business unit. The small works system development had been started in another development project at Alfa. At the time when the mobile system partner and small works system partner developed their systems, the principal partner had already carried out the major part of their development work. They heard about the development of these sub-systems only in telephone meetings with project managers.

The development project lasted for five years, and project managers and personnel changed both at Alfa's side and at the IT companies. This brought own challenges to the project. The project manager of the asset management system explained: "Our project manager changed and the project owner also changed a year ago. To be honest, nobody knows about the entity any more."

Wind power service portfolio development at Alfa

In 2008 the management of Alfa agreed on starting systematic service development for wind power industry inside the firm. They employed a business area director to coordinate wind power business development inside the group. The first task was to make a development plan and business plan for wind power services. For this purpose the business area director formed a core team which consisted of representatives of different business fields in the company. The top management set the targets for the development project and the core team planned the wind power service business. Picture 3 shows how the network for the development of the wind power service portfolio evolved from the in-house team into sub-projects that included various internal and external actors.



Picture 3: Evolution of the network for the wind power service portfolio development at Alfa

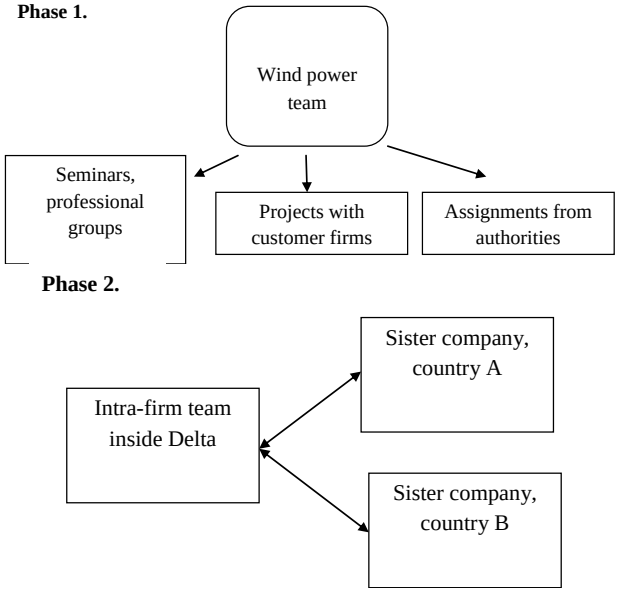
Only a couple of members in the core team could concentrate mainly on development, whereas most of the team members developed besides their actual work. And when new projects started inside the firm, also the full-time developers sometimes suddenly needed to change to another project.

The intra-firm collaboration and contacts with stakeholders finally resulted in a plan to develop ten service modules. These service modules formed Alfa's total service offering for the wind power industry. The service modules were developed in sub-projects. Members of the core team acted as project managers in those sub-projects and team members consisted of employees of Alfa. At that time Alfa, however, went through massive organizational changes. Those who prepared process specifications got new positions in the organization and were torn away from the wind power project. As wind power business was very limited at Alfa and generally in Finland at that time, the problem was to find new people who would know something about wind power. Finally, only a couple of managers and employees stayed longer time in the wind power development team. Alfa, then hired university students to prepare their theses about the wind power business and employed them after permanently.

When Alfa needed external resources for the sub-projects, they concluded contracts with their suppliers to provide their know-how and equipment for the project. Extending the service scope into preliminary planning, however, meant that Alfa needed an engineering and consultancy partner to perform environmental impact assessments. Alfa then found an engineering and consultancy firm which had already some experience in carrying out environmental impact assessments. Alfa seemed to have found a partner whom they had been looking for. And the contact person of the consultant found that they got clear advantage from the relationship with Alfa which provided a wide variety of services in energy sector. Still, two years later Alfa was again looking for a consultant partner. The contact persons of the former partner had changed already four times during the cooperation, and partners did not have much in common any more.

