Marko T. Heikkinen

MANAGING IN R&D NETS

ROLES, PROCESSES, BENEFITS AND CHALLENGES
MARKO T. HEIKKINEN

MANAGING IN R&D NETS
Roles, processes, benefits and challenges

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**Abstract**

Nowadays, the locus of innovations is in research and development (R&D) networks formed by companies, research agencies, universities, and governmental agencies. Innovation is seen as a source of success of corporations, nations and communities, and therefore there is a long tradition for R&D research and innovation research. Networking is the answer for the changed environment caused by globalisation, fragmentation of the knowledge base and specification of the research into several fields that cause increased financial resource and capability demand for the actors developing new offerings. Collaboration in R&D networks is necessary because resources, expertise, and capabilities are not possessed and capable of being managed by single actors. R&D networks may emerge from among willing actors or intentionally by active actors or based on existing social or strategic relationships of actors.

This study focuses on intentional R&D nets and managing in these R&D nets. This study describes and understands, firstly how managing in net is conducted during R&D net formation and collaboration, secondly what benefits are achieved, and thirdly what challenges are noted in relation to managing in R&D nets. Managing in R&D nets is seen to consist of managerial processes and roles for managing.

Managing in R&D nets is studied in two phases, firstly empirically in four (4) peer-reviewed papers. The papers stem from a single longitudinal case study of managing in an R&D net. The case study includes both a historical and a follow-up time perspective. Secondly, as the studies have been published between 2005 and 2008, their results needed to be compared to more novel and contemporary findings to show the contribution. Hence, in the second phase, a systematic literature review covering studies on R&D and innovation network management published between 2004–14 is conducted. Thereafter and based on the comparison to contemporary research, the findings of this study that are supported, contradicted and/or still novel are discussed.

The novel findings of this study are the following. Firstly, this study extends the time frame of managing in R&D nets. Secondly, it proposes a process model for understanding R&D net formation and collaboration, based on overlapping, simultaneous and iterative activities in R&D net. Thirdly, as a novel finding, this study creates a conceptual framework for depicting and typologising roles for managing in R&D nets. Finally, this study extends the understanding of benefits and challenges of managing in R&D nets. This study provides recommendations both for managers as well as for research of managing in R&D nets.

**Keywords:** business networks, managing in business networks, managing in R&D net, process, roles, roles for managing, strategic value networks
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Oulun yliopiston tutkijakoulu; Oulun yliopisto, Oulun yliopiston kauppakorkeakoulu
Acta Univ. Oul. G 96, 2018
Oulun yliopisto, PL 8000, 90014 Oulun yliopisto

Tiivistelmä

Innovaatiot syntyvät yritysten, yliopistojen, tutkimuslaitosten ja julkisten toimijoiden verkostoissa. Innovaatiot ovat yritysten, yhteisöjen ja kansojen menestyksen lähde, joten niiden tutkimuksella on pitkät perinteet. Verkostomaisella tuotekehitystoiminnalla uusien innovaatioiden tuottaminen ja tiedon fragmentoitumisen aiheuttamien tiedollisten ja taloudellisten vaatimusten kasvuun. Yhteistyö tutkimus- ja kehitysverkostoissa (T&K) on välttämätöntä, koska tarvittavat resurssit, osaaminen ja kyvyttä eivät ole yksittäisten toimijoiden hallussa tai hallittavissa. T&K-verkot voivat olla toimijoiden taitoja sekä koko ammattijen että muodostaa uusia ja muodostaa aikaisemmin verkostoissa toimineiden toimijoiden suuruutta tutkimassa ja kehittämissä yhdessä.


Tämä tutkimus antaa suositukset liikkeenjohtajille sekä tulevalle T&K-verkossa tapahtuvan johtamisen tutkimukselle.

Asiakirjat: johtamisen prosessi, liiketoimintaverkkojen johtaminen, liiketoimintaverkostot, organisaatioiden roolit, strategiset arvoverkostot, tutkimus- ja kehitysverkkojen johtaminen, tutkimus- ja kehitysverkot
Managing in R&D nets – Roles, processes, benefits and challenges
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During lonely nights, this dissertation project seemed more like a dissertation process. There are clear signs of teleology: iteration, repetitive and overlapping activities leading to a certain goal. Gladly there is also a clear, definite end, that turned the process into a project. When a project is long, there is also a long list of people that have had significant influence on it and it is my pleasure to acknowledge those important persons and express my gratitude.

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In Oulu 06.12.2017

Marko T Heikkinen
## Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>DCF</td>
<td>Dedicated Co-ordination Firm</td>
</tr>
<tr>
<td>e.g.</td>
<td>exempli gratia</td>
</tr>
<tr>
<td>etc.</td>
<td>et cetera</td>
</tr>
<tr>
<td>FRM</td>
<td>Framework of roles for managing</td>
</tr>
<tr>
<td>i.e.</td>
<td>id est</td>
</tr>
<tr>
<td>IMP</td>
<td>Industrial Marketing and Purchasing Group</td>
</tr>
<tr>
<td>INA</td>
<td>Industrial Network Approach</td>
</tr>
<tr>
<td>NAO</td>
<td>Network Administration Organization</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RN</td>
<td>Rotuaari Net</td>
</tr>
<tr>
<td>T&amp;K</td>
<td>Tutkimus ja Kehitys</td>
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List of Original Articles

This thesis is based on the following publications, which are referred to throughout the text by their Roman numerals:


The articles are all co-authored and hence the individual contributions are discussed in Chapter 2.1: Empirical results
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1 Introduction

1.1 Background

Innovation plays a significant role in the success of individual firms, nations and societies, and the theme has attracted academics for a long time since early economists (see, e.g., Coase, 1937; Schumpeter, 1934). New, innovative products should be the main goal for businesses, because they generate growth (Ahlstrom, 2010). The past Schumpeterian approach (see, e.g., Schumpeter, 1934) to innovation: the discovery of a lone inventor, followed by innovation creation via specific social functions with commercial purposes, is seen as becoming obsolete. Nowadays, innovation is rarely created in isolation, instead, it is co-created and co-produced with other firms (LaPlaca, 2014) and the result of interaction among several actors (Hagedoorn, 2002; Håkansson & Olsen, 2012) Networks have become the unit of innovation (Öberg & Grundström, 2009).

The source of innovation is often scattered and situated among various startups, universities, research consortia, and other organizations, and is often seen as open innovation (Chesbrough, 2003a). Innovations originate from different industries that are part of different business, social, and technological networks, even customer communities (Bessant & Tidd, 2007; Birkinshaw, Bessant, & Delbridge, 2007) are used in innovation activities.

R&D networks are used for co-creating inventions and developing them to be launched to markets. R&D networks comprise businesses, research organizations, universities and government agencies (Rampersad, Quester, & Troshani, 2010b). Actors in R&D network can be customers, suppliers, service providers, laboratories, technology centers, trade unions, service providers, financial institutions, or others engaged in reciprocal, preferential, and supportive actions (e.g., Powell, Koput, & Smith-Doerr, 1996) such as customer (e.g., Bessant & Tidd, 2007; Birkinshaw et al., 2007).

Firms are increasingly performing innovation activities in R&D networks (Rampersad et al., 2010b). Organizations motivate to join R&D network by developing inventions and technologies, gaining access to markets (Sakakibara, 2002), sharing the costs and risks (Johnson, 2008), lowering the costs of R&D (Gilising, Lemmens, & Duysters, 2007), developing dominant designs (see, e.g., den Uijl & de Vries, 2013; Möller & Rajala, 2007; Srinivasan, Lilien, & Rangaswamant, 2006) or creating technology standards (Munir, 2003). Since R&D activities are not
only technologies, but they are also knowledge about customer wishes and desires (Bessant & Tidd, 2007), they can be used to increase the overall capability to adjust to a changing environmental context and gain new strategic opportunities and increasing flexibility (Dittrich & Duysters, 2007), improving innovation performance via knowledge transfer, reducing time-to-market of new technologies (Gilsing et al., 2007) and developing ecosystems. (van Riel et al., 2013)

R&D networks are needed, because companies face a capability limitation: “[n]o company is smart enough to know what to do with every new opportunity it finds, and no company had enough resources to pursue all the opportunities it might execute” (Wolpert, 2002, 80). Focusing on core competencies has made organizations more dependent on suppliers (Möller & Halinen, 1999) as well as customers and third parties because they hold fewer in-house technologies needed to meet customer needs (Ford, 2011). Also, the capability demand for R&D activities is extant: technology and market process capabilities, manufacturing process expertise, network and alliance management capabilities and experience, marketing and distribution expertise, as well as capital are required (Millson & Wilemon, 2008). One actor is rarely in possession of the various resources and abilities therefore co-operation within firm, within industry and beyond industry boundaries (universities, and research organizations, and governmental organizations) is required (Peters, Groenewegen, & Fiebelkorn, 1998). Even large global corporations like P&G, Boeing, Nokia and Siemens use R&D networks for product and service development in addition to technology standard development (Birkinshaw et al., 2007; Dittrich & Duysters, 2007).

In addition, industries have become more knowledge intensive and require the mastering of multiple technological platforms (Möller & Halinen, 1999). Internet (Möller & Halinen, 1999) and social media communities (Mount & Garcia Martinez, 2014) influence R&D activities by enabling direct access to the end-customers and enabling customer engagement. Internet has enabled a global 24/7 marketplace, enabling the high-speed emergence of new markets and the creation of new phenomena, without traditional marketing or distribution activities (Bessant & Tidd, 2007). In addition, globalization has and vast amount of knowledge created on a global scale have made the mastering of all knowledge by one organization difficult, leading to demands for co-operation (Bessant & Tidd, 2007). R&D networks are used as information channel and a facilitator of knowledge exchange (see, e.g., Powell et al., 1996).

The prevailing view of academics (see, e.g., Ahuja, 2000; Ozman, 2009), practitioners, and even policy-makers (see, e.g., European Commission, 2002;
Roxenhall, 2013) has favored networks in R&D activities. There is a notable shift toward innovation policies to encourage multi-sector networks (Corley, Boardman, & Bozeman, 2006). Many countries have noted the importance of R&D networks for developing innovation capacity, international competitiveness, and abilities to create wealth (Rampersad et al., 2010b). Understanding R&D networks is important for governmental perspective. Innovation activities with various types of network actors, even governmental, have become typical since the 1980 Bayh-Dole Act, industrial R&D collaboration organizations such as MCC, SEMATECH, and the European Union-sponsored EUREKA and ESPRIT research programs. (e.g. Johnson, 2008). In fields experiencing rapid progress, such as computers, pharmaceuticals, semiconductors and biotechnology, complex networks of firms, universities and government labs R&D collaboration have become crucial for industries (Powell & Grodal, 2005, 59). Tidd and Bessant (2007) note that knowledge is created on a global scale and R&D is no longer the prerogative of developed nations (USA, Germany, Japan) and that instead it takes place in rapidly developing countries such as India and China (Bessant & Tidd, 2007), underlining the need for understanding R&D networks.

R&D networks are seen as important from the perspective of network researchers, companies and governmental actors. Networks play a key role in the development and diffusion of new ideas and innovations (LaPlaca, 2014) and network management in innovation is considered important (Ojasalo, 2008), even crucial for success (Ferrary, 2003). Further, the need for understanding managing in R&D nets has increased. As collaboration networks in R&D activities has increased, the need for understanding this type of networks has also increased. The following sections discuss and review how the theme is covered in this study. First, a description is presented of the research journey of the study. Second, a discussion follows centered on why managing in R&D nets is such an important research area from both an academic and a practitioner’s perspective and finally these sections conclude with an examination of how this study is positioned among other studies on managing in net studies.

1.2 The research journey of this study

The journey of this study is neither traditional nor straightforward. Therefore, a description is necessary to provide the reader better understanding of the choices I have done in this study.
The research started in summer 2002, with preliminary readings and archive data material reviews of managing in R&D nets literature and archival data gathering. Themes for the preliminary reviews considered R&D networks as the research context along with the theoretical concepts related to value networks, network management, and, from the methodological literature, longitudinal and process studies. The single case study and a longitudinal, follow-up approach for studying net development was identified appropriate method for gaining objectives of this study. I also got an opportunity to begin my research by following the development of a new R&D net that was under formation.

At the beginning of this study, the focus was on R&D net formation. This choice was made as the literature review revealed a lack of theoretical discussion of R&D net formation. Also the case study object, the Rotuaari net (RN), was under formation at that time and enabled to access to follow net formation. The access to Rotuaari net enabled also a longitudinal, follow-up research methodology; such an interesting research setting naturally directed the focus of this study. The data for Data Collection 1 was collected via retrospective study-based theme interviews and archival data, as well as a follow-up study based on interviews and participant observations. Figure 1 depicts the outline, research activities, stages, and outcomes of this study.
The retrospective and follow-up data was analyzed and reported as a conference paper in late 2003. During the analysis and theoretical reviewing of the R&D net formation and the theoretical discussion of manageability in the nets was noted, arising from the key theoretical discussions of this study.

Originally, the plan included a monographic dissertation that would have covered the full life cycle of an R&D net. However, the plan was changed later because a paper on the formation of the net was accepted for publication in a peer-reviewed journal, and hence, it became the paper I of this dissertation.

Once the RN started its mobile service development activities, new data was collected. For Data Collection 2, interviews and participant observation took place during 2004–07, as I could participate in RN management and operational meetings as an observer. Data Collection 2 consisted of interviews from the perspective of formation and collaboration of the net that consisted of mobile service planning, development, testing, piloting, and the early commercializing phase. Both Data
Collection I and II consisted archival data that was gathered along with interview and observation data collection. Collection of archival data continued until the reporting of the RN concluded.

The literature review regarding managing in networks and R&D networks continued throughout 2004–2007. During the literature review in Phase I of this study, the dynamics associated in managing in nets were acknowledged. Already in paper I roles for managing and managerial process were in focus. Roles for managing in net were seen to lack research, and with the ability to study using a longitudinal follow-up approach, there was potential to contribute to that discussion.

Data Set 2 was analyzed during 2005 for the conference paper II. Based on the feedback, its theoretical framework was revised, refocused and rewritten with deeper data analysis. A first manuscript, analyzing Data Set 2 of paper III was presented at the IMP2006 conference. The (revised) manuscript was invited to a special issue of the conference and after another revision, published at the Industrial Marketing Management in 2007. After the presentation of paper IV at an international conference, the paper was invited for publication in a peer-reviewed international academic journal. It was sent after revisions and published in 2008.

During 2006, RN actors prepared and founded a spin-off company. The company commercialized the service offering developed in the RN. I participated in the commercializing activities upon invitation by the CEO of that spin-off company. As a result, the operational activities of that spin-off led to a decrease in the research time available. However, I participated actively in the writing papers III and IV. Due to the lack of available personal resources to research, my motivation to finalize this dissertation decreased and led to the conclusion of Phase I at 2008.

While operating as CEO of the spin-off and as manager during 2008-2012, I noticed that the problematics of managing in nets and roles for managing existed in day-to-day R&D operations. My everyday notion led to an increase in my motivation to approach once again the problem setting of the dissertation. Hence, I initiated Phase II of this dissertation. The route to good theory is seen to be based on gaps in the literature, or rather through engagement with the problems in the world (Kilduff, 2006). Fortunately, these everyday findings attracted my attention and provided sufficient resemblance to the empirically justified findings so that it led to the rejuvenation of the research process of this study.

The beginning of Phase II started with reviewing the literature on managing in R&D nets, which confirmed that a theoretical gap still potentially exists. During repositioning the dissertation research setting, I continued literature reviewing and
prepared literature pool collection. I also summarized the empirical results from the papers included in this study. When summarizing the empirical results from the paper, I noticed that since the empirical results are almost 10 years old, they need to be reflected with current knowledge of managing in R&D nets. The Literature pool is collected systematically as a presentation of that current knowledge. I used literature pool for reflecting the empirical results in contemporary literature. Based on reflections of empirical results to contemporary literature, I could be ensured that findings of this study could provide contribution to theory.

The dissertation writing turned out to be a longer process than anticipated. My estimate for time consumption been unrealistic, due to my inability to invest full-time in the research activities of this study. However, the research journey of this study has ended and it is written in this dissertation with results, theoretical contribution and managerial implications.

1.3 Motivation, objective, and research questions

There is threefold motivation to study managing in R&D nets in this study. Since the networks have become the source and locus of innovation and the cooperation in R&D activities has increased in companies, research institutions, governmental agencies and universities. (see, e.g., Powell et al., 1996), R&D networks are seen to provide several benefits for academics; similarly, the need for practitioners and policy makers to understand R&D networks has also increased.

Managing in R&D nets is seen important to study because networks are acknowledged by academia and practitioners as an important form of multi-organizational governance and a form of operating in R&D activities. (Möller, Rajala, & Svahn, 2005; Möller & Rajala, 2007; Möller & Svahn, 2009; Partanen & Möller, 2012) Increasing the understanding of managing in R&D nets can firstly, provide new and improved understanding, conceptualizations and frameworks for academics. Secondly, it can provide new managerial concepts, tools and implications for practitioners and managers. Thirdly, government policy-makers can benefit from increased understanding managing in R&D nets.

For academics, understanding of managing in R&D net is an interesting theme. When discussing business networks and managing in networks, certain conceptual clarity is required. The industrial networks approach provides a model for understanding business relationships and networks as interrelated layers of actors, resources and activities (Håkansson & Snehota, 1995). The focus of network research has shifted from describing the structure, functions and dynamics of
networks to researching the management of networks (Järvensivu & Möller, 2009). Within the Industrial Network Approach, there is debate about manageability of the network that sees that actors are not in total control of their resources or activities as other actors influence action (Ford, Gadde, Håkansson, & Snehota, 2003; Matthyssens, Vandebempt, & Van Bockhaven, 2013). Management is seen as relative issue based on the level of analysis and type of network, that influence abilities to control and coordinate in networks (Järvensivu & Möller, 2009; Möller & Halinen, 1999; Ritter, Wilkinson, & Johnston, 2004). Therefore, management of relationships within a focal network or net, i.e., managing in network, is seen to be possible (see, e.g., Gadde, Huemer, & Håkansson, 2003; Järvensivu & Möller, 2009; Möller et al., 2005; Ritter et al., 2004). Network management as a phenomenon has been approached from the industrial network approach (INA) perspective, focusing on general networking abilities and capabilities (Ritter et al., 2004), describing management mechanisms in varying types of value-creating networks i.e. strategic nets (Möller & Rajala, 2007) or analyzed different network level management issues and capability requirement (Möller et al., 2005), or reviewed meta-theory of network management (Järvensivu & Möller, 2009) There are also studies that view network management from varying context as network mobilization issue (Mouzas & Naudé, 2007), as management capabilities issue in supply nets (Svahn & Westerlund, 2007), or as an network governance issue in public administration network (Provan & Kenis, 2008) or dynamics in network governance issue in service development. (de Reuver & Bouwman, 2012)

This study adopts perspective of Möller and Halinen (1999) and Möller et al. (2005) and sees that network are manageable in net level. The phenomena under research in this study is managing in nets. In this study, managing in nets is seen in terms of managing the interaction, not about managing other actors. This study sees alongside Ritter’s twofold nature perspective (Ritter et al., 2004), as influencing other actors (to manage) in the net and being influenced (to cope) by other actors. Managing is firstly leading and determining, secondly coping to situation. In generic, it is managing interaction by actor to actor as representative of organization, not managing others. Managing involves initiating and responding, acting and reacting, leading and following, influencing and being influenced, planning, coping, strategizing and improvising, forcing and adapting. Managing is two-way process of influencing and benefiting other organizations resources, initiative and creativity (Håkansson & Ford, 2002; Ritter et al., 2004.)

Understanding business networks management in net level requires an understanding of networks at the macro level and their dynamics (Möller, 2013).
Managing in networks is seen as a pattern of a stream of decisions made by actors and their counterparts. The stream of decisions is seen as a complex and interactive structure of actions, reactions and re-reactions of actors in a network that needs to be understood and taken into consideration (Ford et al., 2003).