Wind power service portfolio development at Delta

Picture 4 illustrates the network formation for the wind power service portfolio development at Delta. Delta's R&D management decided to arrange a wind power workshop in the spring 2010. Managers who were involved in wind power business would learn to know each other and discuss how they could jointly develop a large service entity for customers. The workshop suggested that the firm appoints a coordinator who then forms a wind power development team. In the autumn 2010, the executive group contacted the director of the industry and energy sector and requested him to coordinate the development of wind power services.



Picture 4: Evolution of the network for wind power service portfolio development at Delta

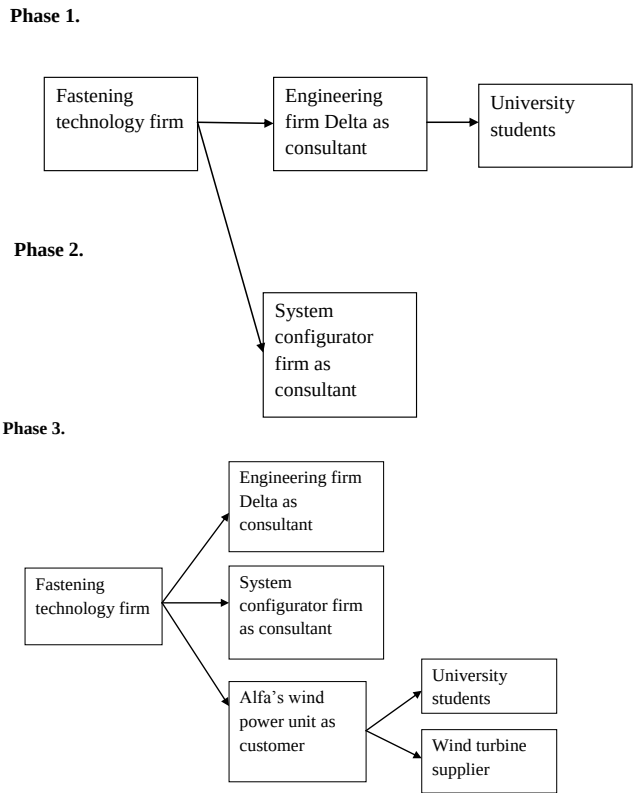
The team consisted of managers in different technical areas inside Delta. The idea was to develop a portfolio of various services which the firm would provide for the wind power customers as large entities. The actual innovating of single services, instead, took place in separate professional groups inside the firm where some of the team members always participated. Also customer projects and assignments that Delta concluded with authorities in the wind power field provided opportunities for development.

All the team members were involved in wind power projects only periodically. And they participated in the development team besides their actual work. The team soon noted that their way of operating did not result in outcomes that they had aimed at. They then proposed that the firm would employ a wind power specialist and coordinator who could concentrate only on wind power business. In February 2012 Delta found a suitable person outside the firm to coordinate the wind power business and development.

Delta group had multifaceted expertise in the wind power field in the Nordic countries. Thus, one of the first tasks of the wind power specialist was widening the contact network to the sister companies in the other Nordic countries. It soon came out that the sister companies needed as much expertise from Finland as the Finnish subsidiary from them. The new contacts from Finland seemed to activate the sister companies as well. Together with the new partners in sister companies the firms aimed at widening the wind power network to new countries, maybe even globally.

Foundation solution development for wind turbine towers

Picture 5 represents the evolution of the network for the foundation solution development. The fastening technology firm initiated the foundation concept development for wind turbine towers in 2009. They concluded a contract with Delta for the design of the new kind of foundation. Delta further hired some university students to prepare their theses for the foundation project.