A central issue in analyzing business networks is defining the boundaries of the focal network and by using focal net as concept, the boundaries of the network can be set by managers’ perception or by researchers for scientific purposes (Alajoutsijärvi, Möller, & Rosenbröijer, 1999). Net is a subset of network that defines relevant actors within network horizon (Möller & Halinen, 1999) defined from the perspective of focal actor, based on spatial proximity or technological interdependence (Mattsson, 1997). The boundary of focal net can be vague for actors in net or boundaries are not perceived static (Alajoutsijärvi et al., 1999). Nets are also used to address how networks evolve as well as how and to what extent they are intentionally created and managed (Möller, Pels, & Saren, 2009, 157). The objective of the focal net approach is to understand how these nets evolve, what roles and network positions they occupy, and how actors are able to take advantage of them (Möller, 2013.) Net is used in this study, as well because it enables the defining of relevant actors, analyzing the process of managing in, defining the roles for managing. Net as a unit of analysis also enables definition of the benefits or challenges of managing in from an actor’s perspective.

Net is formed by limited number of actors and developed intentionally for a specific purpose (Möller et al., 2005). For some researchers, an intentional net presumes that an actor can, at least to a reasonable extent, influence and control the behavior of other actors in managing a business nets (Svahn & Westerlund, 2007). These intentionally created and mobilized nets aiming at a strategic objective, i.e., joint end-state are referred to as strategic networks (see, e.g. Gulati, Nohria, & Zaheer, 2000; Jarillo, 1988), a strategic value net (Möller et al., 2005; Möller & Rajala, 2007; Möller, 2013) or as a strategic net. (Möller et al., 2009)

The strategic net has become a significant domain of business networks research and there is a growing number of studies are focusing different type of strategic nets from different domain such as supply nets (Svahn & Westerlund, 2007), such as manufacturing and marketing, (Gulati, Lavie, & Madhavan, 2011; Lavie, Lechner, & Singh, 2007), and R&D (Kohtamäki, Partanen, & Möller, 2013). Research of strategic net deserves more attention, especially from the managing in net focusing on R&D activities. Research in strategic nets is perceived to be in embryonic state (Möller et al., 2005) and more research is needed (Rampersad et al., 2010b) especially in terms of co-ordination and mobilization of network
Network management, facilitation and formation studies are seen on a limited basis, especially in a service development context (Mustak, 2014, 160).

The interest area of this study are strategic R&D nets and managing in these R&D nets. R&D networks are widely used, but, the research is scarce (Lavie et al., 2007). Within the strategic nets discussion R&D nets are positioned as new value-creating and emerging business nets (see, e.g., Möller et al., 2005; Möller & Rajala, 2007; Möller & Svahn, 2009), that is seen a relatively under-researched context and only few studies focus on management in the R&D nets (Ojasalo, 2012) In this study focus is managing in R&D nets, where managing in net is the research phenomena and R&D networks are seen as context. This study describes and understands, firstly how is managing in net conducted during R&D net formation and collaboration. Managing in R&D nets is seen to consist of managerial processes and roles for managing. Secondly this study describes and identifies what are the benefits of managing in R&D nets for actor, and thirdly what are the challenges of managing in R&D nets for actor.

Managing in nets in this study consists of understanding the process managing and roles for managing in R&D net. Studying process injects time and allows to follow the dynamic changes in the phenomena (Parkhe, Wasserman, & Ralston, 2006). Similarly, when networks has become the locus of innovation, it has become clear that the perception of process should also change. In the R&D net literature, there are studies with different perceptions of change. The different conceptualisation of process includes life cycle, teleological, dialectic and evolutionary processes (Van De Ven, 1992; Van De Ven & Poole, 1995; Van de Ven & Sun, 2011). There are studies that see development of R&D net as evolutionary, i.e., change understood through phases or stages. For example, studies focusing on modes of network governance (Provan, Fish, & Sydow, 2007) or network management mechanisms (de Reuver & Bouwman, 2012; Ritala, Hurmelinna-Laukkanen, & Nätti, 2012) and R&D net management (Klerkx & Aarts, 2013) experience that that network management happens in phases over time. In these studies, the phases are adopted from innovation development phases, where the development follows predetermined paths of innovation development. The phases of the process may originate from product development literature and the exploration of innovation: Design, application, and dissemination (Lundgren, 1995; Möller & Svahn, 2009), or service development literature: planning, development, and market launch of service (Gottfridsson, 2014). The new offering development follows a life cycle of innovation through development, and maturity (Tidd, Pavitt,
There is implication in the literature that life-cycle based process perception of R&D net development processes is challenged. Innovation development stages from management literature have become less linear (see, e.g., Bessant & Tidd, 2007). La Rocca and Snehota (2014) support this notion. Tidd and Bessant (2009, 305) see challenges in managing in net based on phases of the network development as set-up, operating and sustaining phases. Some studies (e.g., Markham, Ward, Aiman-Smith, & Kingon, 2010, 404) extend the phases and the innovation development process is seen as consisting of discovery, pre-new product development, development and commercialization phases. Also, strategic net studies are adding commercialization activities as part of the R&D net development process (Möller & Svahn, 2009; Partanen, Möller, Westerlund, Rajala, & Rajala, 2008) and thus extended temporally the development process. However, the process perception of managing in R&D net should be understood better. This study aims to develop concepts and analysis tools for describing the process of managing in R&D net.

This study reviews the life-cycle analysis of R&D net development, but the focus is on formation and collaboration phases of net development. Temporally, this study perceives managing in R&D nets to consist of net formation and collaboration phases. This study adopts the perception of the innovation network literature (Tidd & Bessant, 2009) and sees that the collaboration phase of R&D net begins when the R&D net with formal structure has been formed and it begins development activities. In this study, an R&D net is formed when a formal structure exists. Formal structures are seen are written or verbal contracts or research agreements, and joint decision-making institutions and conflict-solving procedures (Ring, Doz, & Olk, 2005). The formal structure can also be used for defining the actors within the R&D net (members), the existence of the administrative unit (e.g., directors of board, steering group) or location of alliance (Ring et al., 2005). In the innovation network literature (Tidd & Bessant, 2009) net formation stage is followed by the operating stage and the operating stage is followed by the sustain (closure) stage (Tidd & Bessant, 2009). In this study, the operating stage is defined as collaboration that consists of initiation, design, development, piloting and commercialization activities. In addition, this study evaluates the managing in R&D net as teleological process via iterative and overlapping sub-processes.

In addition to managerial process, roles are under focus in this study. Managing in R&D net is perceived in this study to consists both roles for and process of managing. Roles are one of the main approaches of researching management (Tsoukas, 1994), and roles are also seen as one of the contingencies of network
management (Järvensivu & Möller, 2009). Roles for managing are seen in this study as manifestations of managerial actions undertaken by actors as a way to manage in an R&D net context. The managerial action brings about change in the net, which needs to be understood in the context of dynamic R&D network.

Research aiming to develop a theoretical discussion of roles for managing, defining roles systematically or conceptualizations for categorization of roles and typologies of roles remains scarce and limited. There exists research that studies roles for managing in varying contexts, e.g., in a supply network (Knight & Harland, 2005), a triple helix (Johnson, 2008), a living lab (Nyström, Leminen, Westerlund, & Kortelainen, 2014) and role performances in the automotive industry’s radical innovations (Story, O’Malley, & Hart, 2011). However, the studies tend to settle for a rich description of roles, or position roles located in net e.g., central actors (cf. Partanen & Möller, 2012) or intermediary roles (cf. Howells, 2006; Klerkx & Leeuwis, 2009; Klerkx & Aarts, 2013), or even categorize those that are not hubs as less powerful or visible roles. (Järvensivu, Lukkari, & Järvensivu, 2010). Research could benefit a broader variety of roles, descriptions and systematic analysis with analytical conceptualizations. Also, the importance of understanding roles in interactions with others is acknowledged (Van de Ven, Polley, Garud, & Venkataraman, 1999). This study aims to develop concepts and analytical tools for describing and analyzing roles for managing in R&D nets.

This study also views benefits and challenges of managing in R&D nets for the actors. In research, benefits and challenges are associated with network management in varying R&D contexts, e.g., open innovation, (Dittrich & Duysters, 2007), strategic new product development (see, e.g., Millson & Wilemon, 2008), innovation networks. (Ojasalo, 2008; Ojasalo, 2012). There are studies describing challenges related to managing in R&D nets or innovation activities. These studies include innovation network management challenges in several contexts (see, e.g., Ojasalo, 2008; Ojasalo, 2012) from triple helix organizations (Johnson, 2008), in a discontinuous innovation (Birkinshaw et al., 2007), individual innovative company network challenges (Öberg & Grundström, 2009), service innovation networks (Mustak, 2014), and to challenges related to managing in net during commercialization (Aarikka-Stenroos & Sandberg, 2012). In strategic net literature, benefits and challenges are also identified related to managing in emerging value networks (Möller & Rajala, 2007) or new service development networks (Mustak, 2014). However, systematic research on the benefits and challenges of managing in R&D nets seems lacking. In addition, the unit of analysis of the existing studies
varies, from a single manager’s perspective (see e.g. Millson & Wilemon, 2008) to innovative firms’ network development (Öberg & Grundström, 2009).

Research of managing in R&D nets is an interesting theme for practitioners as well. In general, collaboration in R&D is seen to provide long-term benefits (Campbell & Cooper, 1999) and networking in R&D nets enables resource and knowledge combinations and the ability to profit from those combinations (Batterink, Wubben, Klerkx, & Omta, 2010), and managing in net is seen to shorten R&D development time-to-market (Gilsing et al., 2007). This is considered an important factor in enabling successful innovations (Coles, Harris, & Dickson, 2003) and new product developers need high awareness of their organization’s competencies, in addition to competence in managing network connections (Millson & Wilemon, 2008). Relationships in network are not free and they require investment of financial resources and management time in addition to time to develop (Möller & Halinen, 1999). Biemans (1996) argued that there is a major gap between management practice and academic research because network approaches are developed by academics for academics. Networks are interrelated, historically constructed and contextual, therefore they have difficulties providing toolkits for handling managerial situations. However, network research can provide concepts for understanding networks and management issues in networks (Möller & Halinen, 1999.) For practitioners, this study is able to provide improved understanding and better conceptualizations for understanding the dynamic environment and the context in which they carry out R&D activity and business development decisions.

For policy-makers, understanding managing in R&D nets is important and enables influencing on suitable conditions for the industrial development and the local and regional economy. R&D networks are critical features of a whole industry in rapid development, characterizing the computer, pharmaceutical, semiconductor and biotechnology industries (Powell & Grodal, 2005, 59). Governments are encouraged to focus their attention on the development of strategies that assist networking infrastructure development (Pittaway, 2004), because R&D networks boosts innovation and the success of firms in various industries. R&D networks can be effective instruments for initiating government-sponsored initiatives, due to their proximity in local communities and their private actors in charge of innovation processes (Levén, Holmström, & Mathiassen, 2014). Governmental actors could benefit from the identification of experiences from successful R&D network industries conducting managing in R&D networks. Positive and negative experiences of management of R&D nets and modes of how to conduct management in R&D net could be utilized to support R&D networking in industries,
that have not yet adopted or have been inactive in R&D networking, e.g., construction industry (Bygballe & Ingemansson, 2014; Holmen, Pedersen, & Torvatn, 2005). Considering the importance of R&D nets for academics, policymakers and practitioners, i.e. managers that operate in the context of research and development activities, there is surprisingly little research on their development and management.

The aim of this study is to provide understanding of managing in R&D nets. In this study managing in nets is consisting of roles and processes of managing and benefits and challenges of managing. The objective of this study is to develop concepts and analytical tools for describing and analyzing roles for managing in R&D nets. In addition, the objective is to develop concepts and tools for analysis to describe the process of managing in R&D net. Finally, the objective of this study is to identify benefits and challenges of managing in R&D net for actors.

Firstly, this study examines how is managing in net perceived as roles for managing and as managerial process during formation and collaboration. The objective of this study will be met by answering the following research questions:

- How is managing in R&D net conducted via roles for managing during formation and collaboration?
- How is managing in R&D net conducted as a managerial process during formation and collaboration?

Secondly, this study examines the challenging and benefiting factors of managing in R&D net. The objective will be met by answering the following research questions:

- What are the benefits of managing in R&D net for actors?
- What are the challenges of managing in R&D net for actors?

### 1.4 Positioning of the study to R&D network management literature

In the following sections, the key theoretical discussions of this study are identified and briefly described. In the second sub chapter, the concepts of interest in this study are described and discussed. The third section identifies the context of this study i.e. R&D net. The fourth section discusses the aimed contribution of this study. The fifth section presents the delimitations of this study.
1.4.1 Key theories used

The theoretical basis of this study is in theories of industrial and business marketing. Among these, this study is based on network theory, especially the industrial network approach (INA) (e.g., Ford et al., 2003; Håkansson, 1982; Håkansson & Johansson, 1992), and the Strategic networks approach (see, e.g., Gulati et al., 2000; Jarillo, 1988). The network approaches have adopted from Transaction Cost Economics, social exchange theory, and strategic management literature, RBT resource-based theory (see, e.g., Barney, Ketchen, & Wright, 2011; Penrose, 1995; Prahalad & Hamel, 1990) and its extensions. In addition to approaches of network theory this study utilizes role theory (see, e.g., Callero, 1994; Linton, 1936; Thomas & Biddle, 1966) concepts and theoretical models to describe the research phenomena managing in R&D nets. Also, business strategy and traditional management theory provide useful concepts, classifications and models that have been used in the investigation of managing in network in literature.

![Positioning the study](image)
Figure 2 depicts and positions the key theories this study is based. It identifies the key concepts of interest among the theoretical discussion, identifies the context this study and positions this study in the network discussions. Key theories: Network theories and Role theory are identified in figure 2 as dashed line round edge rectangles. The area this study is positioning is identified in figure as dark gray rectangle, with rounded edges and key concepts that are used in this study are included in the rounded rectangle.

The following section discusses the Interaction and Network Approach (INA) and Strategic Networks and Role theory as key theories used in this study. As a concept of interest, managing in networks, roles for managing, the process of managing in net and benefits and challenges of managing for actors are presented in the second section. The third section depicts the R&D net as the context of this study.

*Interaction and network approach – industrial marketing*

The IMP (International Marketing and Purchasing Group) created the industrial network approach (INA) perspective for understanding and describing business networks and organizational action in a network context. The INA provides at the micro level unit of analysis, the individual relationship and the capability to create, maintain and conclude relationships as a key capability for a firm (Möller & Halinen, 1999). Relationships are seen as economic aspects: investment into relationships, costs of adaptations, and behavioral aspects: expectations, relationship atmosphere, and mutuality (Möller et al., 2009). In addition, the processual character of relationships is comprehended through resource and social exchange adaptations and processes (Möller et al., 2009).

The term network refers to relationships between multiple firms that interact with each other (Möller & Wilson, 1995). A network is a structure of nodes (e.g. business units, organizations, government, research agencies, individual actors or any other relevant actors) for understanding a network (Möller & Halinen, 1999; Möller, 2013), and threads (relationships between nodes) (Håkansson & Ford, 2002).

The unit of analysis in INA consists of viewing networks and relationships (Möller et al., 2009) and the focus of the approach is on both the network structures and the network dynamics. Networks can be analyzed on three varying levels: micro, meso and macro (Möller et al., 2009; Möller, 2013). Firstly, in network research, the micro level focus is on relationships and how relationships are utilized
by individual organizations (i.e. actors) that act in a network context, and how they create, develop, maintain, and dissolve network positions and roles (Möller & Halinen, 1999; Möller et al., 2009). Relationships provide access and the ability to control resources in addition to co-creating new resources (Håkansson & Ford, 2002; Möller, 2006; Möller et al., 2009). The key is the understanding of capabilities and competencies through which actors try to achieve their goals in or through relationships (Möller et al., 2009). At the micro level unit of analysis, the individual relationship and the capability to create, maintain and conclude relationships is a key capability for a firm (Möller & Halinen, 1999). Relationships are seen as economic aspects: investment into relationships, costs of adaptations, and behavioral aspects: expectations, relationship atmosphere, and mutuality (Möller et al., 2009). In addition, the processual character of relationships is comprehended through resource and social exchange adaptations and processes (Möller et al., 2009).

Secondly, networks can be analyzed at a macro level, which sees business networks as being constructed by complex, interdependent and interorganizational relationships (Håkansson & Snehota, 1995) that extend to markets in the form of network-scale structures that contend that industries, clusters, or markets form the networks (Möller, 2013). The macro view perceives the market as one giant interrelated network, much like markets in an industrial organization approach (Möller et al., 2009) or channel systems in channel research, but with a greater focus on resource ties, activity links or social and organizational actor bonds connecting the network actors (Möller, 2013).

At the macro level, industrial networks are described and analyzed via the actors-resources-activities (ARA) framework (Håkansson & Johansson, 1992; Håkansson & Snehota, 1995), which depicts the fundamentals of the network structure and defines the substance of relationships (Ford et al., 2003). Networks consist of multiple actors that carry out, based on their resources, activities through which they produce resource sets or offerings, the value of which is then perceived by other actors (Möller & Halinen, 1999; Svahn & Westerlund, 2007). Actors can be firms, organizations, research agencies, governments, individual actors, collectives or any type of organization that is relevant for understanding the network (Möller & Halinen, 1999; Möller, 2013). Networks are defined through three interrelated elements: Actors (that possess resources and perform activities), resources (that are the means that actors possess to use activities), and activities (which are the ways that actors use to change resources in others resources) (Håkansson & Johansson, 1992; Håkansson & Snehota, 1995). The intertwining
structure of actors bond each other with linking activities to others and bonding resources with others provides the stability and possibility of change in industrial networks (Håkansson & Johansson, 1992). Actors are interconnected as they transform their resources through joint activities and in this way, produce the substance of business relationships: Actor bonds, resource ties and activity links (Håkansson & Johansson, 1992; Håkansson & Snehota, 1995). Consequently, an R&D net can be described through its “web of actors” and the “activity pattern” that performs through their resources constellation. The INA is sensitive to development over time, it assumes that organizations transform resources to carry out transactions linked by it, and that the cumulative effect of the development in relationships influences both the position and the network in which the activities are performed. Actors are seen organic, adaptive and related to their historical events, to the extent that normative and managerial suggestion must be understood in relation to a particular network situation and historical context (Möller, 2013).

Thirdly networks in an INA approach can also be analyzed from the meso level (Möller et al., 2009; Möller, 2013). The INA categorizes organizational networks into evolutionary, historical, and self-organizing groups (Håkansson & Snehota, 1995; Håkansson & Ford, 2002), and sees networks as borderless (Möller, 2013). However, some see that actors possess limited sense-making abilities, limited resources and cognitive capabilities; thus they make sense of their network as focal networks (Möller, 2013). A focal network (see e.g. Alajoutsijärvi et al., 1999) refers to a limited relevant network construction that actors in a network can comprehend and perceive as relevant and that is within their network horizon (Möller & Halinen, 1999). Focal net as concept is utilized, because actors possess limited resources and cognitive capacity, which constrains their abilities to make sense of such a vast organizational structure as macro-level borderless markets as networks structures (Alajoutsijärvi et al., 1999; Möller, 2013).

The objectives of the focal network approach are: ascertaining how these networks evolve and how companies try to utilize them to gain advantage, i.e., focus on analyzing the focal firm’s relationship with its environment, and how an actor tries to utilize its position or roles in a focal network (Möller, 2013), how and to what extent they are intentionally created and managed (Möller et al., 2009, 157) or how value is created in strategic nets (Möller et al., 2005).

This study bases its perception of relationships on the INA perspective that aims to understand and describe the relationships and the management of an individual firm within a network context (Ford et al., 2003; Håkansson & Snehota, 1995; Möller, 2013). The business network approach provides a descriptive theory
that can comprehend how networks emerge, the motivation for the existence of different network structures, drivers for different network structures, and through what kind of processes networks develop (Möller, 2013). This study uses also ARA model conceptualization: Actor bonds, resource ties and activity links for understanding the structure of the focal net as well as the development of the net over time.

In the literature, strategic nets or focal networks are positioned within the INA approach discussion (see e.g. Möller, 2013) as meso-level networks studies that share a similar theoretical base, with a distinction concerning the manageability of business networks. In addition, meso level network addresses how strategic nets evolve and to what extent or how these structures can be intentionally created and managed (see e.g. Möller et al., 2005). In the following section, these intentionally created and managed meso-level strategic networks and strategic nets are presented and discussed in more detail.

**Strategic networks**

Klint and Sjöberg (2003) define networks using two categories: Organic networks and strategic networks. Organic networks are seen similarly to the INA approach as a network of interdependent relationships bonded together with resource ties and activity links. Researchers representing a traditional or strategic management view combined with resources and capability, sees more intentionally created networks with defined roles and a specific set of relationships. (see, e.g., Dyer & Nobeoka, 2000; Möller et al., 2005; Nalebuff & Brandenburger, 1997; Partanen & Möller, 2012)

Strategic networks (Gulati et al., 2000; Jarillo, 1988; Möller et al., 2005) are intentionally developed, goal-oriented and organized networks of organizations cooperating with a certain purpose. Strategic networks consist of interconnected firms with multiple networks of resources and other flows (Gulati et al., 2000). Actors in a strategic network include suppliers, customers, competitors, and governmental institutions, such as universities or research and training institutions (Gemünden, Ritter, & Heydebreck, 1996; Gulati et al., 2000; Ritter & Gemünden, 2003) that are connected through horizontal-, vertical- (Gulati et al., 2000) or even multidimensional- (Nosella & Petroni, 2007) level relationships.

Strategic networks enable learning, achieving scale and scope economies and enabling firms to achieve strategic goals. The possibility of a lock-in effect of
ineffective relationships or precluded partnering with viable actors is seen as a 
negative effect of networking in strategic networks. (Gulati et al., 2000.)

Strategic networks have been divided into two categories: strategic multi-actor 
networks and hub-driven strategic networks (García-Canal, Valdés-Llaneza, & 
Ariño, 2003; Partanen & Möller, 2012). Strategic networks like multi-actor 
alliances are collective voluntary organizational associations that engage their 
actors interactively in multilateral value activities, e.g. collaborative R&D, 
sourcing, production or marketing of technologies, products or services (see e.g. 
Lavie et al., 2007). The network is characterized by shared management, the pursuit 
of common objectives and overarching contractual agreements (Partanen & Möller, 
2012), and multilateral interaction among actors that generates unique dynamics 
(Lavie et al., 2007). Actors in multi-partner strategic networks strive for common 
objectives but may differ in terms of their individual interests and compete for their 
share of benefits created in co-operation (Lavie et al., 2007).

A second type of strategic networks – hub-driven strategic networks or 
egocentric networks (Ozcan & Eisenhardt, 2009) - are formed from three or more 
dyadic relationships which all contribute to the hub-actor business operations. 
Strategic networks are a means for the hub company to improve its competitive 
position in relation to its competitors (Gulati et al., 2000; Jarillo, 1988). Its central 
position attracts actors to the network, thus enabling greater access and potential 
control over relevant resources. Actors are able to control relevant resources and 
increase other actors’ interdependence on themselves (Brass, Galaskiewicz, Greve, 
& Tsai, 2004). Hub networks are centrally embedded within broader industry 
structures (Powell et al., 1996) and with many diverse partners (Baum, Calabrese, 
& Silverman, 2000) that provide information, flexibility, and resource benefits that 
are likely to enhance firm performance. Hub-driven networks are identified as 
being common in creating emerging business systems (Möller & Rajala, 2007) or 
networks, and there is a growing body of literature on hub-based strategic network 
management. (see e.g. Järvensivu & Möller, 2009; Möller et al., 2005; Möller & 
Rajala, 2007; Partanen & Möller, 2012) However in this study the acknowledges 
the multi-actor strategic networks, that have not received such extend of research 
attention.

Discussion on strategic value nets is taking combined approaches from the 
industrial business networks approach as well as strategic networks. In the 
following section, the strategic nets discussion is depicted in more detail.
Strategic nets

In the literature, several definitions of “strategic networks” can be found. Some see strategic networks as “strategic alliances” (Klint & Ulf Sjöberg, 2003), a portfolio of sets of ties (Ozcan & Eisenhardt, 2009), value nets (Parolini, 1999) or focal networks (Alajoutsijärvi et al., 1999; Möller, 2013)), strategic value nets (Möller & Svahn, 2003; Svahn, 2004), strategic business networks (Järvensivu et al., 2010), strategic nets (Möller et al., 2005), or strategic business nets (Möller & Rajala, 2007) to separate the discussion from the more generic and emergent nature of INA network perception.

The concept of strategic business nets combines the elements of intentionally developed networks, value creation in co-operation within a value net (see e.g. Nalebuff & Brandenburger, 1997) and elements from a traditional strategic network. Strategic business networks are seen as intentionally developed and managed interorganizational co-operation between three or more organizations, i.e., focal nets (Alajoutsijärvi et al., 1999) for mutually beneficial strategic business goals (Järvensivu et al., 2010; Möller et al., 2005; Möller & Svahn, 2009), typically hub-driven networks (Möller, 2009), or multi-actor networks (Partanen & Möller, 2012).

Strategic nets combine horizontal (competitors, public agencies, research institutes) and vertical actors (suppliers, subcontractors, distributors, customers) (Möller, 2009; Nosella & Petroni, 2007). Strategic nets are partially closed systems, with a defined set of members, with jointly agreed roles and objectives (Möller, 2013) consisting of relationships that have strategic importance to the participating firms. Also, the ability to identify roles, capabilities and modify strategy in a net noted (Möller et al., 2005). Strategic nets are collective, voluntary organizations that interactively engage multiple legally independent firms in such activities as manufacturing and marketing, or R&D (Gulati et al., 2011; Lavie et al., 2007), and R&D services or R&D service providers (Kohtamäki et al., 2013).

Network, network management and innovation is typically covered in the strategic business literature as intertwined phenomena (see e.g. Järvensivu & Möller, 2009; Möller et al., 2005; Möller & Rajala, 2007). The business network classification model by Möller and Rajala (2007) is used in the literature to approach management in networks, and the approach to innovation is discussed. In the strategic nets literature, different value-creating system definitions are used to identify different types of networks and management activities and required capabilities (Möller & Svahn, 2003; Möller et al., 2005; Möller & Rajala, 2007).
An emergent value-creation system concept is used among strategic nets discussion to identify networks that intentionally create new value networks.

In this study, a network is seen as meso-level focal nets, thus it enables analysis and understanding of the intentional creation and management of focal network structures. However, the characterizing aspects of an interaction and network approach to relationships and networks have been adopted in this study, thus understanding macro networks and their dynamics is fundamental to understanding focal networks (Möller, 2013). This study sees relationships as the basic unit of analysis in networks, filled with actor bonds, resource ties, and activity links, characterized by behavioral, economic and processual factors, enabling access to resources and as means to achieve the goals of the network. In this study network refers to a structure of restricted number of interconnected organization, i.e focal net. A net is a collection of actors that possess resources, and perform multiple activities in order to create or change resources that could be perceived as value appreciated by other actors. Boundaries of the multi-actor net are defined according the joint development task and each actor in the net recognizes other actor as members.

Similarly to other strategic nets studies (Järvensivu & Törnroos, 2010; Möller et al., 2005; Partanen & Möller, 2012), in this study the strategic nets have been acknowledged as being based on explicit definitions. The strategic nets discussion provides a beneficial theoretical frame and a conceptual background for this study, and thus the shared perception of basic units of analysis consisting of networks, nets and relationships. The key phenomena in strategic nets is to understand the strategic nets that a firm is embedded in, and the position and roles that actors play in business relationships. In the context of new business development in emerging business networks, the focus is also on being able to manage actors from several fields of business, including demanding, visioning, networking capabilities like actor evaluating, direction through agenda setting, and motivating. In addition, the ability to identify roles, capabilities, and modify strategy in a network is perceived as being central (Möller et al., 2005).

In the following section, the third key theory i.e. role theory is described more in detail.

**Role theory**

The role is widely used in social scientists (see, e.g., Linton, 1936; Thomas & Biddle, 1966; Zurcher, 1983) that use concept “role” differently. However, the
different perceptions the core-concept the aim of the theory is similar. The scientific aspiration of role theory is to understand, predict and control the human behaviour. The difference in perception among Role Theory relates typically to the behavioral expectations constituting roles. (Zurcher, 1983) Some researchers perceive roles as fixed components of established social structures, that predetermine and restrict behaviour of people and single persons. Others focus According to Zurcher (1983, 11) on the way roles appear in social setting and how single individuals influence the character of behaviour expectations.

Roles theory views roles from three distinctive approaches: Structural functionalist, symbolic interactionist, and resource-based (see, e.g., Callero, 1994; Thomas & Biddle, 1966). The structural functionalist approach sees that the network position determines the roles in which an actor can act. Based on Zurcher (1983) “[the role] typically refers to the behaviour expected of individuals who occupy particular social categories.” These social categories include statuses of formal (e.g. fathers or mothers in family, clerics in churches, professors in universities) or informal social statuses (e.g., movie audience or supermarket customer) as well as statuses reflecting the cultural values of society (e.g. hard worker). (Zurcher, 1983, 11) Thomas and Biddle (1966) refer to the expected behaviour of these social statuses as “designated location in certain structure” and name these statuses as positions. In organizational setting role behavior is based on recurring action with appropriate interaction with other actors performing their activities, that are creating predictable outcomes (Katz & Kahn, 1966, 174).

Therefore, for analyzing roles it is required to identify the relevant surrounding structure and locate the events that are used for converting inputs to outputs. In structural functionalist approach a role is seen as a dynamic extension of a static position, that is used to situate the actor in its network, with the actor filling the pre-existing position (Nystöm et al., 2014). Role carries the depicting elements of the static position of an actor within network structure, its abilities to change position and expectations of behaviour in the network structure.

The symbolic interaction perspective (Ashforth, 2000; Thomas & Biddle, 1966) perceives roles as emergent and negotiable. Role are not consequence of a position in a social, but must be claimed before able to defined as position (Callero, 1994). Actors are able to jointly define what constitutes a role, based on their preferences, perceptions and interpretation (Ashforth, 2000). An actor can change its position in a role in situation-specific constructs. (Anderson, Havila, Andersen, & Halinen, 1998; Ashforth, 2000) In addition, roles are regarded (Anderson et al., 1998) as concepts describing the intentions of business actors, the construction of the
meanings in their situation, and the construction of their preferences to changing it by acting in a role.

The third approach within role theory is the roles as resource approach (Baker & Faulkner, 1991; Callero, 1994). Roles can be seen in two ways as resources (Nyström et al., 2014, 484). Firstly as means to claim, bargain for and gain membership and acceptance in social community (Winship & Mandel, 1983) Role can be used to grant access to social structural and material capital that are usable to pursue its own targets (Baker & Faulkner, 1991). Roles are tools to control other resources and establish social structures and they make the action possible. (Callero, 1994) Callero (1994) depict the roles as combination of role-making and role-taking. This duality in nature of roles have been acknowledged in this study as well and adopted to perceiving role behaviour as expected and emergent. The roles as resources approach is dissimilar with symbolic interactionist approach, thus it sees roles transferrable to other structures (Nyström et al., 2014). Comparison to position that are context specific roles can be seen transcend to over structural boundaries and “role can be known independent to any particular structural location” (Callero, 1994, 229).

Understanding roles requires understanding a role-related concepts: role-set, role expectation and role behaviour. Role set refers to expected acting in a role. The role set is used to define the interdependence of actors to each others e.g. managers immediate supervisor, subordinates and other departments that are closely in collaboration (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964; Shivers-Blackwell, 2004). Role set refers to any and all features that are able to send role expectations in the organizational structure. Role set refers to expectation sent by the individuals as well as the expectations sent by the characteristics of the organization. Expectations based on organization characteristics consists both demands and constrains that provide the minimum core duties, activities, standards, objectives and that must be met. These organizational expectations are seen in short run seen to limit actors choices, but they are able to modify and eliminate in long-run (Shivers-Blackwell, 2004).

Sent role is understood as communicated role expectation (Kahn et al., 1964) to focal person (Shivers-Blackwell, 2004). These expectation, are communicated differently i.e. sent directly or indirectly (Shivers-Blackwell, 2004). Example of direct role-expectation is typically job description, task description in collaboration agreement or indirect expectation is colleagues admiration (Shivers-Blackwell, 2004). Role expectation may also be directly related to position in the network.
structure, that defines the behavioral expectation per each position as the Structural functionalists perceive (Ashforth, 2000; Thomas & Biddle, 1966)

Role behaviour is defined as system relevant behaviour (not necessary congruent with the expectations and requirements of others) that is performed by accepted member of the system, and whose behavior is reinforced by the formalities of the organization (Kahn et al., 1964, 18) The domain role theory is focusing on depicting and understanding the rich tapestry of human behavior. Roles have been in focal area when depicting organizations (Katz & Kahn, 1966). This study follow (Katz & Kahn, 1966, 16) their definition of organization as social system that consists of patterned activities performed by individuals. Organizations create outputs, from inputs through these patterned activities that is ensuring the existence and continuation. The activities are by nature overlapping, seeking common outcomes and interdependent. The actors as organizations in net are accordingly system of individuals performing roles that consist of acts with materials, machines and interaction with others (Katz & Kahn, 1966, 173).

Roles have seen as research perspective in management studies as a perspective alongside management functions, management task characteristics and management control. (Tsoukas, 1994) Role have been utilized in understanding in several management studies that provide descriptions of managerial roles. (see, e.g., Mintzberg, 1973; Snow, Miles, & Coleman Jr., 1992) In role theory organizations are seen not only utility maximizing entities, rather collection of roles where role carries information about the expected and socially constructed behaviours (Montgomery, 1998). This notion is further developed by Anderson et al. (1998), that see role as description of intentions of an actor, a construction of the meanings in their situations and a construction of preference of changing it by acting in a role.

Role theory in combination with network theories is able to conceptualization required for this study. The role theory can provide extended conceptual understanding of the actions that actors perform towards activities, resources and other actors, i.e managing in net. The concept of role has been utilized in the numerous studies in order to understand the dynamics in the business networks. (Anderson et al., 1998; Knight & Harland, 2005; Nyström et al., 2014) The role theory facilitates observations about the roles, ancillary activities and the resources that the actors in role have influence (Markham et al., 2010, 405).

In the following section, the key concepts used in this study and contribution of this study are depicted in detail.
1.4.2 Key concepts used in this study

This section identifies the theoretical concept of interest and identifies the discussion this study is aiming to contribute. The key concepts required for reaching the purpose of this study are identified within the theoretical discussion as industrial business networks, strategic network discussion, and strategic nets discussion. Role theory have been utilized in this study to create new insights to network theories both industrial network approach and strategic nets discussion. The following section discusses how managing in networks i.e. perceived within relevant network theories of this study.

Network management – managing in networks

Within network theories in the INA approach and strategic networks discussion, there is a debate about the nature and possibility of management in networks (Ritter et al., 2004). Networks studies note that “network control kills networks” (Waluszewski, 2004), or “no company manages it [the network] although all companies try to manage in it or no company is the hub of a network” (Ford et al., 2003, 175). The INA stresses the futile search firms or networks undergo toward the optimum, thus resources, actors and activities are inhomogeneous (Håkansson & Ford, 2002), and stability and change co-exist in networks (Freytag & Ritter, 2005). Actors are not in total control of their resources or activities, as other actors influence or limit the actions. (Ford et al., 2003). Conversely, strategic network argue that firms are in control of themselves and their surrounding firms as hub firms that control strategic networks (Gulati et al., 2000; Jarillo, 1988).

Within the strategic net discussion (see e.g. Möller & Halinen, 1999; Möller & Svaln, 2003; Möller et al., 2005; Möller & Rajala, 2007), there is discussion of managing networks with overlapping concepts within the boundaries of the industrial network approach (INA) and strategic networks literature. Strategic nets “rejects the assumption of unmanageability” (Matthyssens et al., 2013, 416) and regards networks as intentional management (Järvensivu & Möller, 2009; Möller & Halinen, 1999; Möller et al., 2005; Möller & Rajala, 2007). They take strategic net approach, with its less rigid approach toward network management, see it as a relative issue based on the unit of analysis. (Järvensivu & Möller, 2009; Möller & Halinen, 1999; Ritter et al., 2004) An intentionally created and mobilized focal net pursuing a joint strategic objective can be labeled as a strategic net (Möller et al., 2009) or a strategic value net (Möller et al., 2005; Möller & Rajala, 2007; Möller,
Strategic nets are specific focal network e.g. supply nets, competitive coalitions, R&D and innovation nets (Möller et al., 2009).

Strategic net researchers argue that networks are being managed all of time. (see e.g. Järvensivu & Möller, 2009) An ability to manage a network is regarded as crucial to success in organizations, and sees relationships as an asset in generating change in a network (Mouzas & Naudé, 2007). Strategic net researchers argue, that “if nets were not able to be managed there would not exist functioning value networks” (Järvensivu & Möller, 2009, 654). Some even argue that actors being able to choose when to lead and when to be led by other actors (Ford & Mouzas, 2008).

Managing in nets as an ability to influence in a network is already seen as a realistic choice to manage networks, thus the focus is on limited entities such as nets (Golletto, Salle, Borghini, & Rinallo, 2007). Managing in a network can be seen as a self-initiated process by network members themselves or mandated or contracted to an external actor (Provan & Kenis, 2008), or facilitated by a network broker (de Klerk & Kroon, 2008). Managing in networks may also be conducted via external or internally mandated Network Administrative organization (Provan & Kenis, 2008). The structure of the network is seen to influence managing in net (Möller et al., 2005; Provan & Kenis, 2008). Network structures form a continuum, from decentralized to centralized forms (Provan & Kenis, 2008).

In a centralized network, the connections between the actors are organized through a centrally located actor, i.e., lead organization, with few direct actor-to-actor connections, as in hub and spokes. The lead actor coordinates all network-level key decisions; this is possible when the actor has sufficient resources and legitimacy (e.g., in vertical buyer-supplier networks, Japanese Keiratsu, major studio film production or horizontal multiactor networks). (Provan & Kenis, 2008.) In strategic networks, centralized structure is seen to improve the abilities for competitive advantage and utilization of resources of other members (see, e.g., Gulati et al., 2000; Jarillo, 1988).

In decentralized networks, all actors interact with each other, and manage through that interaction and shared activities. Management is performed through designated actor meetings or informal and uncoordinated efforts by those who have a stake in network targets. (Provan & Kenis, 2008) As the power is symmetrically dispersed (although the actors vary in size, resource capabilities and performance), the network acts collectively without a distinct administrative entity. (Provan & Kenis 2008.) Actors strive for the common objectives of the net, but may differ in
their individual interest and may compete for their shares of jointly created benefits (Lavie et al. 2007).

Both presentations of network structure are extreme and there is an option in the middle of the both extremes. In a mid-range structure, a single organization may take on some management activities and leave other management activities to some other member. In this form of shared management, responsibilities are divided among various subsets, or clique of actors, with no single organization taking on a significant management task (Provan & Kenis 2008.) This structure is identified in nets developing a new product (see, e.g., Venkatraman & Lee 2004) in business networks.

This study features a network structure that is neither de-centralized nor hub-based. In this study managing in net is based on shared management of actors and no single organization is in a role or position to manage all activities. Participant-governed nets are dependent on the involvement and commitment of actors that manages the relationships inside the nets and external relationships (e.g., funders, customers, and the government). Coordination and administration is performed in the net by a subset of actors and is distinct without a distinct formal administration. (Provan & Kenis 2008.)

The discussion related to managing in networks and manageability requires scrutiny of the key concepts and the unit of analysis. In this study managing in nets is seen as relative issue (see, e.g., Möller et al. 2005, Möller & Rajala 2007, Ritter et al. 2004) likewise strategic net approach. This utilizes nets or meso-level networks (Möller & Halinen, 1999; Möller et al., 2009; Möller, 2013) or in terms of Möller and Halinen (1999) as second level, i.e., firms in strategic net as unit of analysis to review managing in R&D net. Strategic net discussion is applied in this study to enable abilities to depict and conceptualize managing in R&D nets. Strategic net discussion focuses on how these nets evolve, which positions they occupy and which roles they play (Möller & Halinen 1999). Additionally, strategic net discussion is able to clarify how actors are able to utilize nets and which roles or positions an actor is able to gain within a net (Möller 2013). In addition, the ability to identify roles, capabilities, and modify strategy in a net is perceived as being central (Möller, Rajala et al. 2005).