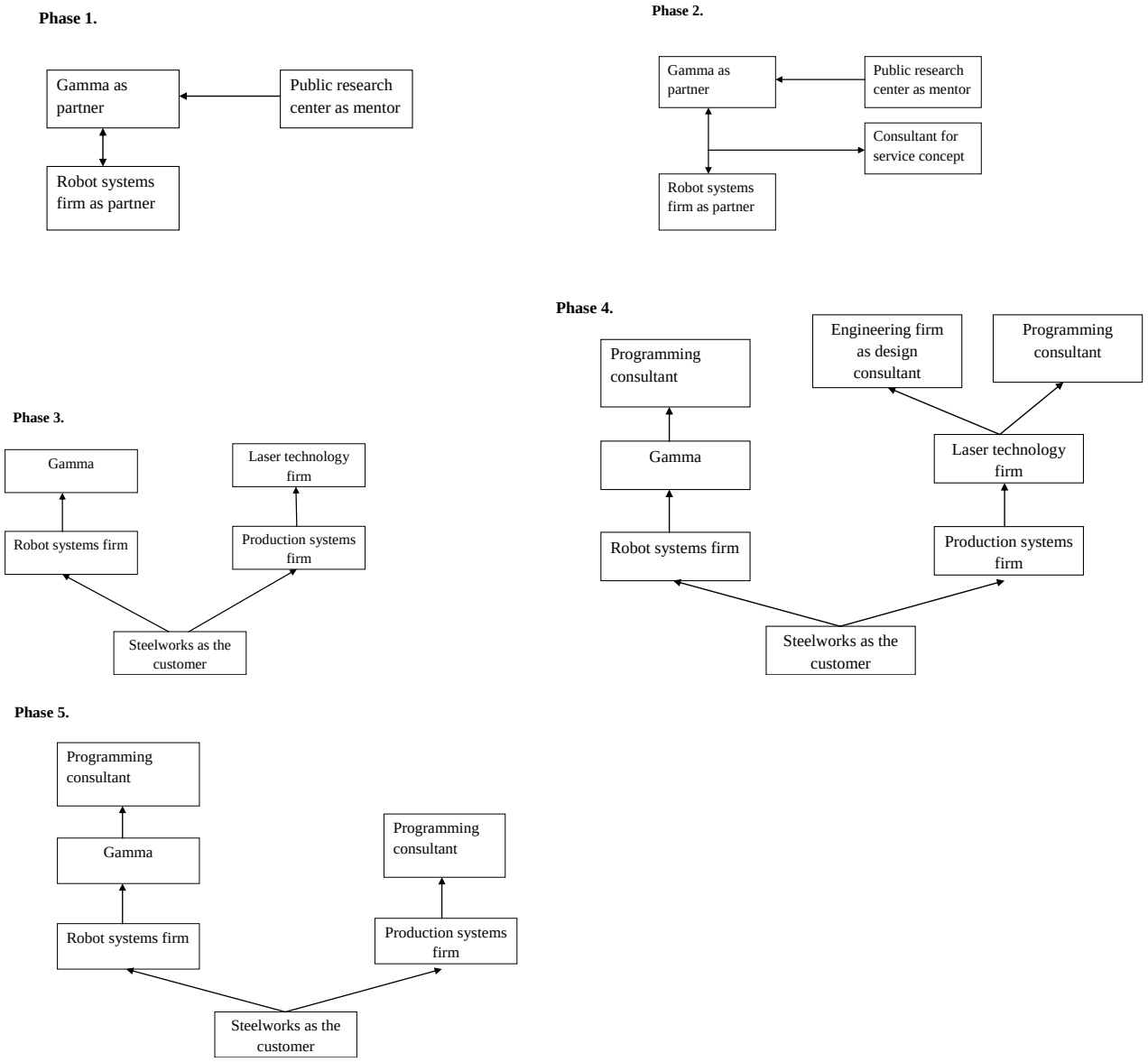
Picture 5: Evolution of the network for the foundation solution of wind turbine towers

Later the fastening technology firm widened the network with a system configurator firm as Delta had no experience in system configurations. When the first foundation prototype was ready in 2011, the fastening technology firm and Alfa concluded a contract where Alfa became the pilot customer for the new foundation solution. Alfa and the technology firm together developed the solution for a couple of construction sites where Alfa acted as the main contractor. Alfa further hired university students to prepare their theses for the wind power turbine projects. They also agreed with the fastening technology firm on selling the idea of the new foundation concept to the wind turbine supplier.

Alfa expected that the partnership with the fastening technology firm would extend beyond the existing contract which was concluded for all the projects where the given supplier provided the turbines. The aim was to continue the development of the foundation solution in the years to come. Some experiment took also place between the fastening technology firm and Alfa to extend the solution to other constructions of the wind turbines. The technology firm, however, found that it was not possible to lean on Alfa when the aim was to find new foundation projects. Also certain tensions existed among the partners as the fastening technology firm showed interest in providing total solutions in the future. This would mean that the partners would become competitors as well.

In the end of 2012, the turbine supplier had no more ongoing projects in Finland. This also meant that the fastening technology firm and Alfa had not active cooperation because further development of the foundation solution was reasonable only in real construction projects. In addition, the contact person of the fastening technology firm had left the company. Therefore Alfa's relationship to the fastening technology firm was less strong than before.

Picture 6 portrays the evolution of the network that developed automation solutions for the mechanical engineering industry. Both Gamma and a robot systems firm sought for a partner to develop a robotics solution for mechanical engineering industry for a long time. They found each other in 2009 through an intermediary. A couple of months later, Gamma got a phone call from the public research center that suggested cooperation in a publicly funded research project. Gamma agreed on joining the research project, and the public research center acted as Gamma's mentor in the newly established robotics solution development project.



Picture 6: Evolution of the network for automation solutions

When the salespersons discussed with potential customers about the new robotics solution it became obvious that the solution had to include also extensive services, from the leasing possibility to life cycle services. The robotics firm and Gamma decided to turn to a consultant who helped them in planning the service entity. But when Gamma launched the new robot solution for the SMEs in metal industry in 2010, it did not sell. This caused severe tensions in the partnership.

The robot systems firm, instead, received an invitation to tender from a large steelworks in 2010. The customer, however, wanted to purchase a turnkey sample production solution which included also laser cutting which Gamma and the robot systems firm could not provide. At that time a laser technology firm contacted Gamma for the same project. The three firms joined forces and succeeded in getting the project.

The laser technology firm, however, could not get the advance payment guarantees because their economic situation turned out to be weak. Their divisional director, then, came to think of a production systems company. He knew that they would be able to produce the laser cutting system if the laser technology firm would design it. The laser technology firm contacted the production systems company, and told them that they had a ready contract with a customer. And they would now need a partner who could take the responsibility for the project towards the customer. The firms then concluded a partnership. Because of the weak economic situation of the laser technology firm the project was divided into two parts. The other part was coordinated by the robot systems firm and the other by the laser technology firm.

The project started in the spring 2011, and the project manager of the laser technology firm changed already in the same summer. This delayed the time tables. And this led to delays in payments to the consultants of the laser technology firm. The laser technology firm used some engineering firms for planning and design. When the payments did not arrive in time, the planning did not proceed as expected.

In August 2011, the production systems firm employed a project attendant outside the firm. Only two weeks later the new project manager of the laser technology firm called him to tell that the project is no more under control because of the delays in time tables. Soon after it became clear that the laser technology firm could not finish the design as their cash was empty. Next the firm went bankrupt. The project attendant of the production systems firm suddenly became the new project manager in October 2011. He knew very little of the project at that time. But it soon revealed that they need to do the most of the design again because the documents did not meet the requirements of the customer. The production systems firm hired persons from the ex-laser technology firm to continue with the project which helped the situation.

The laser technology firm had made a contract with a programming firm for the development of the software for the laser cutting machine. Programming was the most critical part of the laser technology supply. The work was only half-done when the laser technology firm went bankrupt. The production systems firm had to solve the financial problems with the programming firm although they had nothing to do with the contract.

The robot systems firm and Gamma had also severe difficulties in their cooperation. This was the first project to Gamma that had so far only sold machines. Their impressions of the ways to act during the project varied considerably from the views of the robot systems firm. They spoke different language and understood things in very different ways. They both were confused of the project organization of the other partner. The robot systems firm even took some of the development work over to themselves as Gamma was not able to perform them.