This study uses the Ritter et al. (Ritter, Wilkinson et al. 2004) twofold perception of managing, influence other actors in the net (to manage) and be influenced by other actors (to cope). Managing is firstly leading and determining, secondly coping to situation. In general, it is managing interaction from actor to actor that is representative of organizations, not management of others. In this study
managing requires initiating and responding, acting and reacting, leading and following, influencing and being influenced, planning, coping, strategizing and improvising, forcing and adapting. Managing is a two-way process of influencing and benefiting other organizations’ resources, initiative and creativity (Håkansson & Ford 2002, Ritter et al. 2004.) Managing in net refers to an actor’s capability to mobilize and coordinate other actors’ resources and activities (Möller, Halinen 1999). Managing is seen in this study similarly with Ojasalo (Ojasalo 2008), in that not 100% control of each aspect of the subject, but rather it is a conscious attempt to define and reach goals with actions. Managing in nets is performed by actors by acting reacting and adapting in in a complex social system [i.e. net] in such way that both individual and communal goals of actor are reached (see e.g. Chiu 2009, Yen 2008). It is also seen as particular and intentional actions of an actor within a net in order to achieve its goals and joint goals of the net. The actor and the network have overlapping goals, to the extent that achievement of the networks’ goals progresses the goals of individual actors and vice versa. In general, goal consensus and similar perception of domains allows an organization to perform better (Provan & Kenis 2008). Also, mutual understanding and acceptance of vision, targets and frame of action similarly, i.e., cohesiveness, has an influence (Järvensivu et al. 2010).

Strategic nets discussion (see, e.g., Möller et al. 2005, Möller & Rajala 2007) use a model for defining managing in different types of nets and capabilities required. The level of determination of the value creation system (i.e., value constellation) clarity of the joint goals and outcomes of the net are used for defining managing in different type nets (Möller et al. 2005). A key matter in managing in net is then the actor’s ability to mobilize and coordinate other actors in net and what positions or roles it can achieve (Möller et al. 2005). Managing in net additionally requires the ability to form a valid view of the net and their potential evolution, i.e., net visioning capabilities (Möller & Halinen 1999). In this study, the limited net visioning capabilities are expanded by systemically generating and evaluating information on R&D net by reviewing it though roles for managing and the process of managing.

The following section introduces roles for managing and discusses potential conceptualizations in understanding managing in nets.
Roles for managing

Management functions (planning, organizing, commanding, coordinating and controlling) (see e.g. Fayol 1949) are among the classical research perspectives in management. In addition to management functions, management roles, management task characteristics, and management control are noted as research perspectives in management (Tsoukas 1994). Järvensivu and Möller (2009) characterize network management on four levels: Management in industrial and socioeconomic contexts (level 4), management in different governance modes or function-level contingencies and management in networks (level 3), management in tasks (level 2), and managerial roles (level 1). This study, adopts the perception of the managing in R&D net as phenomena related to roles for managing at the management task level. The role theory is able to provide insight into discussion of managing in nets, thus role theory provides observations about the roles, activities and the resources that the actors in those roles ultimately influence (Markham et al., 2010, 405). Role rhetoric can be used to improve understanding of R&D nets and relationships by identifying each actor’s roles in the network (Nyström et al. 2014).

The concept of role is applied and used in organizational and business networks studies, due to the shared perception of an organization as an aggregation of activities. The concept of role and role theory (Katz & Kahn, 1966; Thomas & Biddle, 1966) has been used in relation to organizations in varying contexts in organizational role studies (Snow et al., 1992), in marketing relationships (Heide & Wathne, 2006), in relation to embeddedness (Montgomery 1998) and in building knowledge networks (Büchel & Raub, 2002).

Roles for managing and role theory has also been gaining importance in business networks-related discussion. Role theory conceptualizations have been used to understand networks already in early INA studies (see e.g. Anderson et al. 1998) and within INA approach managing in networks discussion from varying contexts, e.g., supply networks (Knight & Harland, 2005), in R&D networks in context in living labs (Nyström et al. 2014), and in radical innovation contexts (Story et al., 2011).

Role theory views roles from three distinctive approaches: Structural functionalist, symbolic interactionist, and resource-based (Callero, 1994; Thomas & Biddle, 1966). Action based approach is the most recent proposition among role theory approaches (Nyström et al. 2014).
The structural functionalist approach sees that the network position determines the roles in which an actor can act. A role is seen as a dynamic extension of a static position (Nyström et al. 2014) that is used to situate the actor in its network, with the actor filling the pre-existing position “as a designated location in a certain structure” (Thomas, Biddle 1966) and performing relevant roles. In relation to roles, Van de Ven et. al. (1999, 112) notes that roles should be viewed as being dependent on others in constellation, thus “understanding roles requires knowing its relationships with others.” A structural functionalistic approach was explicitly utilized in early industrial network studies (Mattsson 1985) and implicitly in strategic net literature, viewing from the perspective of hub actors (e.g., Partanen & Möller, 2012), or studies that view the position based on resource and activity possession as a determinant of managerial abilities. (Järvensivu & Möller, 2009; Järvensivu, Lukkari, & Järvensivu, 2010; Möller et al., 2005)

The symbolic interaction perspective (Ashforth 2000) perceives roles as emergent and negotiable. An actor can change its position in a role in situation-specific constructs (Anderson et al. 1998, Ashforth 2000) and socially constructed behavior. In addition, roles are regarded (Anderson et al. 1998) as concepts describing the intentions of business actors, the construction of the meanings in their situation, and the construction of their preferences to changing it by acting in a role.

Roles are seen fluid and context-dependent (Tsoukas 1994) in relation to managing, and therefore role conceptualization from varying context benefits the discussion. In this study, role is used as a concept for understanding managerial actions both as dynamic phenomena and as a collection of purposeful actions in order to achieve change in the network. Role theory and roles are understood both from a structural functionalistic perspective and a symbolic interactionist perspective. The interactionist approach is seen as useful in earlier network management studies (Knight & Harland, 2005). Role theory approaches can be seen as complementary for describing network role dynamics (Nyström et al. 2014), and therefore the use of several approaches is seen as useful in understanding R&D network management.

In network management discussion metatheory (Järvensivu, Möller 2009) and some studies that focus on roles of managing in varying contexts (Knight & Harland, 2005), research on roles of managerial roles is divided to two paths. The first path aims to identify roles in different contexts, and the second path seeks out roles that can be identified over contextual boundaries, i.e., generic roles. Generic roles typically appear in varying network contexts, e.g., role champions (Batterink
et al., 2010; Klerkx & Aarts, 2013), intermediaries (Howells 2006), or identify
generic roles based on existing role definitions (Weichhart, Feiner, & Stary, 2010),
or identifying generic individual roles within an organization (Gemünden, Salomo,
& Hölzle, 2007).

This study uses role theory as a conceptualization for contributing to the
strategic value net discussion by utilizing roles for managing as key
conceptualizations of this study. As this study aims to expand the discussion of
roles in managing in nets based on empirical results from the R&D network context
as well as reflections to contemporary literature, while acknowledging that roles
are seen as fluid and context-dependent (Tsoukas 1994) with limited potential for

Roles for managing is seen also applicable in this study, thus role as a concept
is seen to describe the dynamics in the network, the actions and intends of an actor.
(Anderson et al. 1998) As Symbolic interaction roles studies (Ashforth, 2000;
Thomas & Biddle, 1966) appreciate the development of roles by actions of an actor
in net towards a direction, therefore roles as concept are applicable to describe
dynamics in social structures i.e nets. Roles as a concept are used in studies for
describing the change and dynamics in the business networks (Anderson et al.,
1998; Knight & Harland, 2005; Nyström et al., 2014), and describing the changes
in management in phases of development. (Markham et al., 2010) In addition, by
understanding how the roles are related and linked together, the progress towards
subsequent phases (Markham, Ward et al. 2010) and the whole R&D process can
be achieved.

As the managing in net and roles for managing in nets as collections of intended
and interpreted actions are seen as dynamic phenomena, the ability to comprehend
such dynamic phenomena requires understanding managing in net as a process. In
the following sub-chapter, process aspect is discussed in more detail.

**Process of managing in networks**

Studying networks is challenging, because dynamic and constantly changing
networks set challenges for network research Process studies take the researcher
into a conceptual terrain of events, episodes, activities, temporal ordering, and
fluidity, which enables understanding of change, stability, and emergence (Langley,
Smallman, Tsoukas, & Ven, 2013) and why certain causalities happen. (cf. Van De
Ven 1992, Makkonen H. et al. 2012) Process studies incorporate different types of
effect in their explanations, including critical events, turning points, contextual
influence formations that imply the overall direction of the change, or factors that influence the sequencing of events (Van de Ven & Poole, 2005). Process refers to a sequence of events or activities, which describe development over time (Van De Ven 1992). The focus on process injects time as an element to the study and allows the dynamic changes for the phenomena in question to be reviewed (Parkhe et al., 2006). In this study process is seen alike (Pettigrew 1997, 338) as sequence of individual and collective events, actions and activities unfolding over time in context. Actions generate change and drive processes, but they happen in context that influences actions and their perception. Time and history are central to any process (Pettigrew 1997), and time and temporality is connected to change (Halinen, Törnroos 2005). To understand and interpret change, it is essential to understand how it unfolds over time in addition to how time and timing affects it (Van de Ven & Poole, 2005). The past shapes the future: what happens, how it happens, and why it happens. The results it yields or the changes it generates is dependent on when it happens (Pettigrew 1997).

In network studies, time is a relational concept (Halinen & Törnroos, 2005) consisting of past, present, and future. According to the temporal focus, network studies are divided into historical studies, which focus on the past; present studies, focusing on follow-up studies; and future studies, which focus on forthcoming times (Halinen & Törnroos, 1995; Halinen & Törnroos, 2005). This study views development in network in present time.

A key aspect in process studies is the quest to find underlying mechanisms. Process studies use events, chronologies, and retrospective data, but only to the extent that they enable holistic understanding. The aim of processual analysis is to produce a case study that rises above events and analysis and is able to describe, conceptualize, models, measure and explain. (Pettigrew 1997.)

To improve the understanding of the underlying mechanism, an understanding of different process approaches is also needed, because a single conceptualization of change provides only a partial view of complex processes (Van de Ven & Sun, 2011). Different conceptualizations of process include life cycle, teleological, dialectic, and evolutionary (Van de Ven, Sun 2011, Van De Ven, Poole 1995, Van De Ven 1992) A life cycle process, i.e., a regulated change model, is depicted by prescribed sequences of change that seek to find and assess linear, irreversible, and predictable progression of events or states over time (Parkhe et al. 2006). A teleological process, i.e., planned change, emphasizes purposeful collaboration by actors toward certain end states. Dialectic process models, i.e., conflictive change, explains stability and change in terms of balance between opposing entities (Van
An evolutionary process reviews change and development in terms of recurrent, cumulative, and sequential variation, selection and retention (Parkhe et al., 2006). In this study both life cycle and teleological model is used for describing process in managing R&D net.

Business network approach provides also conceptualization and models for underlying mechanism of change. Business networks are loosely coupled systems, flexible by nature, thus change is inherent feature. Temporal dimension is also included in business network change. They are also embedded in different spatial, social, political, technological and market structure, which makes the context specific and unique. (Halinen & Törnroos 2005.) Network approach offers conceptual tools for understanding dynamics in business markets, concepts for understanding how networks change, and what are underlying forces of change in networks (Halinen et al. 1999). The industrial network approach sees process as interaction between active and purposeful actors, which affects and is affected by the relationships in which it occurs (Ford & Håkansson, 2006).

In this study, change and process are related to perception of managing in net. Managing in net is seen as actions of actors that are leading to a certain end state defined jointly by actors within the net. The process of managing is seen as teleological (Van de Ven & Sun, 2011), as a planned change of actors in a net purposefully aiming towards end states. Managing is performed by actors by acting, reacting and adapting in net in such way that both individual and communal goals of actors are reached (see, e.g., Chiu, 2009; Yen, 2008). Managing is seen the same way in Ritter et al. (2004), firstly as leading and determining, secondly it is coping with a situation as a two-way process of influencing and benefiting other organizations’ resources, initiative and creativity (Håkansson & Ford 2002, Ritter et al. 2004). Managing is seen with Ojasalo (2008) as conscious attempt to define and reach goals via actions. It is also seen as particular and intentional actions of an actor within a net in order to achieve its goals and joint goals of the net. When an actor and the net have overlapping goals, to the extent that achievement of the net’s goals furthers the goals of individual actors and vice versa. The change may be generated from events arising from the interaction or from the business environment-generated event (Halinen et al. 1999). Processes seen in interaction suggest that the outcomes in network processes are the result of the action, reaction and re-action of actors that take place in series and in parallel (Ford & Håkansson, 2006). Understanding network processes means also understanding the change in sequence of events that change network structures over time (Ryan, Tähtinnen et al. 2012). Consensus of goals and similar perception of domain [i.e., net] (Provan &
Among business networks discussion e.g., focal network (Alajoutsijärvi, Möller, & Rosenbröijer, 1999) and strategic nets (Järvensivu & Möller, 2009; Möller et al., 2005) are used to provide conceptualizations and models for understanding actors’ relationships, their interaction, evolution, change and managing in net.

In addition to network evolution, also the management in net is also apparently evolving. The studies exist that perceive changes of network management during different phase of network evolution in (see, e.g., de Reuver & Bouwman, 2012; Provan et al., 2007) or managing during certain phases, e.g., network formation (Birkinshaw, Bessant, & Delbridge, 2007; Doz, Olk, & Ring, 2000; Hagedoorn, Roijakkers, & Kranenburg, 2006; Partanen & Möller, 2012; Ring, Doz, & Olk, 2005) and review the latter phases of network evolution (de Reuver & Bouwman, 2012), or review managing business model development over different phases (Palo & Tähtinen, 2013).

However growing body of literature more research is of process of managing in nets is required. Mouzas and Naude (2007) argue that much could be gained from developing a clear and coherent framework that describes the dynamics and development processes of net management. In this study, nets are seen as dynamic phenomena and management in nets are perceived to be changing. The dynamics of managing in nets are understood via concepts that enable change implicitly. In addition to roles for managing, network structure is perceived as dynamic depiction over time. Finally, management in net is depicted both via teleological process as actions performed by actors aiming to a certain end state or goal of a net.

Process studies point out that development is seen as a sequence of events that happen over time in a certain context (Pettigrew 1997, 338). In the following section, the context of this study is described more in detail.

1.4.3 R&D networks as a context of managing in net

In the literature, R&D networks and innovation network are used rather freely and with overlapping characteristics. The concept of innovation covers invention with research and development of invention to innovation and launching to markets. In addition, the concept innovation comprises changes made to products/services itself, but also changes in processes, positioning in markets and mental models i.e. paradigms. (Francis & Bessant 2005) Innovation networks may refer to a set of actors mobilized by a focal company for R&D activities (Ojasalo 2008) or as a relatively loose science and technology-based research network guided by the ethos
of scientific discovery, involving universities, research institutions and research organizations of major corporations (Möller & Rajala, 2007). In this study, the context for research is R&D networks.

R&D networks are designed to share risk, cost and competencies in the development of new technologies, during pre-market competition or in project-like cooperation. They are typically a creation of a number of actors perceiving a certain issue or problem similarly and inquiring after solutions to that problem. (Möller & Rajala, 2007.) R&D networks are created and kept together by the joint task among number of actors inquiring into a particular problem and they perceive mutual dependence and adjustments with respect to this collective inquiry, however sectoral or geographical dispersion (Hellström, Eckerstein, & Helm, 2001), and share perceptions regarding the environment and the required adaptations. (Doz, 1996; Doz et al., 2000)

R&D networks consist of multidimensional actors: Customers, suppliers, universities, governmental organizations, technological agencies (Gilsing, Lemmens, & Duysters, 2007; Möller et al., 2005), individual customers and customer communities (Aarikka-Stenroos et al., 2014; see e.g. Birkinshaw et al., 2007) or triple helix organizations as combinations of companies, universities, and governmental agencies (Johnson, 2008) or between academy and industry (Hellström et al., 2001, 258). R&D network is a type of technologically oriented strategic net that provides new value based on new technologies or new business concepts (Möller et al., 2005). They networks may emerge to face competition against a dominant firm or market leader (Lavie, Lechner, & Singh, 2007), they may be initiated by crisis (Bessant & Tidd, 2007), or actors’ willingness to prepare for future needs (Birkinshaw et al., 2007) or arranged through informal knowledge exchange or formalized cooperative agreement around research or product related to particular area or task (Hellström et al., 2001, 258).

In this study, the R&D net defined as any form of formal and informal cooperative arrangement of group of actors perceiving joint task related to joint value creation and development of new offerings by based on new technology, solutions, services or business concepts.

The definition adopts from Hellström et al. (2001) definition of R&D network based on joint perception of task among group of actors that operate via formal or informal collaborative arrangement. Definition also adopts Millson and Wilemon (2008, 40) definition of strategic product development network, that is combined with strategic net (Möller & Svaehn, 2003; Möller et al., 2005; Möller & Rajala, 2007) approach.
of joint value creation for end-user perspective. In addition, the definition of R&D net is extended to multi-actor network, that adopt from multi-network approach and define net as group of actors that “strive for common objectives but may differ in terms of their individual interests and compete for their share of benefits created in co-operation (Lavie et al., 2007).

In this study, R&D net in the empirical phase I was developing a new service. In literature, R&D networks that develop products or services development networks are seen separately as new product development and new service development nets. (see e.g. Möller et al. 2008, Mustak 2014, Syson & Perks 2004, Tether & Taj 2008) This study acknowledges the differences of product or service development as objective of development of the net. However, in this study, services and products are perceived as offering and therefore this study perceives R&D net both as a new service and a new product development net. The strategic net approach (Möller et al. 2005), notes that in multidimensional R&D nets, the emergent nature of the value activities and actors forming the net and goal clarity influence abilities to manage in R&D net, not the contents of the offering. As the objective of this study is to describe, understand and conceptualize managing in net, the purpose of the net itself (a new product or new service development) does not influence the phenomenon of managing in net.

In this study, managing in R&D nets is seen as a process consisting temporally formation and collaboration of the net; i.e. planning, developing, piloting and commercialization. Temporally, R&D net development tends to follow the path of product or service innovation. The phases of the development process are based on product development literature (e.g. Dunn & Harnden, 1975) or on a series of detection, development, and deployment (Yadav, Prabhu, & Chandy, 2007) in addition to contracting (Ostendorf, Mouzas, & Chakrabarti, 2014) or on service development literature; planning, development, and market launch of service. (Gottfridsson, 2014) Also in strategic net discussion the development is seen to follow paths of offering development and consist of phases of exploration of innovation: Design, application, and dissemination (Möller & Svahn, 2009) There are also studies that have extended the discussion of the phases R&D nets both phases that precede and follow R&D activities. R&D net formation has been researched in varying context: the strategic network perspective based hub-centric strategic value network follow –up study (Partanen & Möller, 2012), from the innovation network formation (Birkinshaw et al., 2007) and learning networks (Bessant & Tidd, 2007) Also the motivation of network formation has been discussed at a general level in business network literature (Coles, Harris, & Dickson,
Researchers (e.g. de Reuver, Stein, & Hampe, 2013; Ritala et al., 2012; Story, Hart, & O'Malley, 2009; Story et al., 2011) have also noted phases after the market launch as part of the time frame of R&D network research and there is also a growing number of studies focus on commercialization networks. (Aarikka-Stenroos & Sandberg, 2012; Aarikka-Stenroos et al., 2014) However, the whole timeframe of the R&D net development is covered only in few studies.

In the innovation network literature, the time frame of network development is seen beyond the time frame of actual innovation development. Tidd and Bessant (2009, 305) separate innovation network management into specific stages of development such as the operating stage and the sustaining (or closure) stage. They adopt the time frame of innovation network management and the R&D net definition covers temporally the whole offering development process: The R&D net development is seen as formation, when the R&D net is actually created, as collaboration, when the R&D net develops the actual offering for the end-users and sustaining (or dissolution). The network is disbanded if the specific purpose is met, or actors may remain within a network when it is providing benefits for actors.