Also the testing of the system took much longer than expected. The steelworks customer had also a large IT system development project going on at that time. This system development had faced unexpected difficulties and delays, and the customer had to annul the development contract with an IT firm. The sample production project had to adjust to the progress of the customer’s IT project. The other challenge at the customer side was that their contact person left the firm which caused some

confusion in the sample production project. Furthermore, the recession had reduced the orders of the steelworks. It was thus difficult to find enough material for test drives.

Management of dynamics in networks for innovation

The empirical cases provided a good outlook to dynamics that networks face during the innovation process. The findings let also suggest that network management can mitigate the challenges that dynamics causes in the networks at least to some extent. The findings indicate that similar kinds of changes cause network dynamics in various innovation projects. Careful project planning and preparation and active network management seem to be the key in coping with network dynamics. Table 2 categorizes different types of dynamics that were found in empirical cases and shows how they manifested in the networks for innovation. It then provides knowledge on the means to manage various network dynamics.

Table 2: Means to manage different kinds of network dynamics

Type of dynamics	**Manifestation in networks for innovation**	**Means to manage dynamics**
Change of firms	Firms focus on their own work. Problems in seeing the entirety.	Taking care of team formation during the entire innovation process. Providing means to follow the entire project back in time, in real time and onward.
Change of individuals	Loss of knowhow, skills and project knowledge. Delays in time tables. End of (innovation) relationship between the firms.	Sharing project knowledge continuously inside the organization and network. Taking care of the existence of standby persons and at least two contact persons.
Variable network boundaries	Development may take place also outside the network that is purposefully created by the focal actor (in an extended network). Materializing of risks that other actors may not have considered earlier.	Agreeing with the network actors on ways to manage the extended network and on rules in such relationships. Preparing a risk mapping and agreeing on the risk sharing inside the network.
Fluctuation in the amount of human resources	Delays in time tables or loss of the meaning of time schedules. Insufficient results.	Ensuring sufficient resources through continuous resource management.
Changes in the needs of the innovation project	Shortening or prolonging of the time tables. Needs for new network actors or additional human resources. Needs to change the already developed parts.	Developing systematic working methods. Applying continuous resource management. Involving the customers and all network actors sufficiently to development.

Conflicts between actors	Decrease in commitment and trust. Decrease in collaboration. Delays in time tables.	Putting effort to project planning and taking care that all the network actors are involved in planning. Coordinating the activities and controlling progress. Ensuring common understanding and team formation among the network actors.
Changes in external environment	Problems in the innovation process, e.g. in launching. Active innovation relationships may become dormant.	Monitoring constantly the environment and seeking for new possibilities.

As new firms could enter and some firms leave the network during the innovation process, it easily led to a situation where firms focused on their own work and failed to communicate with the most of the network actors. This could also prevent the firms in seeing the innovation project as an entirety. Network management has an important role here in taking care of the team formation among the network actors during the entire innovation process. Network management can also provide means to the network actors to follow the innovation project back in time, in real time and onward if possible.

Also change of individuals had many consequences to the innovation projects. Besides loss of specific knowhow and skills, especially the loss of project knowledge affected the innovation project. Change of individuals easily led to delays in time tables and even to termination of relationships between the firms. These kinds of challenges can be, however, overcome through network management. If the persons share their project knowledge actively inside their organizations and inside the network, it helps to avoid a situation where the exit of some person or firm means also disappearance of essential knowledge. Similarly existence of informed standby persons and more than one contact person inside each firm provide smoother continuation of the innovation process.

Since the network boundaries turned out to be variable also in the purposefully created networks for innovation, some part of the development often took place in an extended network. Sometimes even the critical part of development was realized outside the network that was formed by the focal actor. The risks attached to extended networks which other network members might not even be aware of could also realize during the innovation process. When the network actors agree on the ways to manage the possible extended network and on the rules in such relationships, the risks might be diminished. Preparing a risk mapping and agreeing on the risk sharing inside the network also help in coping with the dynamics caused by extended networks.