In the following section, the aimed contribution of this study is discussed in detail.

1.4.4 Contribution

The theoretical basis of this study is in INA networks, strategic networks (see, e.g., Gulati et al., 2000; Jarillo, 1988), strategic value nets discussion (see, e.g., Järvensivu et al., 2010; Möller & Rajala, 2007). This study aims to contribute to strategic nets or meso-level networks (Möller & Halinen, 1999; Möller, 2013; Pels et al., 2009), and discussion of how managing in nets is conducted in context of R&D nets.

Mouzas and Naudé (2007) argue that much can be gained from developing a clear and coherent framework that describes the dynamics and development processes of network management. In this study, the organizational change and management processes in the empirical phase I and the contemporary literature review phase II are reviewed according to Van de Ven and Sun (2011) Organizational process models of change. The implications of the adopted process model of change can be adopted to develop the theoretical discussion around managing in R&D nets. It is thought that studying or managing change from one of these perspectives is unlikely to provide an adequate explanation of the observed
process (Van de Ven & Sun, 2011) The research setting of this study enables the potential for reviewing the contribution of models on managing in R&D nets. The adopted research setting enables the utilization of varying time perspectives, thus providing new insights, findings and providing potential for change process models.

This study contributes to the managing in nets discussion (Järvensivu & Möller, 2009; Möller et al., 2005; Möller & Rajala, 2007) and more in detail this study aims to contributes to the value system continuum (Möller & Svahn, 2003) at the low level of determination value system discussion, and the emerging new business nets discussion (Möller & Rajala, 2007). As the focus on strategic nets discussion have been in single hub studies, this study is able to provide insights from multi-hub nets (e.g. Lavie et al., 2007). This study uses R&D nets as a context in order to contribute to the strategic value net discussion, from the perspective of a new value-creating emerging business network, which further describes the formation and management of innovation and application networks (Möller & Rajala, 2007) by using empirical findings and a contemporary literature review.

Within strategic nets discussion this study aims to contribute to discussion (Möller, 2013) on how nets evolve, and how actors try to utilize nets to gain advantage, and how actors try to utilize their positions and/or roles in the net. In this study, managing in nets is perceived to consist of managing as process and roles for managing. Managerial action is perceived to influence the managing in R&D nets as development process. The offering development process is followed from temporal perspective over the phases from net formation to collaboration including early commercialization activities of the net. Secondly, managerial action is perceived and described via actors actions that are interpreted by other actors in the net forming a role. The actors in nets are seen as collection of roles that is arisen from the influencing behaviour of the individuals in net. These roles in managing can be described in various contextual setting and analysed systemically. This study contributes to growing number of studies (Knight & Harland, 2005; Nyström et al., 2014), that use role theory to understand managing in nets. This study furthers understanding and identifies roles for managing in context of R&D. (see e.g. Gottfridsson, 2014; Howells, 2006; Johnson, 2008)

This study also contributes to those processual studies researching strategic nets. This study aims to understand the process on managing, thus the dynamics of networks by combining role theory and process models managing in nets. The research is lacking studies that can describe the development phases of an R&D net from formation to collaboration phases.
With this study, the frame of research covers the entire time frame of R&D net
developing an offering in traditional management term (see, e.g., Markham et al.,
2010) a life cycle of an R&D network, from initial idea generation to the early
commercialization of a ready offering. Tidd and Bessant (2009, 305) identify set-
up, operating and sustaining (or closure) as phases innovation network
development. This study contributes to studies researching managing in R&D net
during network formation i.e. discussion of strategic net building (Partanen &
Möller, 2012), or R&D net consortia formation (Doz et al., 2000; Ring et al., 2005)
and collaboration. (see e.g., de Reuver & Bouwman, 2012)

In the following section, the delimitations of the study are discussed in more
detail.

1.4.5 Delimitations of the study

This section identifies the areas that are beyond the scope of this study on a
theoretical basis.

Firstly, structural innovation and R&D network studies are out of scope of this
study. Structural studies investigate and measure networks based on their structural
caracteristics and relationship with a variety of variables, e.g., their position in a
strategic partnership network (Fox, Smith, Cronin Jr, & Brusco, 2013), such as tie
strength and structural hole existence in relation to innovation success, (Ahuja,
2000) specific properties of alliance network relational embeddedness or structural
embeddedness, or degrees of redundancy (Vanhaverbeke, Gilsing, & Duysters,
2012), the diffusion of innovations (Liu et al., 2005), or even more specific
characteristics of the innovation network, such as optimal characteristics of
network board composition (see, e.g., Wincent et al., 2010; Wincent et al., 2009).
Structural studies tend to focus on structures, relations, and outcomes, rather than
addressing firm-level questions of strategies, processes or behaviors (Dhanaraj &
Parkhe, 2006) of actors that are in the focus of this study. The structural literature
takes a strong deterministic view by considering how environmental conditions
determine network optimality in relation to innovation (Gilsing et al., 2007) rather
than aiming to understand a more voluntaristic view of why and how certain
phenomena takes place in managing in R&D net. This study views similar with
INA that rather than futile search for the optimum in relationships in networks
(Håkansson & Ford, 2002); the focus of network research should be on
understanding dynamism and the abilities to cope (Freytag & Ritter, 2005) such
environment.

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In this study, the objective is to view managing R&D net as a processual phenomenon appearing in a subjectivist-perceived world, focusing on understanding the continuous change of networks through the actions of actors in networks. A mismatch exists between this study and structural network studies, which see the environment via a positivistic worldview of condition network optimality, which is measured with structural characteristics to such an extent that the abilities of this study regarding structural network studies are limited.

Roles in managing in R&D net are in great importance in this study. However, there are also studies that use the concept of roles, but they are not referring to role theories or positioning themselves within the role theoretical discussion. These viewing roles in multi-network leadership in an aerospace context (Nosella & Petroni, 2007), describe intermediary roles (Howells, 2006; Johnson, 2008), varying roles in service innovation development in an SME context (Gottfridsson, 2014), or roles in a distribution networks context (Abrahamsen, Henneberg, & Naudé, 2012). Also, studies that focus in single actors perspective on innovation collaboration e.g. customer (Öberg, 2010) or roles of project organization (Gemünden et al., 2007) exists. This study acknowledges studies that are not contributing to role theory. This study is able to provide similar rich description of roles from R&D context, however this study does not aim to contribute however the similarities of the research context to those studies.

In R&D network-related literature, a specific innovation network management approach has been identified. R&D networks that are characterized to exist around a hub-actor without strong influencing abilities have been noted to require a specific type of network management, i.e., innovation network orchestrating (Dhanaraj & Parkhe, 2006). This study acknowledges the wide array of innovation network orchestration studies, from varying contexts in disruptive innovations (Sabatier, Craig-Kennard, & Mangematin, 2012), smart business networks (Busquets, 2010), the agrifood sector (Batterink et al., 2010), developing airplane and sales and marketing automation as a SaaS service (Nambisan & Sawhney, 2011), service innovation (see, e.g., Hurmelinna-Laukkanen et al., 2012; Nätti et al., 2014; Rita al et al., 2012), biopharmaceuticals (Sabatier, Mangematin, & Rousselle, 2010), the internet of things (Prince, Barrett, & Oborn, 2014), managing research and innovation networks (Levén, Holmström, & Mathiassen, 2014), and public management (Bakici, Almirall, & Wareham, 2013). innovation intermediaries focusing on how organizations operate in a broker role in networks (Klerkx & Aarts, 2013; Sabatier et al., 2010).
Orchestration literature has also used individual organizations as unit of analysis and used role conceptualizations in studies in various theoretical discussions, from champion theory (Klerkx & Aarts, 2013) and focusing on how organizations operate in a broker role in networks (Klerkx & Aarts, 2013; Sabatier et al., 2010), as an innovation integrator or platform leader (Nambisan & Sawhney, 2011), or what dialogical strategies are available for the orchestrator (Prince et al., 2014), and how individuals are acting in champion roles, i.e., as a broker (Klerkx & Aarts, 2013), without positioning itself within the role theoretical discussion.

This study acknowledges network orchestration as a research approach, focusing on the management of a specific type of R&D networks. In this study orchestration discussion is delimited beyond the scope. The motivation for the delimitation is due to the restricted perception of abilities to manage in networks, according to orchestration literature. This orchestration is seen to deviate from network management, and orchestration researchers separate themselves from the network management discussion and consider that networks can be consciously orchestrated rather than managed in a traditional sense (Hurmelinna-Laukkanen et al., 2012; Ritala et al., 2012) Ritala et al. (Ritala et al., 2012) consider that orchestration does not lead or direct, but instead influences other firms through “coordination by enabling”. In addition, the perception of network formation is rather limited, thus innovation orchestration studies aim to contribute specific network contexts with fuzzy or vague network forms, such as innovation communities (Hurmelinna-Laukkanen et al., 2012).

In innovation and R&D network-related discussion, there is discussion that approaches similarly as R&D networks, innovation as collaborative operations of open actors. The source of innovation is seen as scattered and situated among various startups, universities, research consortia, and other organizations, and is often seen as open innovation (Chesbrough, 2003a) originating from different industries and being part of different business, social, and technological networks. Some even argue that open innovation is a paradigm shift that makes lone inventors and closed R&D departments of large corporations obsolete (Bessant & Tidd, 2007).

Open innovation shifts the R&D activities from the internal processes of a company to external, network processes. Open innovation enables permeable innovation boundaries of companies, thus ideas created beyond the boundaries of an internal research unit or IPR created elsewhere. Open innovation enables development and commercialization of ideas to current or new markets of the firm. (Chesbrough, 2003b.) Open innovation approach discusses similarly as R&D networks study problematics of joint R&D efforts with others and coordination of
these joint activities (Dittrich & Duysters, 2007). The purposive inflows and outflows of knowledge (Chesbrough & Bogers, 2014) are key concepts of open innovation, that separate closed innovation systems. This study acknowledges the discussion of open innovation and its permeable boundaries, and inflow and outflow of knowledge during the innovation development and commercialization process. However, the present study does not aim to contribute to open innovation discussion. Conceptually strategic net discussion concepts are able to describe the phenomena of open flow of knowledge within the boundaries of relevant actors and network horizon (see, e.g., Alajoutsijärvi et al., 1999; Halinen, Salmi, & Havila, 1999) in managing in R&D nets.

There is a growing number of commercialization network (Aarikka-Stenroos & Sandberg, 2012; Aarikka-Stenroos et al., 2014) studies. Aarikka-Stenroos (Aarikka-Stenroos & Sandberg, 2012) defines commercialization network as a “group of actors involved formally or informally in the commercialization of an innovation.” In this study commercialisation activities are identified during R&D net collaboration activities in empirical results of this study. The present study acknowledges commercialization networks as separate discussion and delimits that beyond the scope of this study. The focus in commercialization network studies are in launch, diffusion and adoption of innovation. (see, e.g., Aarikka-Stenroos & Sandberg, 2012; Aarikka-Stenroos et al., 2014; Thistoll & Pauleen, 2010)

In the following section, defines the research process, method utilized as well as the research phases of this study.

1.5 Research process, research phases and method of this study

The intellectual journey requires description and reflection (Dubois & Araujo, 2007). In the following chapter, the intellectual journey of this study is described in terms of the research process, research phases and methodology selected.

Firstly, the research process of this study is described. This is done by using the research objective as the guideline for all decisions related to methods (Halinen & Törnroos, 2005). The research process consisted of two phases. Phase I – the empirical phase – consists of a processual, longitudinal single case study of an R&D net during the formation and collaboration phases. Findings of Phase I are reported in Papers I, II, III, and IV included in this study. The Empirical results of each paper are discussed to the extent they provide answers to the research questions in Chapter 2.
Phase II—reflecting the results to the contemporary literature—contains a systematic literature review of R&D management research published during 2004–14. The review identifies current knowledge and reflects the empirical results of this study (papers I, II, III, IV) to highlight the contribution. This is necessary, as the papers I—IV have been published about 10 years ago, after which many other studies on the topic have been published and increased our knowledge. Phase II consists of reflection on empirical results with similar and controversial findings identified in contemporary literature. The reflection in Phase II identifies empirical results that are not noted in contemporary literature and thus considered to be novel findings.

Table 1 presents the research phases of this study and the research activities. The research activities of this study are research setting, theoretical framing, data collection, data analysis and reporting research.

**Table 1. Research phases of this study.**

<table>
<thead>
<tr>
<th>Phase I – Empirical results</th>
<th>Phase II – Reflecting results with contemporary literature</th>
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</thead>
<tbody>
<tr>
<td>Research setting</td>
<td>Systematic literature review of contemporary literature</td>
</tr>
<tr>
<td>Case study: Single case, Follow-up, longitudinal process study</td>
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</tr>
<tr>
<td>Theoretical frame</td>
<td>Managing in R&amp;D nets:</td>
</tr>
<tr>
<td>INA, SN</td>
<td>Benefits of managing in R&amp;D nets:</td>
</tr>
<tr>
<td>R&amp;D net formation</td>
<td>R&amp;D net for actors</td>
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<tr>
<td>Managing in R&amp;D nets:</td>
<td>Challenges of managing in R&amp;D net for actors</td>
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<tr>
<td>INA, SN, SVN, RT</td>
<td>How is managing in R&amp;D net conducted during formation and collaboration as process and via roles</td>
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<tr>
<td>Managerial roles</td>
<td>Management management</td>
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<td>Managerial roles</td>
<td>Managerial roles</td>
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</table>
## Phase I – Empirical results

<table>
<thead>
<tr>
<th>Data collection</th>
<th>DATA 1, 3</th>
<th>DATA 2, 3:</th>
<th>DATA 2,3:</th>
<th>DATA 2,3:</th>
<th>LITERATURE POOL</th>
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</thead>
<tbody>
<tr>
<td>Interview- Formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Systematic</td>
</tr>
<tr>
<td>Archival data: RN</td>
<td></td>
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<td>literature review</td>
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<tr>
<td>Single Case, Longitudinal</td>
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<td>Snowballing</td>
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### Analysis
- Descriptive
- Time: Sequential mapping
- Process Model: Teleological process

### Outcome and contribution
- Chapter 2: Phase I: Empirical Results
  - Managing in R&D net as process (I, III)
  - Managerial roles in managing R&D nets (Paper I, II, III)
  - Managerial roles framework: Dimensions of managerial roles (Paper IV)
  - Benefits of managing in R&D net for actors (I, II, III, IV)
  - Challenges of managing in R&D net for actors (I, II, III, IV)

### Reporting research
- Paper I
  - Conference proceeding: Paper II
- Paper III
- Paper IV
- Dissertation report

The research setting consists of identifying the motivation for the study, defining research objectives, and choosing appropriate research and data analysis methods for each individual research paper, as well as stating the objective for this dissertation as a study. Theoretical framing refers to key theories and applied theoretical concepts used in each phase of this study, as well as the targeted theoretical contribution and delimitations. Data collection refers to the gathering of data for conducting this study. Data analysis activity defines the reasoning method...
and describes the analysis processes that have been gone through to achieve the findings of this study.

In the following two sections, the research activities are discussed for each phase of this study. Firstly, Phase I – empirical research – is described, followed by description of Phase II – a contemporary literature review.

**Phase I – Empirical research**

Phase I of this study combines the empirical results of this study. The empirical results are combined in Chapter 2 of this study. The following sub-chapter depicts in more detail how the case study is conducted in order to create research papers for Phase I.

Case studies, especially single cases (Dubois & Araujo, 2004), have been widely adopted in industrial marketing research and utilized extensively in the interaction and network approach (Beverland & Lindgreen, 2010; Dubois & Araujo, 2004; Dubois & Araujo, 2007). The research setting in Phase I – the empirical phase of this study – is conducted as a longitudinal single case study, in follow-up style. The case study was selected as the research method for Phase I, because case studies provide unique means of developing theory by utilizing in-depth insights of empirical phenomena in their contexts (Dubois & Gadde, 2002). Case studies are considered a useful method for researching in real-life contexts (Yin, 2014, 13) and they enable the study of contemporary phenomena and its dynamics while considering the context in which the research object is embedded (Halinen & Törnroos, 2005). According to Shank (2006), case studies are based on participatory relationships between informant and researcher. In addition, the participation involves the researcher as listener and observer and in some rare instances as an active participant. It is also noted by Yin (2014, 3), based on the stated research questions, that “the more your questions seek to explain some present circumstance (e.g. ‘how’ or ‘why’ some social phenomenon works), the more case study research will be relevant.” Case studies also provide the possibility of combining information from several sources (Yin, 1994) that is beneficial in this study network, which enables data gathering through interviews, participant observations and access to archival data of the case network.

The case study approach is seen as a good fit as a research method for this study, as the aim is to increase the understanding of managing in R&D net as processes. Halinen and Törnroos (2005) argue that due to its ability to study change processes, contextual factors and process elements in real-life situations, case
studies are best suited for researching business networks. Case studies can also provide a means of refutation or extensions to existing concepts (Dubois & Araujo, 2007).

Phase I is conducted as a single case study. This approach was selected in order to achieve an intensive case study strategy of one business network, with multiple sources of evidence in order to gain a holistic description of the network and its management (Halinen & Törnroos, 2005). A single case study is seen as being closer to classical theory generation and leads the researcher to see new theoretical relations and question old ones (Dubois & Gadde, 2014). Single case design was also seen as “unavoidable” (Easton, 1995), thus it enabled improved understanding of complicated network processes and connectedness of case networks (Halinen & Törnroos, 2005). The case object in this study is Rotuaari net (later RN), which was formed and collaborates to develop mobile services. This study includes qualitative research on a RN single case net its relevant actors.

However, a brief description of the case net is included in order to enable better understanding for the reader. RN was an R&D net for developing and researching technologies and business models for context-aware mobile multimedia services. RN net consists of a multiparty technology project consortium, comprising technology providers, hardware and software providers, competing operators, content providers, a media house, and university research groups from several technical fields: electric engineering, machine learning, secure software programming, business administration and marketing: business networks and eMarketing, education project and governmental actors. The task of the Rotuaari net was to develop, operate and evaluate the service system, evaluate the services in field trials and construct and observe value networks consisting of users, content providers, technology and service providers, operators, other business partners and research parties. The structure of RN net structure could be seen as decentralized (Provan & Kenis 2008), thus the decision-making and coordination of key activities of the net were dispersed among several actors. Formally decision making was an objective of the Management Group, that all parties had the freedom to participate in bi-annual meetings. Formal decision-making was also conducted on the operative level in the Operative Steering Group that was established by the Management Group. The operative steering group joined monthly, with representatives of selected actors among RN and heads of the research parties. The case net under analysis is defined in detail in each of the research papers included in this study.

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In addition, in Phase I this study utilizes a longitudinal approach to a case study. Longitudinal single case research design was selected as a case study strategy due to the exploratory nature of this study, its suitability to the research process in organizations and networks, as well as the complex, dynamic nature of the features of the research phenomenon. Network research, thus focusing on inherently dynamic phenomena, benefit from adopting longitudinal approach (Pittaway 2004, 160). An underlying idea of the case study approach is the ability to provide a multifaceted view of a situation in a context (Halinen & Törnroos 2005). Case study in combination with longitudinal approach, that improved understanding of organizations by providing the ability to see how parts interact with each other and enabling the “researcher to make inferences about why things happened” (Miller & Friesen, 1982) enables this study to generate understanding of such dynamic and complex phenomena as managing in R&D net. Longitudinal research also enables a better position for understanding causal relationships (Miller & Friesen, 1982) and it allows the present to be explored in relation to the past and the emerging future (Pettigrew 1990). By using longitudinal research in this study were able to create longitudinal data that seen is necessary for seeing how process unfold over time. (Langley et al., 2013)

For process research, a longitudinal approach is suitable, as it enables processes to be identified and empirically documented (Miller & Friesen, 1982, 1042). Longitudinal research approaches benefit innovation network research, thus providing a network-inherent nature of networks as dynamic phenomena (Pittaway 2004). The longitudinal approach is a temporally relevant method for studying management in a network (Halinen & Törnroos 2005). Therefore, the longitudinal approach is applied in this study. Temporal issues are of importance in case studies when considering the importance of internal or external processes or events, thus enabling us to present how a network is constituted and managed (Halinen & Törnroos 2005). Pettigrew (1997) noted that without temporality, the dynamics of a process, i.e., the relationship between the past, present, and future and the interrelationship between contexts at different levels of an emerging process or interdependent effect of context and action, would not be able to be revealed.

In addition to the research setting, the case study conducted in Phase I is processual (Pettigrew 1997), and it utilizes a follow-up nature and a real-time approach. (Halinen & Törnroos 2005) Temporality is seen important, thus the study aims to understand the process of managing in net during formation and collaboration. Phase I of this study consists of both historical data based and a real-time follow-up study (Halinen & Törnroos 2005) of a single case network.
Each paper included in this study is an independent research entity that consists of theoretical reviews, empirical data gathering and analysis, and concluding remarks, including a discussion related to theoretical and managerial contributions, to such an extent as defined according to the objective statements in each paper. There are some differences in the focus areas and empirical data usage of Phase I that warrant detailed descriptions. Theoretically, Phase I adopts concepts of managing in R&D nets based on the INA, strategic networks, and strategic value net discussions. Phase I creates links between R&D net formation discussion, managing in nets discussion, network development process discussion (Paper II), managing in R&D nets discussion related to role theories and roles for managing in R&D net (Papers III and IV) and finally general level of R&D network management discussion (Paper IV). As an outcome and a contribution to the INA, SN, and managing in R&D net discussions, empirically identified benefits and challenges of managing in net are presented (Paper IV). In addition to the INA and SN discussions, Phase I provides an empirically justified teleological sub-process model of an R&D net, and the role of webber in an R&D net formation (Paper I). The outcome and the contributions also includes framework of roles for managing (later FRM) (Paper II and III) that can be utilized for the interpretation, evaluation of roles and the dynamics of roles during the development process of R&D net. As an outcome of Phase I of this study, a collection of roles for managing in R&D net (Paper I, II III) and a framework for analyzing roles for managing R&D net (Paper II, III). Overall, Phase I gathers an empirically justified theoretical understanding of the process of managing in R&D net during formation and collaboration, roles for managing and framework for analyzing roles for managing in addition to benefits and challenges of managing in net for actors.

In this study, during Phase I – empirical research – data is gathered from single events in the development process, the case object is perceived as a holistic entity, and the unit of analysis is then the chosen focal network i.e., the net and the development within it. Empirical data gathering in Phase I consists of three main sources of data: firstly, archival data from the formation and collaboration phase of the case’s R&D net development during the developing of mobile services. Secondly, data from the empirical phase consists of interview data collected from executives of varying agencies and research organizations during network development. Interview data 1 focuses only on the formation phase of R&D net development, thus it is gathered during the formation of the case network. Interview data 2 consists of interviews collected during the network collaboration phase, with executives from agencies and research organization representatives, shortly after
the mobile service development and early steps of the commercialization phase of a mobile service development had taken place. The empirical data gathering process, the list of interviewees and the data analysis is presented in more detail in each of the research papers included in this study.

The fundamental purpose of Phase I of this study is to come up with theoretical conclusions on the basis data analysis of a single case longitudinal follow-up study. The data analysis activities in Phase I of this study are aligned with an abductive research approach to a continuous process of theory and empirical data interaction (Dubois & Gadde, 2002). The data analysis activities consisted of data reduction by data simplification, selection, and focusing. Data analysis activities also consisted of the construction of chronology-based sequences of actions based on empirical data. Empirical data consisted of verbatim interview data, observation data, emails, and archival material (presentations, funding applications, status reports, meeting minutes, and project annual reports). Computer-aided programs (QSR N’Vivo, Excel) were used to reorganize the data. After this stage, data in the form of early empirical findings is reflected alongside theory. The interaction with theory and early empirical findings as a process of matching, direction and redirection sets challenges for the researcher for ensuring a clear focus (Dubois & Gadde, 2002; Halinen & Tönnroos, 2005). Clarity of focus in analyzing activities is achieved, with the units of analysis being the net, the perception of time and the perception of teleological process.

The time perception utilized to depict change in Papers I, II, III and IV is sequential mapping (Halinen, Medlin, & Tönnroos, 2012), thus it enabled both the retrospective and real-time possibility of data gathering. Time in Phase I is understood as the flow of time and periods. With the longitudinal approach employed in this study, time is adopted through events that are seen to happen in the past (retrospective) and at the moment (real-time) – the “here and now”.

Perceptions of researching change in organizations in Papers I, II, III and IV adopt a strong process perspective (Poole, Van de Ven, Dooley, & Holmes, 2000; Van de Ven & Poole, 2005). The perceptions toward change in networks presented in Paper 2 are explicitly defined as teleological change, i.e., a planned change’ (Van De Ven, 1992; Van De Ven & Poole, 1995; Van de Ven & Sun, 2011) process consisting of sub-processes leading to certain end state. Papers I, III and IV adopt a process that is perceived implicitly as life cycle development. Data analysis activities in each paper included in this study are described in detail in the relevant paper.
In this study, an R&D net is seen in different phases, which comprise the formation of the R&D net and collaboration for offering development. In terms of R&D net evolution, Paper I is focused on R&D net formation, while Papers II, III and IV use the possibility of analyzing initiation, planning, development, piloting, and early commercializing phases of R&D net.

The results of each paper are discussed in Chapter 2 (titled Empirical Results) to the extent they provide answers to the research questions on the processes, roles, benefits and challenges of managing in R&D net. The papers I, II, III and IV of phase I of this study have been analyzed systemically. Each paper is analyzed according to the relationship with each research question of this study: How is managing in R&D net conducted via managerial roles and as process during formation and collaboration? what are the benefits of managing in R&D net for actors? and what are the challenges of managing in R&D net for actors? in separate analysis subsections. Findings of that empirical phase of the empirical review are summarized firstly per paper as written main points and sentences in an Excel sheet, according to the research questions. In the second phase of the empirical review, the empirical findings are summarized in a separate table that consists of empirical results per research question of this study. This summary is presented in Chapter 2.2 and sub-chapters study and consist of the empirical results of this study.

The following section presents the Phase II - contemporary literature review - and how it was conducted in more detail.

**Phase II – Contemporary literature review**

In the following section, Phase II – the contemporary literature review – is elaborated upon in more detail. The research activities of Phase II of this study are research setting, theoretical framing, data collection, data analysis, and reporting. Table 2 presents the research activities of phase II.

The second phase of this study consists of a systematic literature review of contemporary literature of managing in R&D nets. The motivation for the systematic review is to identify current knowledge, compare and reflect the findings of papers I-IV against that knowledge, to ensure that the findings offer theoretical value and contribution even today. This is required, as papers I-IV have been published ca. 10 years ago, after which many other studies on the topic have been published and increased our knowledge.
A systematic review identifies the scientific contributions to a field and enables a transparent and replicable process to minimize bias through exhaustive literature searches and by providing a trail of the researcher’s decisions and procedures. (Tranfield, Denyer, & Smart, 2003) A systematic literature review is typically conducted in phases (see e.g. Aarikka-Stenroos et al., 2014; Mustak, 2014) consisting of research identification, selection of studies, study quality assessment, data extraction, monitoring progress, and data synthesis (Tranfield et al., 2003).

The research identification of managing in R&D net literature is already stated in the research setting of the dissertation. In addition, the collection of the literature pool – appropriate publications are identified from relevant databases using a systematic database review, by snowballing literature, and by identifying the references to the four papers included in this study.

The selection of studies for the systematic database review was conducted is based on temporal and conceptual limitations. The motivation of the contemporary literature review is to review current knowledge, reflecting empirical results and highlight the contribution. The temporal limitation for contemporary literature review for current knowledge in this study is stated to period from 2004 to 2014. The systematic literature review was conducted in 2014 that created a natural upper limitation for current knowledge. Since empirical results (papers I-IV) covers the earlier than 2004 knowledge of managing in R&D nets, the lower temporal limitation could be set to 2004. In order to avoid subjectivity-related bias, the literature pool also includes partially overlapping period with the literature reviews of the empirical results (papers I-IV) from pre–2004–until 2007.

The conceptual limitations are based on theoretical framing activities conducted during the beginning of Phase II of this study, as well as on the pre-understanding gained from the empirical phase I literature reviews (Papers I,II, III, and IV) included in this study. The databases selected for systematic review were Business Source Complete (EBSCO) and reference databases SCOPUS and Web of Science (ISI). The criteria for the selection of databases (cf. Mustak 2014) were their ability to provide a broad pool of managing in R&D net-related journals, coverage of time frame of managing in R&D net studies, and clear search functionalities to ensure error-free search results. The databases were searched using a variety of keywords, with all publications within the temporal frame containing those words in either title, abstract, or keyword sections. The search terms I used “managing in R&D net”, “R&D network management”, “R&D net management”, and “Network management”. The search term “Social Network”
was excluded in order to exclude social network studies, theories and to avoid futile data reduction in the latter phases of the systemic review.

In addition to the systematic literature review, snowballing based on literature by key contributing authors (see e.g. Martin 2012) and shared academic ground (cognitive communities and databases (see e.g. Fagerberg & Verspagen, 2009) was used as a literature selection method for the contemporary literature review. Key contributing authors were identified based on snowballing according to the roots approach (Möller & Halinen, 2000; Möller et al., 2009; Pels et al., 2009). Using this approach, Gulati et al. was used as a key referred article (e.g. Gulati et al., 2000), along with strategic nets literature by Möller et al. (Möller et al., 2005; Möller & Rajala, 2007) The selection of studies was limited to the time period 2004 – 2014.

An additional selection criteria was used to delimit irrelevant studies from the contemporary literature review. Firstly, only articles published in peer-reviewed journals were included among the selection of the articles. Secondly, only those articles contributing to the R&D network literature were included. Thirdly, articles with network management or managing in nets as their main focus were included. The strict criteria are applied to ensure the basis for review of best-quality evidence (Tranfield, Denyer et al. 2003).

In addition, all journal articles that refer to phase I – empirical papers I, II, III, and IV - as a reference are included in the literature review pool. All studies that are identified in the SCOPUS and Web of Science (ISI) reference databases that refer to the four papers included in this study are included in the contemporary literature review. In total, 77 articles were identified in the SCOPUS and 90 in the Web of Science ISI. In total, 34 articles were identified as referring to the empirical findings of the papers included in this study during the period 2004–2014. Based on analysis, the body text of those 34 articles, 11 used concepts from papers I, II, and IV in their theoretical discussion or frame development. The remaining 23 articles were only referring to articles as, for example, context as examples of joint service development. Figure 3 depicts the selection of studies (a combination of systematic review, snowballing, and articles referring to papers I-IV) and the resulting literature pool.
The analysis in phase II - the systematic literature review, empirical results of this study are reflected to the current knowledge to highlight the contribution. The empirical results are depicted in detail in chapter 2.2 of this study.

The contemporary literature review is conducted systematically. The articles in the literature pool are reviewed systematically based on abstract and keywords review to ensure that they match the relevancy requirement for the contemporary literature review. The literature pool articles have then been systematically reviewed based on the following data analysis procedure.

During the analysis, papers in the literature pool have been read in order to collect supporting and contradictive notions from the contemporary literature. During the analysis, papers in the literature pool have been read systematically and findings related to matching concepts of process of managing, managerial roles, benefits of managing in R&D net and challenges of managing in R&D net are categorized as contemporary literature notion. If a paper is considered to be relevant, the reading continued to findings and conclusions of the paper. Based on the reading, contemporary literature notions were entered in an Excel sheet. Each notion of contemporary literature was entered in an Excel sheet in categories based on research questions. Categories were: How is managing in R&D net conducted during formation and collaboration as managerial process and roles for managing, what are the benefits of managing in R&D net for actors and what are the challenges of managing in R&D net for actors, also the source, i.e., author(s) of the paper were added into the column accordingly. In total, 81 papers were read and
162 contemporary literature notions were made. Seventy-eight (78) were related to how organizations are managing in R&D net, twelve (12) findings covered roles for managing, sixty-seven (67) covered managerial process. Benefits of managing were covered twenty-six (26) findings, and fifty-eight (58) covered the challenges of managing. After identifying the contemporary literature notions to categories per research questions, they were also categorized into whether or not they are supportive based on their findings and conclusions chapters. The analysis sheets of contemporary literature notions are presented as an appendix to this study. (tables 14,15,16 and 18)

Analysis is continuously performed in relation to the research questions of this study. The empirical results of this study and the contemporary literature notions are then reflected in terms of notions that support empirical results or notions that contradict with empirical result. By identifying the supporting and contradicting notions to contemporary literature, it is possible to discuss and reflect each empirical result in detail. The motivation to conduct the contemporary literature review is to reflect the contribution and ensure that the findings offer value through a 10-year period of managing in R&D net studies. Similarly seen Empirical results and notion from contemporary literature share the finding both Phase I and Phase II findings. Similarly seen findings expand discussion by adding new contexts or new perspectives of the phenomena with current knowledge of contemporary literature. Motivation to identify controversies between the empirical results of this study and contemporary literature is to expands the understanding of managing in R&D nets and possibly identify areas that contemporary literature has not yet identified. The results that contradict to contemporary literature are identified also from aspects that the empirical results are potentially reviewing from different angle or from different context and thus being able to expand discussion of the current knowledge.

Finally, the findings not identified in current knowledge (during more than ten years of research) and noted in empirical results of this study underline the contribution of this study. The findings noted in empirical results and not noticed in current knowledge provide the contribution area of this study to the managing in R&D nets discussion. Similar findings, controversies, and novel findings are reported in separate sub-sections in Chapter 2, and are summarized in table 10, 11, 12.

The following section describes the structure of the thesis in more detail.
1.6 The structure of the thesis

This dissertation is divided into two main parts. Part I presents the objective, methodologies, theoretical positioning and key concepts used in the study. Secondly, part I presents the empirical results related to the managing in R&D net and the benefits and challenges related to managing in R&D net. Empirical results are reflected to the contemporary literature. The reflections are described from the perspective of similarities, controversies and novel findings per research question. Finally, the first part presents a discussion of the contribution to the current theoretical literature.

Part I is divided in three main chapters: Introduction, results of the study and their relation to the contemporary literature and conclusions. Figure 4 presents the structure of the thesis and identifies the relationship between the chapters of the study.

The first chapter discusses the motivations of this study to focus on managing in R&D net, it describes the research objective and research questions and positions this study within the theoretical discussion, and it provides a perspective on the areas to which this study is aiming to contribute. The first chapter provides also delimitations of this study and a views literature that appraises similar research phenomena that is positioned beyond the scope of this study. It also contains a description of the research process and methodologies utilized in this study.
The second chapter consists of three subsections. The first subsection identifies the empirical papers included in this study and the authors’ contribution to those empirical papers.

The second subsection covers empirical results - Phase I of this study and the second subsection consist of the Phase II reflections of the empirical results to contemporary literature. The first subsection 2.2.1 identifies the empirical results related to managing in R&D net is conducted during formation and collaboration. Secondly in subsection 2.2.2, the empirical findings of the benefits of managing in R&D net are described. Finally, subsection 2.2.3 describes the empirical results related to challenges of managing in R&D net.\footnote{1\textit{As a suggestion for the reader of this study. It is recommended to read, the empirical papers included in PART II of this study before advancing to subsection 2.3 second and latter chapters.}}

The second subsection of this chapter of this study reflects the empirical result to the contemporary literature, identifies the theoretical results and highlights the theoretical contribution. Subsection 2.3 reflects the empirical results to the contemporary literature related to managing in R&D net during formation and collaboration. The following subsection 2.4 describes the reflections of the benefits
of managing in R&D net. Finally, the 2.5 describes the reflections of the challenges of managing in R&D net to contemporary literature.

Chapter 3 presents the conclusions of this study. This chapter provides answers to the research questions based on Phase I – empirical results and Phase II – reflections on contemporary literature review. In addition, both theoretical and managerial contribution are discussed in this chapter. Finally, limitations and noted future research venues are identified in this chapter.

Part II of this study consists of the original empirical papers that are included in the full text.
2 Results of the study and their relation to contemporary literature

2.1 Phase I-Empirical papers

The empirical phase of this dissertation includes four papers. Papers I, III and IV are published in peer-reviewed international journals and paper II is published in academic conference proceedings. Table 2 presents the papers included in this study. The original empirical papers are included in the full text in Part II – original research papers.

Table 2. Empirical papers included in this study.

<table>
<thead>
<tr>
<th>Paper number</th>
<th>Empirical results</th>
</tr>
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</table>

The papers are written as a team effort by individual writing teams, per each paper. Table 3 presents and identifies the contributions of each author to each paper and shows summary of the main and sub-tasks of the paper. The table consists of four main tasks and sub-tasks according to the paper’s publication process. The main tasks are the research process, theoretical frameworks, data, and article process. The research process consists of research design, primary data gathering, and the secondary data gathering sub-tasks. The theoretical framework comprises literature review, theoretical gapping, theoretical frameworks direction/redirection, and framework matching sub-tasks. The data consists of gathering designs, interviews, data transcribing, typologizing, secondary data sourcing, and analyzing sub-tasks. The article process refers to the paper-writing process and its phases, which consist of design, paper writing, conference presentation, and paper finalization and coordination sub-tasks.
### Table 3. Author’s contribution in papers.

<table>
<thead>
<tr>
<th>Task</th>
<th>Subtask</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<td>Secondary data gathering</td>
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<td>Literature reviewing</td>
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<td>Data typologizing</td>
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<td>Publication process</td>
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**Abbreviations:** Marko T Heikkinen (MH), Johanna Still (JS), Jaana Tähtinen (JT), Tuija Mainela (TM)

Paper I utilizes theoretical literature and empirical data from Phase I Data collection and archival data focusing on the formation of R&D net. Paper I presents an empirically justified model of managing in R&D net, consisting of three elements: Initial conditions, sub-processses of R&D net formation and role of network webber. Paper II identifies action-based roles in which organizations can manage in net. In addition, Paper II describes managing in R&D net through actors and network elements. Paper III describes managing in R&D net through actors and network elements. Paper IV is a theoretical
overview of managing in R&D net and evaluates the problematics of R&D networking and developing offering in net.

Papers II and III use theoretical literature in combination with empirical data from Phase I data collection. Both papers focus on understanding managing in R&D net during network formation and collaboration and both papers (II and III) based on notions of action-based roles. For Paper III, the theoretical framework was revised, refocused and rewritten, and further, the data was analyzed in greater depth.

The following subsections summarize the empirical results of this study. The empirical findings from papers I, II, III, and IV are based on systematic analysis and are reported per the research question presented in the subsections. First, the subsection identifies the empirical results of how managing is conducted in R&D net during formation and collaboration. The discussion is followed by subsections that identify benefits and challenges of managing in R&D net for relevant actors. The empirical results are summarized in table sheets presented as tables 5, 7 and 8.

2.2 Phase I-Empirical results

The following sections identify the empirical results of how managing in R&D net is conducted during the formation and collaboration phase of R&D network development. Section is divided in three sub sections

2.2.1 How is managing in R&D net conducted during formation and collaboration

In this study, managing in R&D net is seen as a process and as roles for managing in R&D net. Table 4 presents the empirical results of how managing in R&D net is conducted during formation and collaboration as process.
Table 4. Empirical results Managing in R&D net during formation and collaboration as process.