Fluctuation in the amount of human resources in the innovation projects caused typically delays in time tables. In some cases the meaning of time schedules disappeared because of constant lack of human resources. This dynamics also clearly manifested as insufficient results in the innovation projects. Network management has thus an important role in ensuring sufficient resources for innovation through constant resource management activities.

Changes in the needs of the innovation project were often the result of some defects in the innovation process. They could arise because of the lack of resources, failures to involve customers and other network actors sufficiently to the project or deficiencies in the earlier innovation process. Therefore

systematic working methods, continuous resource management and sufficient involvement of customers and other network actors may help in avoiding the changes in time tables, resources and already completed work.

Conflicts between the network actors were not rare during the innovation process. They easily led to decrease in commitment and trust between the actors and decrease in collaboration. As conflicts could thus seriously affect the actions of the network, putting effort to project planning may considerably increase the ability of the network to operate. Involvement of all actors to planning enhances the cohesion and team formation inside the network and helps in ensuring common understanding among the network members. Coordinating of the activities inside the network and controlling the progress of the project further helps in avoiding conflicts.

Also changes in the external environment caused dynamics in innovation networks. Changes in the demand or actions by the competitors or other actors could notably affect the innovation process and especially the launching of the service. They could also terminate the innovation relationship. Therefore network management may show new possibilities to the innovation network by constantly monitoring the environment.

The findings show that capability to manage constant change is a necessary capability in innovation networks. Networks that are well prepared to face changes, can better manage the challenges that dynamics may cause to the innovation process in a network. Systematic network management was found to help in coping with the network dynamics and facilitating the challenges that dynamics may cause. Network management helps in anticipating the changes and taking the necessary means in many cases already beforehand. Considering the risks that are connected to an innovation project in a network of actors, aids in planning how to prevent or reduce them.

Discussion and Conclusion

This paper explored how the network dynamics manifest in networks for innovation and how the dynamics can be managed during the innovation process. So far network and innovation research has predominantly taken a static view on networks and collaboration (Baraldi & Strömsten, 2009; Nooteboom & Gilsing, 2013). Thus extant knowledge on network dynamics is very limited (Provan et al., 2007). This study, however, shows that dynamics is an integral part of networks for innovation.

Different types of dynamics have received scarce attention in innovation research so far. Ojasalo (2008) is the only one found to bring up different kinds of changes in networks during innovation. This paper suggests that dynamics can be placed into seven categories: 1. change of firms, 2. change of individuals, 3. variable network boundaries, 4. fluctuation in the amount of human resources, 5. changes in the needs of the innovation project, 6. conflicts between actors and 7. changes in external environment. Ojasalo (2008) also found in his research change of actors, needs and resources.

Essén (2009) suggests that innovation process may involve unexpected interactions between factors at the individual, organizational and societal level. This paper proposes that those interactions belong to the network dynamics. They manifest in the network often in an unexpected and negative way unless the network is prepared to face dynamics. Although several studies argue that managing networks is not possible (Freytag & Ritter, 2005), this paper suggests that network management is an essential part of coping with network dynamics in innovation. This paper further shares the view by Pittaway et al. (2004) that management of innovation networks affects effectiveness of the network and its possibilities to carry through the innovation process. An innovation network that is not

properly managed is easily paralyzed because of network dynamics. This paper suggests that capability to manage constant change is therefore a necessary capability in innovation networks. Network management helps in anticipating the changes and facilitating the challenges that dynamics may cause to the innovation process.

This study confirms the network management tasks that have been found important in earlier research, i.e. planning (e.g., Ojasalo, 2008), organizing (Ritter et al., 2004), staffing (e.g., Möller et al., 2005), coordinating (e.g., Heikkinen et al., 2007) and integrating activities (Ritter et al., 2004), and controlling the results (e.g., Ojasalo, 2008). This paper further suggests that these tasks aid in coping with network dynamics. Careful project planning and human resource management provide important means to face network dynamics. In addition to the above mentioned tasks, network dynamics call for further management tasks. They include creating conditions for collaboration and team formation, enhancing sharing of project knowledge and monitoring the environment. Network management needs to cover also those parties that participate into innovating outside the network formed by the focal actor.