<table>
<thead>
<tr>
<th>How is managing in R&amp;D net conducted during formation and collaborating</th>
<th>Phase I - Empirical results</th>
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<tr>
<td>Managing in R&amp;D net takes place with actions that managers as representatives of network actors performing in order to influence resources and activities of other actors in network. Actors can perceive managerial action positively, negatively and they will react to managerial action. Actions can be aimed to tasks in the R&amp;D net are performed, actions can be aimed to the net the actors are located or to the network beyond R&amp;D net. Influence of action can be perceived as radical, when influencing relationships either enabling new formation or existing dissolution or incremental, when shaping tasks that network is performing based on existing relationships. Action can be perceive as expected and emerging based on weather action was perceived to be anticipated from the position of actor by others. R&amp;D net formation can be managed by active actor that manages network formation sub processes: Enabling formation, acquiring actors, assuring continuity, developing commitment, creating formal structures and learning. Network webber, that actions are approved by others can structure and speed-up formation process. Managing in net requires conceptualizing, operations mobilizing R&amp;D net that develops offering is not necessary the net that is commercializing offering. R&amp;D net formation does not follow pre-determined path, rather than appear in iterative and overlapping structure. Commonly acknowledged goals enable managing in R&amp;D net.</td>
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Managing in nets as process

According to empirical results, managing in R&D net is used to achieve a planned change in network structures. Managing in R&D net happens through actions that managers, as representatives of network actors, perform to influence the resources and activities of other actors in the net. Managing in R&D net requires the ability to identify potential actors with contribution potential and enables them to band together in cooperation toward the joint goals of a net. Table 5 presents the
Managing in R&D net takes place with actions that managers as representatives of network actors performing in order to influence resources and activities of other actors in a network. Actors can perceive managerial action positively, negatively and they will react to managerial action. Actions can be aimed at tasks in the R&D net. Action can also aimed at the net the actors are located or to the network beyond R&D net. Influence of action can be perceived as radical, when influencing relationships either enabling new formation or existing dissolution or incremental, when shaping tasks that the network is performing based on existing relationships. Action can be perceive as expected and emerging based on whether the action was perceived to be anticipated from the position of an actor by others.

In the empirical results of this study, the development process of R&D network formation and collaboration are presented both as a life cycle of invention and teleological change process models (Van De Ven & Poole, 1995; Van de Ven & Sun, 2011). The empirical results of the development process of R&D net is based on phases (papers II, III, and IV) of R&D net development as stages of innovation: network formation/service initiation, service planning, service development, service piloting and service commercialization. In addition to phase, an interesting notion is also made. R&D net formation (Paper I) in this study is seen as teleology (Van De Ven & Poole, 1995; Van de Ven & Sun, 2011) that views the development process as a collection of iterative, overlapping, and simultaneous sub-processes that groups of actors utilize when acting, reacting and interacting toward a certain, shared end state.

Based on the empirical results of this study can be noted that managing in R&D net can be seen through teleological, iterative and overlapping sub-processes that can be used for understanding the actions of actors towards a certain shared end-state of R&D net. Based on teleological process model adoption, the time dependencies of sequences of events are questioned, the path of events in the development process is not seen as predetermined, and the activities of R&D net formation are seen to appear in an overlapping and iterative structure, i.e., sub-processes. The sub-processes of the R&D net that are focused on the net formation phase are discussed in Paper I. Based on the empirical results (in Paper I), R&D net formation consists of six sub-processes. Enabling formation, acquiring actors, assuring continuity, developing commitment, formal structuring, and learning. Sub-processes may happen in a simultaneous, overlapping, or repeated manner during the formation process. Paper I note that e.g., acquiring actors were noted to take
place several times during formation. Sub-processes are not evolving on predetermined paths.

*Enabling formation* includes developing the fundamental elements of an R&D net, i.e., a network domain including participants, scope of development, and mutual definitions of performance expectation.

*Acquiring actors* consists of the activities of attracting potential new actors, selecting suitable actors, and restricting unfit actors. Sub-processes contain actions that actors perform when they seek and persuade actors to join or show aspiration to join the network. The sub-process includes identification of the best actors for co-operation, not just identifying the best individual ones. In addition to formation, the acquisition of actors also appears during the collaboration phase of the net based on empirical results. New actors were also noted to emerge during late collaboration of the R&D net i.e., close to commercialization.

*Assuring continuity* refers to activities that aim to create and communicate the future benefits and rewards of collaboration among actors. Signs of trust and willingness to adapt to joint operations also imply that activities that assure continuity exist. The sub-process of assuring continuity signs and conditions that increase actors’ reliance on each other is perceived as important, because during formation, actors have not been able to create a joint history capable of creating trust. In addition, the formal structure of the network may have not yet been established.

*Developing commitment* refers to sub-process that increase an actor’s perception of their significance as a member of the R&D net. Commitment is developed through investment of time, personnel, and money, in addition to establishing common ground and fulfilling commitments among actors. Open communication among actors is also seen to develop commitment.

*Formal structuring* refers to a sub-process that aim to create structures that enhance co-operation, decision-making, communication, and learning in networks. Formal structures in the empirical case consisted of a research plan and a research agreement, which also comprised a plan of a steering group, an operative steering group, project meetings, research directors’ meetings, and documentation procedures. The empirical results also identified a formal structure as written or verbal agreements, decision-making organs, and procedures for conflict situations, even at the extreme of actors’ exit.

In the forming of an R&D net, *learning* is seen as a necessity in order to achieve the share of the benefits of the collaboration. Adaptations and learning is seen as necessary to ensure continuity of co-operation. Learning is gained through the
development of collective worldviews, ideologies and cognitive systems in the R&D network under formation.

Based on empirical results (Paper IV) of this study, managing in R&D net during collaboration requires conceptualizing, gathering actors, allowing resources, mobilizing operations, and planning commercializing activities. Conceptualizing refers to idea formulation regarding the concept of the offering. Gathering actors consists of acquiring actors needed for the development concept. Actors may use existing ties or shared perception of the concept of the offering in order to attract potential actors to join. It may also contain limiting actors that are not suited to the R&D net scope. Allowing resources means enabling and providing the required development resources: monetary, personnel, time or existing IPRs, content for development purposes. Planning commercialization refers to finalizing the offering and business model to suit markets.

In addition managing in R&D net during collaboration was perceived as phases of the offering development, i.e., the net formation, initiation, planning, development, piloting, and commercialization. According to the empirical results, actors act differently in distinct stages of the offering development process, based on their ambitions, connection and resources in each stage.

In the empirical results in end of collaboration several actors performed actions on planning commercialization. Based on (Paper III) the action of actors commercializing activities were seen unexpected and causing confusion, thus the actor had not been aware of the actor’s part in development process. In empirical results (Paper IV) the dispersion to several commercialization net were seen natural among actors. The Actors even perceived that the joint development among wider group were seen justified, as the actors are able to focus on their own commercialization activities.

Based on the empirical results, it can be noted that the R&D net that develops offerings is/are not necessarily identical to those nets that commercialize offerings. Significant changes between the final phase of collaboration is identified. The third and fourth papers (Paper III and Paper IV) note that due to the different views and motives of actors among the R&D net during the commercialization phase, the R&D net was separated into several smaller nets that aimed to pursue their own goals. Some actors, such as universities, can operate with no commercial aspirations. As an empirical result of this study, it can be noted that the nets that are creating the solution are not the nets that commercialize solutions. Creating a business network that commercializes may necessitate new actors joining the R&D net. Empirical results also show that actors may decrease their contribution to net,
e.g., governmental actors may decrease in contribution due to their operation policies, that halt their ability to participate in commercialization activities, or some actors may act in roles that enable the network to be changed according to their needs.

In addition, in the empirical results are noted the varying level of managerial activity of individual actors during R&D net management. According to the findings of the empirical phase, the level of active management actions can vary from continuous cooperation and continuous management actions, to timely managerial actions according to the progress of development. An actor’s contribution to network management may vary over time during the development process, based on the goals said actor is pursuing and the expertise it possesses. In addition, the actor may refrain from using its managerial abilities when it sees that its goals are to be met by ongoing activities. The actor’s performance in R&D activities influences its abilities to manage the R&D net process.

Managing in R&D net with roles

Based on empirical results, managing in R&D net can be utilized in order to achieve planned change in network structures. Managing in R&D net happens through actions that managers, as representatives of network actors, perform to influence the resources and activities of other actors in the network. In the empirical results, roles are defined to base on action and defined as an aggregation of actions that actors perform. These actions are perceived, re-acted and re-re-acted by other actors.

The empirical results of the papers related to R&D net managing as a process and via roles for managing are gathered and summarized in Table 5.

Table 5. Empirical results - Managing in R&D net during formation and collaboration via roles.

<table>
<thead>
<tr>
<th>How is managing in R&amp;D net conducted during formation and collaborating</th>
<th>Phase I - Empirical results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Via roles</td>
<td>Managing in R&amp;D net can be based roles that derive from actor bond possession, resource tie possession or activity link possession. Roles change over time: Actor may act in several roles during phase of development, or within phase. Actors can improve their abilities to analyze individual actions of others and plan their own actions in net</td>
</tr>
</tbody>
</table>
The roles are utilized to understand the dynamics and the complexity of the functioning and managing in R&D net. Through acting, actors perform a role, which influences the relationships between the actors in the net. By acting in a role, actors manage in an R&D net by changing the relationships between actors. The definition of *aggregation of action* is based on perceptions of other actors.

Based on the empirical results of this study (papers I, II, and III) in total 13 roles for managing are identified form an R&D net context. In the following, all roles presented are combined and described briefly. Table 6 shows the roles identified in the empirical phase of this study, describes them briefly and defines their association with phases of R&D network development.

Table 6. Roles for managing identified in empirical results.

<table>
<thead>
<tr>
<th>Roles for managing</th>
<th>Paper nro</th>
<th>Empirical description</th>
<th>Relation to phase R&amp;D net phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webber</td>
<td>I, II, III</td>
<td>Manages through attracting connection, creating and maintaining relationships and influences to scope of the network. Facilitates organizational activities of the net. Initiates net connection by deciding potential actors. Behaviour expected and approved by others</td>
<td>Formation, collaboration</td>
</tr>
<tr>
<td>Roles for managing</td>
<td>Paper nro</td>
<td>Empirical description</td>
<td>Relation to phase R&amp;D net phase</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------</td>
<td>-----------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Resource provider, Gatekeeper</td>
<td>II, III</td>
<td>Manages through resource i.e. technologies, knowledge, connection and other key element of the outcome (offering) possession. Ability to combine resources and thus able to manage towards desired end-state. Influences actors that are approved and disapproved within the net, though fit of resources and potential contribution.</td>
<td>Formation, collaboration</td>
</tr>
<tr>
<td>Organizer</td>
<td>II</td>
<td>Manages through ability to coordinate activities. Possess certain key activity links that used to actions to connect actors towards the goal of net.</td>
<td>No indentified phase</td>
</tr>
<tr>
<td>Instigator</td>
<td>III</td>
<td>Influences other actors’ decision-making process in net level</td>
<td>Forma,-ation, collaboration</td>
</tr>
<tr>
<td>Advocate</td>
<td>III</td>
<td>Communicates positive information about the process. Operates in net level and may remain unnoticed with others though providing significant contribution to outcome.</td>
<td>Formation, collaboration</td>
</tr>
<tr>
<td>Producer</td>
<td>III</td>
<td>Active actor performing the tasks in net. Influences significantly to the outcome of the net via though enabling resources for the net.</td>
<td>Collaboration</td>
</tr>
<tr>
<td>Planner</td>
<td>III</td>
<td>Actor provides inputs to the development process and thus affecting intentionally to the net outcome. Action focuses on outcome and others perceive action expected an incremental</td>
<td>Collaboration</td>
</tr>
<tr>
<td>Entrant</td>
<td>III</td>
<td>Actor that performs action based on the connections of the surrounding network and possession of the resources. Role is perceived as emergent and action may be perceived interfering.</td>
<td>Collaboration</td>
</tr>
</tbody>
</table>
First role network webber is identified in papers I, II, and III. Network webber manages in net by creating and maintaining relationships with actors. Network webber initiates net connection by deciding on potential actors, attracting them to join or rejecting actors that are not seen to fit. Others perceive the behavior of webber as expected and they approved the action. In Paper II, managing in R&D net is approached through acting in roles that derive from actor-bond possession, resource tie possession, or activity link possession. Based on the findings in Paper II, webber manages through actor bonds by intentionally connecting to other actors and managing connections in order to influence the composition of the net.

Managing in the R&D net during formation is strongly related to the existence of a central actor in the network webber role. Network webber is seen during net formation, as seen in Paper I, to trigger the R&D network formation process by enabling actors to perceive their shared interests. During R&D net formation, the network webber can develop commitment among actors via open communication. The formation phase sees the creation of formal R&D net structures: written or
verbal agreements, plans, decision-making procedures and organs, and conflict-solving procedures. However, as a central role in network formation, the network webber is seen as a neutral actor pursuing the interests of the whole network under formation, not just the interest of the central actor.

The network webber actively participates in all sub-processes of net formation. It enables formation by pointing out the need to co-operate with potential actors, and it is being active in acquiring actors by attracting, approving, and disapproving potential members. The network webber’s role in assuring continuity and formal structuring is also seen as influential in the findings of this paper.

Network webber actions are approved by others and generate change in the R&D network. Its actions are perceived as an assurance of continuity, thus managed resource acquisition (compiling funding applications and research plans – agenda construction) and as a representative of the network according to others, through influenced formal structuring, i.e., the design of the organization, and decision-making mechanisms for the network. The webber is also seen as an influential role during the formation, planning and commercialization phase of the R&D net development based on Paper III.

In the second role as is strongly related to resource possession. In paper II the actor manages through resource ties and acts in – resource provider – role. In paper III sees similarly as resources provides role the gatekeeper. An actor is seen to act in Gatekeeper role when an actor manages through resource possession i.e. technologies, knowledge, connection and another key element that is required to outcome creation of the R&D net. Gatekeeper acts to combine resources that is required to offering and thus able to manage towards desired end state. Gatekeeper is able to influence actors that are approved and disapproved within the net, though fit of resources and potential contribution.

The Gatekeeper role is associated with the formation and collaboration phase: the planning, development, piloting and commercialization, of R&D net development.

The actors that act in the role – organizer – manages through activity links, as noted in Paper III. Organized acts possession of key activities of the event, or the processes that are used for the co-ordination and connection of operations of the network toward its goals. The organizer role is not associated with specific space in empirical results, thus the development was not in the scope of Paper II.

Several changes are noted in roles during the different phases of R&D net development. Changes among actors, their contributions, roles and centrality during different phases are also noted. Existing connections were influential factors
during the initiation and network formation phase. In the development phase, three central actors acted in the producer, planner, gatekeeper, and compromiser roles.

In the piloting phase, three central actors, namely the research project, content provider and sports team, acted in several roles: the research project in the planner, auxiliary, and compromiser roles; the sports team as facilitator; and the content provider as producer and advocate. Negotiating with external actors arose as key activities during this phase: A national media house and a national league questioned the legal rights of piloted service content distribution and thus threatened the continuation of the offering development.

In the paper III in total of 12 network management roles are identified, that in addition to webber and gatekeeper roles consists of instigator, advocate, producer, planner, entrant, auxiliary, facilitator, compromiser, aspirant, and accessory provider.

Actors that act in the instigator role were seen to influence other actors’ decision making. Instigators aim to activate other actors to perform, to extend the offering that the R&D develops. The role of instigator is associated with formation, planning, development, piloting and the commercialization phase of R&D net development.

Actors in the advocate role communicate actively positive aspects of the R&D process within the R&D net. The actor is not seen as being active in operative action, but more background action and facilitating publication contributes to net development. The role is associated with planning, development, piloting and the commercialization phase of R&D net development.

Actors in the producer role are active in performing the tasks in R&D net. They significantly influence the outcome of the net by concretely acting to realize the offering. The producer contributes with labor hours and other enabling resources that are required to create the offering of the net. The role is associated with the planning, development, piloting and commercialization phase of R&D net development.

Actors in the planner role provide inputs (mostly intangible resources) to the development process and thus intentionally affect the net outcome. Action in the planner role focuses on outcome of the R&D net. The action in the role is perceived as expected and influences the net incrementally. The role is associated with the planning, development, piloting and commercialization phases of R&D net development.

Actors in entrant perform actions that are based on the connections of the surrounding network and possession of the resources. Action in the role is
perceived to radically influence the tasks of the net. Thus, the action is perceived as emergent the other actors may even perceive action interfering. The role is associated with the piloting and commercialization phases of R&D net development.

Actors in auxiliary roles are seen to emerge in the net though connection to others. The contribution of auxiliary is seen as significant, but the other may perceive that the actor with have no “official” role in the process. This misperception is caused by a misinterpretation during R&D net development or that the development enables a greater contribution opportunity to the actor. The role is associated with the piloting phase of R&D net development.

Actors in the facilitator role act as resources for the whole net with its resource possession, but remains on the background on task and the net level on R&D net offering development. The role is associated with formation, planning, development, and the piloting phase of R&D net development.

Actors in the compromiser role balance actions and relationships with others in the net. The role also consists of action that may lead to retreating from one’s own goals in order to ensure the goals of the whole R&D net. The role is associated with planning, development and the commercialization phase of R&D net development.

Actors in the aspirant role perform actions that indicate to others their desire to participate in the future of the net. Actors in the aspirant role are perceived as "outsiders,” which necessitates other actors to define aspirants fit to net and contribution to the offering. The role is associated with formation, planning and the piloting phase of R&D net development.

Actors in the accessory provider role perform actions that are used to seek the opportunity to provide offerings (products, services, expertise) to fit the whole offering entity developed by the net. The role is associated with the piloting phase of R&D net development.

Three roles (Webber, advocate, and compromiser) are identified as generic roles that are applicable in other contexts. Webber, advocate, and compromiser have already been identified in the earlier literature and they are stated in the findings of the paper III as being applicable in specific phases of development and in other network contexts, in addition to a R&D net developing a new mobile service. The webber is an influential role during the formation, and collaboration phases i.e planning and commercialization. The advocate is regarded as a collaboration phase role, which can enhance or prevent the task, net and network levels from achieving its goals. Typically, for generic roles, the advocate role is not
associated with a central position in a network. Finally, the compromiser role appears during disagreements and conflicts, which inevitably appear over time in developing network. Actors with less invested resources and lower contributions to the end state are expected to allow more room for other interests and be more passive in the short term, if the net’s overall success is enhanced. Actors are noted to act as compromiser during conflicts.

**Framework of roles for managing**

The empirical results identify the wide extent of pluralism of action among actors in an R&D net context. Pluralism and even complexity is created as the roles for managing are based on action of actors and seen as an aggregation of actions that they perform and other actor’s perceptions of these actions.

Actors can perceive managerial action positively and negatively, and they will react to managerial action. Actions can be aimed at tasks that the R&D net is performing, the focal net the actors are located in, or a network beyond the R&D net in which it is embedded. Influence of actions is perceived as radical, while influencing enables the formation of new relationships or the dissolution of an existing one. Influence is perceived as incremental, when shaping tasks that the network is performing based on existing relationships. Actions can be perceived as expected or emerging, based on whether the relevant action was perceived to be anticipated by the actor by others. Actions can be perceived as emerging when the actor aims to change the role intentionally. The roles are also seen to change over time therefore in order to understand the dynamics and pluralism systematizing analytical concepts and tools are required.

The empirical results also extend the analytical frame of defining managerial roles and creates the framework of roles for managing (later FRM) as empirical result of this study. FRM increases understanding of the characteristics of the roles for managing. The roles entailed for managing can be defined based on three dimensions used for describing the acting and those role dimensions can be used for further understanding of managing in net. Figure 5 illustrates FRM.
The FRM can improve actors’ abilities to interpret its ability to manage in R&D net, interpret how other actors are aiming to manage, or why a particular actor is acting in particular way in R&D net. The perception of roles for managing is based on actions and reactions of other actors performing tasks, understand the level of acting in the task, net, or interaction with network level, in addition that the perception influence and expectation, therefore roles can be used as concept to depict the dynamics in the network.

The FRM is based on how actors act in the focal net and on what basis and how others may interpret actions. The FRM also considers the temporal change of roles between phases of R&D net development. Using FRM creates understanding of roles that appear in an R&D net for actors. By utilizing FRM, actors can improve their abilities to analyze the individual actions of others and plan their own actions towards tasks, plan their actions in net and actions that influence beyond net in a network.

### 2.2.2 Benefits of managing in R&D net for actors

Managing in R&D net is seen to provide benefits for actors in net. This section, the benefits that arise in the empirical results are identified and described.

Firstly, managing in net may be the prerequisite for the initiation of the formation of the R&D net. The empirical results note that the individual actors possessed such scarce resources that individually they would not have been able to conduct R&D activities with their own resources. Thus, as a benefit, it can be seen that managing in R&D net enables R&D activities to start in the first place. In addition, managing in R&D net also enables the challenges created by complexity to be overcome. In the empirical results, the actors in R&D net perceived several heterogeneous interests to join, e.g., access to research information and knowledge as well as potential reference value. Also, the action performed by network webber...
helped actors perceive future value, identify the interdependencies and joint shared interests, and thus enable actors to join their R&D activities in net.