To conclude, this study provides a picture of network dynamics in innovation and the role of network management in coping with the network dynamics. As the research in this topic is in a very early stage, this paper adds considerably to current knowledge in network dynamics and ways to manage it.

References

Baraldi, E., & Strömsten, T. (2009). Controlling and combining resources in networks - from Uppsala to Stanford, and back again: The case of a biotech innovation. *Industrial Marketing Management, 38*(5), 541-552.

Bizzi, L., & Langley, A. (2012). Studying processes in and around networks. *Industrial Marketing Management, 41*(2), 224-234.

Busquets, J. (2010). Orchestrating smart business network dynamics for innovation. *European Journal of Information Systems, 19*(4), 481-493.

Cantù, C., Corsaro, D., & Snehota, I. (2012). Roles of actors in combining resources into complex solutions. *Journal of Business Research, 65*(2), 139-150.

den Hertog, P., van der Aa, W., & de Jong, M. W. (2010). Capabilities for managing service innovation: Towards a conceptual framework. *Journal of Service Management, 21*(4), 490-514.

Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. *Academy of Management Review, 31*(3), 659-669.

du Chatenier, E., Verstegen, J. A. A. M., Biemans, H. J. A., Mulder, M., & Omta, O. S. W. F. (2010). Identification of competencies for professionals in open innovation teams. *R & D Management, 40*(3), 271-280.

Dubois, A., & Araujo, L. (2007). Case research in purchasing and supply management: Opportunities and challenges. *Journal of Purchasing & Supply Management, 13*(3), 170-181.

Dubois, A., & Gadde, L. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research, 55*(7), 553-560.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25-32.

Essén, A. (2009). The emergence of technology-based service systems: A case study of a Telehealth project in sweden. *Journal of Service Management, 20*(1), 98-121.

Freytag, P. V., & Ritter, T. (2005). Dynamics of relationships and networks - creation, maintenance and destruction as managerial challenges. *Industrial Marketing Management, 34*(7), 644-647.

Gardet, E., & Fraiha, S. (2012). Coordination modes established by the hub firm of an innovation network: The case of an SME bearer. *Journal of Small Business Management, 50*(2), 216-238.

Gardet, E., & Mothe, C. (2011). The dynamics of coordination in innovation networks. *European Management Review, 8*(4), 213-229.

Halinen, A., Medlin, C. J., & Törnroos, J. (2012). Time and process in business network research. *Industrial Marketing Management, 41*(2), 215-223.

Hallen, B. L., & Eisenhardt, K. M. (2012). Catalyzing strategies and efficient tie formation: How entrepreneurial firms obtain investment ties. *Academy of Management Journal, 55*(1), 35-70.

Heikkinen, M. T., Mainela, T., Still, J., & Tähtinen, J. (2007). Roles for managing in mobile service development nets. *Industrial Marketing Management, 36*(7), 909-925.

Jarillo, J. C. (1988). On strategic networks. *Strategic Management Journal, 9*(1), 31-41.

Jarvensivu, T., & Möller, K. (2009). Metatheory of network management: A contingency perspective. *Industrial Marketing Management, 38*(6), 654-661.

Landsperger, J., & Spieth, P. (2011). Managing innovation networks in the industrial goods sector. *International Journal of Innovation Management, 15*(6), 1209-1241.

Marshall, C., & Rossman, G. B. (2006). In Rossman G. B. (Ed.), *Designing qualitative research*. Thousand Oaks, CA: Sage.

Möller, K. (2006). Managing in the network economy. *European Business Forum,* (27), 30-35.

Möller, K., Rajala, A., & Svahn, S. (2005). Strategic business nets - their type and management. *Journal of Business Research, 58*(9), 1274-1284.

Möller, K., & Rajala, A. (2007). Rise of strategic nets - new modes of value creation. *Industrial Marketing Management, 36*(7), 895-908.

Möller, K., & Svahn, S. (2003). Managing strategic nets: A capability perspective. *Marketing Theory, 3*(2), 209-234.

Nooteboom, B., & Gilsing, V. A. (2013). *Density and strength of ties in innovation networks: A competence and governance view.* (No. ERS-2004-005-ORG). Rotterdam, Netherlands: Erasmus Research Institute of Management.

Oerlemans, L. A. G., Meeus, M. T. H., & Boekema, F. W. M. (1998). Do networks matter for innovation? the usefulness of the economic network approach in analysing innovation. *Tijdschrift Voor Economische En Sociale Geografie (Journal of Economic & Social Geography), 89*(3), 298-309.

Ojasalo, J. (2008). Management of innovation networks: A case study of different approaches. *European Journal of Innovation Management, 11*(1), 51-86.

Perks, H., & Jeffery, R. (2006). Global network configuration for innovation: A study of international fibre innovation. *R&D Management, 36*(1), 67-83.

Pettigrew, A. M. (1997). What is a processual analysis? *Scandinavian Journal of Management, 13*(4), 337-348.

Pittaway, L., Robertson, M., Munir, K., Denyer, D., & Neely, A. (2004). Networking and innovation: A systematic review of the evidence. *International Journal of Management Reviews, 5/6*(3-4), 137-168.

Provan, K. G., Fish, A., & Sydow, J. (2007). Interorganizational networks at the network level: A review of the empirical literature on whole networks. *Journal of Management, 33*(3), 479-516.

Quintens, L., & Matthyssens, P. (2010). Involving the process dimensions of time in case-based research. *Industrial Marketing Management, 39*(1), 91-99.

Ring, P. S., Doz, Y. L., & Olk, P. M. (2005). Managing formation processes in R&D consortia. *California Management Review, 47*(4), 137-156.

Ritala, P., Hurmelinna-Laukkanen, P., & Nätti, S. (2012). Coordination in innovation-generating business networks - the case of Finnish mobile TV development. *The Journal of Business & Industrial Marketing, 27*(4), 324-334.

Ritter, T., Wilkinson, I. F., & Johnston, W. J. (2004). Managing in complex business networks. *Industrial Marketing Management, 33*(3), 175-183.

Russo-Spena, T., & Mele, C. (2012). "Five co-s" in innovating: A practice-based view. *Journal of Service Management, 23*(4), 527-553.

Schilling, A., & Werr, A. (2009). *Managing and organizing for innovation in service firms. A literature review and annotated bibliography.* (No. Vinnova VR2009:06). Stockholm, Sweden: Stockholm School of Economics.

Scholz, R. W., & Tietje, O. (2002). In Tietje O. (Ed.), *Embedded case study methods: Integrating quantitative and qualitative knowledge*. Thousand Oaks, CA: Sage.

Silverman, D. (2006). *Interpreting qualitative data: Methods for analyzing talk, text and interaction*. London: SAGE Publications.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: SAGE.

Stake, R. E. (2008). Qualitative case studies. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry* (pp. 119-149). Thousand Oaks, CA: Sage Publications.

Tether, B. S., & Hipp, C. (2002). Knowledge intensive, technical and other services: Patterns of competitiveness and innovation compared. *Technology Analysis & Strategic Management, 14*(2), 163-182.

van de Ven, A. H. (2005). Running in packs to develop knowledge-intensive technologies. *MIS Quarterly, 29*(2), 365-377.

Warren, C. (2002). Qualitative interviewing. In J. F. Gubriem, & J. A. Holstein (Eds.), *Handbook of interview research: Context and method* (pp. 83-102). Thousand Oaks, CA: Sage.

Yin, R. K. (2009). *Case study research design and methods* (4th ed. ed.). Los Angeles: Sage.