Secondly, as a benefit of managing in R&D net is the ability to structure and speed up the formation of R&D net, that is noted in the empirical results of this study (papers I, II, III, and IV). Based on the empirical results of this study a network webber manages, with the consent of other actors, R&D net formation sub-processes that enable an increased pace of R&D net formation. Managing in R&D net enhances network formation, thus actors that joining the cooperation have a better understanding of the process that they are involved in. In addition, network webber was able to dissolve the relationship with undesired actors during formation.

Following table 7 presents the empirical results of benefits managing in R&D net for actor.

<table>
<thead>
<tr>
<th>Research question</th>
<th>Phase I -Empirical results</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the benefits of managing in R&amp;D net for actors?</td>
<td>Enables R&amp;D net formation and performing</td>
</tr>
<tr>
<td></td>
<td>Structures and speeds up net formation</td>
</tr>
<tr>
<td></td>
<td>Ability to extend resource and knowledge base: 1. Extend magnitude by combining and acquiring resources and knowledge,</td>
</tr>
<tr>
<td></td>
<td>2. Extend magnitude by acquiring net type, even scarce resources and knowledge.</td>
</tr>
<tr>
<td></td>
<td>Connected actors (i.e. webber) able to link actors from various networks. Influences innovativeness of the net.</td>
</tr>
<tr>
<td></td>
<td>Structures and speeds up offering development</td>
</tr>
<tr>
<td></td>
<td>Enables modular design</td>
</tr>
<tr>
<td></td>
<td>Optimize resource utilization. Identify missing resources</td>
</tr>
<tr>
<td></td>
<td>Increase understanding on roles: Enables role planning, enables relationship management optimization</td>
</tr>
<tr>
<td></td>
<td>Increased understanding of process: comprehend change in network over time, phases and roles, comprehend actions abilities to influence to task, net or embedded network structures</td>
</tr>
<tr>
<td></td>
<td>Enables positive atmosphere among development group</td>
</tr>
</tbody>
</table>

Thirdly as s benefit of managing in a R&D net for actor is the ability to extend the resources and knowledge base for R&D activities from different types of actors and organizations. The origins of resource and knowledge base extension is twofold. In empirical results managing in R&D net were seen to expand the scope of development activities and conduct development activities with an extended
resource base. Managing in R&D net enables the joint value creation of actors that possess resources and activities that are required in new value offering creation. By managing in net, actors are able extend the magnitude of the developed offering rather than conduct development activities individually as single actors. Managing in net expands the resource and knowledge available for R&D activities and enables utilization of a new type or scarce resources and knowledge. In the empirical results, it is seen that managing R&D net enables actors to combine varying types of knowledge and resources, even new and scarce. Managing in R&D net also enables attracting actors that operate on the frontiers of different (technological, geographical) nets, or networks. Actors may possess varying technological backgrounds, they may originate from different industries or be distantly located geographically. In empirical results as benefit were seen the ability to use new types of resources or rare resources, e.g., commercial actors could utilize university researchers as highly competent knowledge sources, and resources for information acquisition about service technologies, potential business models and end-users.

Managing in R&D net also enables benefiting from linking actors that act as links between different networks, i.e., weak link actors. The benefits of managing in R&D net via weak link actors are seen in empirical results to influence the innovativeness of the R&D net. Findings from the empirical result indicate that the ability to utilize a central actor (i.e., a webber) with connections to and between multiple types of organizations, nets and networks, can be seen as beneficial to R&D net and influence the achievement of goals and innovativeness of the net offering.

Fourthly, managing in R&D net can be utilized to speed up the collaboration phase activities and joint offering development. According to empirical results, the offering development in R&D net was divided into modular design elements. Modular offering development was a factor that increased the pace of offering development based on empirical results. The benefit from modularity was achieved when managing in net enabled actors to focus. In the empirical results, actors can gain the benefits of focusing when they have agreed upon modules, mutually agreed upon precise roles, shared schedules and they are aware of other actors’ development activities. With managing in R&D net, actors are aware of other actors’ roles and activities, and are thus able to focus on their own activities, tasks, and contributions to the shared goal of the net.

In addition, the modular offering development in R&D net enabled the utilization of previously developed technologies and content, which were based on
existing resources and activities. The empirical results (papers II, III and IV) note that existing relationships within a network can be used to speed up the development process. Existing relationships and a shared history can speed up the need recognition of complementary offerings from cooperating actors. They can also increase the pace of new offering development through the use of joint resources and activities in a modular sense that benefits the development of the offering. Increased pace can be achieved as well when each actor has their own separate targets that combine joint targets, clear schedules and agreed upon roles during the development process. It all could be combined as a joint offering for the end-customer that helped the offering development.

The sixth benefit of managing in R&D net is associated with improving understanding of network structure, the various actor roles within it and the changes related to network development. With improved understanding or roles for managing, actors can coordinate their relationships with other actors. Thanks to the ability to understand managing in net through roles, an actor can plan its actions toward the desired roles and goals of the net. Actors can focus on collaboration with actors that jointly possess optimal resources, focusing on activities that are identified as missing in the net structure. Managing in net increases actors’ abilities to understand relationship management within the net. It allows them to focus on influential actor roles such as gatekeepers or webbers in order to ensure access to the net. Actors can also perform acts that lead to role behavior that are noted as missing in the net.

Empirical results identify that R&D net changes over time and managing in R&D net increases actors’ understanding of temporal change. Change in R&D net is seen to happen to the roles of actors in a task, net or network-level change, during phases of innovation such as network formation, offer planning, development, piloting, and launches into markets, i.e., commercializing in R&D net change, or when development is seen to happen in sub-processes of R&D net development as teleology.

The seventh benefit of managing in R&D net empirical results of this study can be associated to take place during the final phases (i.e., when closing to commercialization) the net’s development process. An R&D network faces pressure when shifting from offering development during the collaboration to market launch. Pressure is originating from the surrounding socioeconomic, technical network that the R&D net is embedded in. Managing in R&D net enables new actors to join a net before commercialization, when and if it is regarded as
necessary. Managing in R&D net enables the R&D net actors to change their roles that they are perceived to act in.

The final benefit of managing in R&D net is that it enables the development of a positive atmosphere among a development group. Empirical results noted that there exist actors whose role is to enable a positive atmosphere by encouraging a positive attitude toward R&D; networks outside the boundaries of the network may even emerge. Managing in net enables a positive “pioneer spirit” formation within the R&D net, which enhances experiences and creates a joint understanding of justified workload division among actors.

2.2.3 Challenges of managing in R&D net for actors

As indicated in the empirical results, the challenges that are noted in managing R&D net are related to understanding the complexity of networks per se. Managing in dynamic and complex R&D net requires the ability to identify potential actors with contribution potential and bind them together in cooperation toward the joint goals of a net. However, the ability to pool the best actors with all technological, IPR and financial resources is not enough. Managing in R&D net as a process and ability to understand the functioning of network organizations can help achieve their goals. Challenges are related to understanding the importance of common vision and shared roles among actors, and the dynamics within the R&D net. Challenges are also related to applying managing in net at the optimal level, thus overly active managerial actions during formation may affect innovativeness, while an overly passive approach may delay formation.

Firstly, the complexity of the R&D net is noted as a challenge of managing in net based on the empirical results of this study. The largest challenge of managing in R&D net related to understanding the R&D net as structures characterized by multidimensional heterogeneous actors pursuing a joint goal. Complexity is derived from the dispersed motivations of actors that can only partially be mutual and sometimes even conflicting in R&D nets. Actors managing in R&D are challenged to understand that R&D net is a structure of actors and their relationships that are heavy with actor bonds, activity links, and resource ties. Actors managing in R&D net are challenged to understand that existing relationships and actor bonds may be utilized during cooperation during the formation or collaboration phases of R&D net development. Actors need to take existing resource constellations into consideration. Existing resources can influence the adaptability and compatibility of the offering and its fit for the
surrounding network. Existing resources that have not been seen during the formation or collaboration may influence managing in R&D net. The motivation to cooperate with actors in a net may be derived from certain resources it possesses, due to its existing relationship that is heavy with resource ties its partners may have been accepted to join. Additionally, a challenge of managing in R&D net is that actors can perceive the limiting effects of R&D nets where they are bound to unproductive relationships that prevent collaboration with others.

The actors also need to understand the goals and motivation of individual actors in net. The comprehensive understanding of motives of other actors prevents misunderstandings and perceptions of opportunistic behavior. Table 8 presents the empirical results of challenges of managing in R&D net.

**Table 8. Identified challenges of managing in R&D net for actors.**

<table>
<thead>
<tr>
<th>Research question</th>
<th>Phase I - Empirical results</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the challenges of managing in R&amp;D net for actors?</td>
<td>Understanding complexities of networks: Common vision, shared roles, context, dynamics and net embeddedness to network</td>
</tr>
<tr>
<td></td>
<td>Transformation between the major development phases of formation and collaboration</td>
</tr>
<tr>
<td></td>
<td>Apply management at appropriate level</td>
</tr>
<tr>
<td></td>
<td>How to embed in the surrounding network</td>
</tr>
<tr>
<td></td>
<td>How managerial action influences in task of net, in ent and beyond net level</td>
</tr>
<tr>
<td></td>
<td>How to cope unexpected role behavior in R&amp;D net</td>
</tr>
<tr>
<td></td>
<td>Ensuring actor visibility in roles</td>
</tr>
</tbody>
</table>

Secondly, the development of networks over time is seen as challenge in managing in R&D net. In the empirical results acknowledged as challenge for managing in R&D net the transformation between phases of R&D net development. The identified challenges are derived from changes in R&D net over time during formation and collaboration. The challenges are identified to relate both in terms of offering development and operating within the net structure. Empirical results note as challenge the understanding of an actor’s managerial actions in the formation phase, which can have an impact on the latter phases of collaboration. A challenge related to managing in R&D net is that actors’ contribution varies over time during the offering development process. From the managing in R&D net perspective, it is essential to note that during the different phases of offering development, an actor’s contribution to the R&D net varies. As stated in the section on empirical results (papers II and IV), a device manufacturer’s active contribution
at the beginning of the offering development varies from active management to activation when needed. Actors may also perceive the continuation of the R&D net differently, e.g., collaboration after launch to market and joint commercialization is not necessarily a motivation for all actors. For example, government actors may be pressured not to participate in commercialization, or they decrease their contribution in the final phases of offering development. Non-governmental actors may have such a strong interest in commercializing that it leads to network dispersion of the net that developed the offering for multiple new commercialization nets.

There are also challenges related to the network webber actions during the offering development process. A noted challenge of managing in R&D net is related to central actors, i.e., the webber’s ability to gain acceptance from others for its managerial actions, as well as the actor’s abilities to create joint goals for the network as a whole. In the empirical results, the network webber’s actions must be accepted by the other actors in the network. The other actors accept the changes as long as they perceive that the benefit is mutual and leading to a joint goal. Even a central actor like a network webber must understand that its actions may also be perceived as negative or even opportunistic. If the actions are perceived to be unacceptable by other actors, their reactions hinder the abilities of network webber to perform acts aiming to change the interaction in the net.

The empirical results of Phase I of this study indicate that there are managerial challenges related to the R&D formation phase. The specific challenges for formation phase are related to actors or characteristics of the network formation phase itself.

The challenge of managing in R&D net for an actor during formation phase is derived from continuous adaptations, when new actors are acquired, accepted, or refused. There are also challenges identified as specific to net formation sub-processes, such as actor acquisition, formal structuring, assuring continuity, developing commitment, and learning. During R&D net formation, there are challenges for managing in net related to actor acquisition. Firstly, actors need to create a mechanism how to attract potential actors to join the net, how actors are accepted or rejected to join and how potential relationship dissolution is performed.

In addition, the ability to create formal structures are seen as challenge for managing in R&D net. During R&D net formation a managerial challenge is to find actors that are able to make joint decisions of goals and tasks of the R&D net. During R&D net formation developing commitment is seen challenging for actors managing in net. The development activities may remain limited for a significant
period, due to the development activities that have not yet started. Perception of the future of the net, benefits of the participation of the net and commitment among actors need to be created under the condition that nothing concrete or no joint development activities has not yet taken place, besides a verbal agreement. There might be also low level on interaction and activities among actors that is challenging for ensuring the continuity and learning among actors of the R&D net. Also during formation phase, interaction and the potential for learning may be challenging, and when there are continuous changes of network members due to new actors joining and/or actors exiting. During formation the ability to adapt and learn among continuous changes in the net becomes important.

There is also noted challenge of managing of the R&D net related to the appropriate level of managing. Empirical results note that managerial action during the formation phase influence the latter phases of the R&D net development. Even the innovativeness of the whole network is may be influenced by the level of managing in R&D net performed by actors, which is realized in the latter phases of development. Actors need to use managerial actions during network formation with careful attention and appropriate level, in order to avoid too much influence from one active actor rather than utilizing the resources and knowledge of all potential actors in R&D net.

The dynamics and continuous change in R&D net create challenges for managing in the net. A noted challenge of managing in R&D net (based on papers II, III, and IV) is the continuous change and transformation among actors and their relationships. In the empirical results, change within the net also took place between the major phases of development. In R&D net, it seen as important to understand changes that can be caused during the transformation from major development phases, i.e., from net formation to actual collaboration, while offering design, development, piloting, and finally commercialization of the offering. A challenge for managing in R&D net is the notion that a net that develops an offering is not necessarily the net that commercializes applications for markets. Based on the empirical results, some actors were waiting until the development activities were finalized, until they could start commercializing activities based on their own separate operations leading to significant changes in R&D net, even relationship dissolution. The challenge for managing is then the ability to identify actors that can contribute to R&D network cooperation and justify the exclusion of actors that want to participate during collaboration. Actors with joint perceptions in the R&D net to develop offerings together may not share the joint perception during the late phase of collaboration when the market launch is closing. These challenges can be
overcome by understanding the networking itself and the motives of each actor in
the R&D net. Understanding an actor’s motives is challenging, especially the
evolving motivation between the offering development phase and the early
commercialization phase.

While managing in R&D net, a manager must take into consideration the
compatibility and adaptability of the developed offering to surrounding business
network and the socio-technological environment. Managing in R&D net is
challenged by the required understanding of the influence of R&D net external
actors on the net. Actors in R&D net need to understand all of the actors; even the
“outsiders” note in Paper III can have a positive, negative, or partial influence over
actors in the network. A challenge for an actor in managing in net is setting the
boundaries of the net that potential entrants and actors influencing the net are
included.

In addition, the challenge for managing R&D net is to understand resource and
knowledge acquisition over actors that link several networks. In R&D net,
resources and knowledge that are required may be gained via through weak links,
i.e., actors that operate between nets. The challenge is understanding the
requirements of new technology, distribution channels, new business models or
new business fields in addition to ability to identify the relevant actors that possess
resources, perform activities and possess knowledge.

One managerial challenge of managing in R&D net is related to the shared
understanding of roles for managing among actors within the R&D network. There
are noted challenges based on the empirical phase of this study related to
understanding the complexity of the roles for managing that individuals, companies
or network actors use when managing in an R&D network. Actors must be able to
comprehend how managerial actions have an influence over the development tasks
and interaction at the R&D net level, as well as how managerial action has an affect
beyond R&D net boundaries to networks the net is embedded. Actors execute
actions that aim to change the tasks or R&D net itself, and the influence of the
action is dependent on the perception of other actors performing tasks, reacting in
the same net, or beyond the network boundaries that the network R&D net is
embedded in. Other actors may perceive managerial action as expected or emerging.
Complexity may arise from the notion that managerial actions toward changes in
the R&D net may be perceived as radical. Change in a net is perceived as radical if
it leads to the creation of new relationships or the ending of existing ones, or
incremental if it is perceived to complement existing relationships. Managerial
action may be perceived among actors as expected or unexpected, and the influence
of action may be interpreted as radical or incremental. Based on an understanding of the level of influence, perception, and interpretation, actors may create an understanding of roles as collections of managerial actions. A challenge related to roles is the understanding of dynamics, and thus roles may emerge and change during the development process of R&D net. Through managing in nets, the roles for actors may change, new roles may emerge, and actions interact with actors as well as others in the surrounding network. Additionally, challenges are identified which relate to understanding the influence of managerial actions at varying levels; therefore, managerial action influences interaction among actors in tasks that actors are performing, interaction in relationships between actors in a focal net and surrounding network. In addition, surrounding networks are being influenced by actors from beyond network boundaries.

Finally, one noted challenge in managing in R&D net is related to actor’s expectations of role behavior in R&D net. Managing in an R&D net also leads to awareness of unexpected role behavior. Even with written agreement on roles among actors, emergent role behavior exists, thus acting in a role is a process of constant action and reaction to the behavior of others in the network. The challenge in managing in R&D net is the constantly changing and unexpected actions – reactions and re-reactions of actors.

In the following sub chapter, the empirical results of this study phase I are reflected to findings to contemporary literature Phase II in more detail. The following sub-chapters reflects the empirical results to the contemporary literature (i.e., current knowledge) of managing in R&D net literature. The sub-chapter 2.3 reflects the empirical results of managing in R&D net as a process and via roles for managing to the contemporary literature. The followed sub-chapter 2.4 reflects the empirical results of the benefits of managing in R&D net to contemporary literature. The final sub-section 2.5 reflects the empirical results related to the challenges of managing to contemporary literature.

2.3 Phase II-Contemporary literature review– Comparing the results to contemporary managing in a R&D net literature

The following three sections reflect the empirical results of managing in R&D net to the contemporary literature. The first sub-chapter reflects results that are supported by contemporary literature. Second sub-chapter reflects contradicting findings from current knowledge and empirical results. Finally, third sub-chapter describes results that are adding to contemporary and thus contribution this study.
2.3.1 Managing in a R&D net; results supported by contemporary literature

The empirical result reflection begins with results that are supported by contemporary literature.

*How is managing in R&D net conducted as process supported by contemporary literature*

When analyzing the process, this study initially reviews managerial action. Based on the empirical results, managing in R&D net takes place with actions that managers as representatives of network actors performing in order to influence resources and activities of other actors in a network. Actors can perceive managerial action positively, negatively and they will react to managerial action. A number of studies see similarly that managing in net is performed by actors by acting, reacting and adapting in a complex social system [i.e., net] in such way that both individual and communal goals of actors are reached (Chiu 2009). In an innovation network context, Ojasalo (2008) sees similarly, in that management is not 100% under the control of each aspect of the subject, but rather it is a conscious attempt to define and reach goals with actions. Managing in net can be seen as an ongoing task of acting, reacting and adapting in a complex social system in such a way that both individual and shared goals are reached (Yen 2008).

It is also seen as particular and intentional actions of an actor within a net in order to achieve its goals. The actor and the network have overlapping goals, to the extent that achievement of the networks’ goals progress the goals of individual actors and vice versa. In generic goal consensus and similar perception of domain, it allows organizations to perform better (Provan & Kenis 2008). Additionally, mutual understanding and acceptance of vision, targets and frame of action similarly, i.e., cohesiveness influences (Järvensivu et al. 2010). In strategic nets, discussion sees that managing in net is determined by the level of determination of the value constellations and clarity of the pursued goals and outcomes through the net (Möller et al. 2005.) A key matter in managing in net is the actor’s ability to mobilize and coordinate other actors in net and what positions or roles it can achieve (Möller et al. 2005).

The empirical results of this study provide process conceptualization based on managing in R&D net as a process by using two different process approaches. Firstly, the development process of R&D net is presented chronologically based on
a temporal path order of events in the form of a life cycle (Van De Ven & Poole, 1995; Van de Ven & Sun, 2011). This phase approach of perceiving the R&D net development process has typically been adopted from product or service innovation literature, where the process and phases of development follows phases of innovation development. The phases of the development process may be based on product development literature and the exploration of innovation: design, application, and dissemination (Lundgren, 1995; Möller & Svahn, 2009), and service development literature: planning, development, and market launch of service (Gottfridsson, 2014).

In the empirical results, it has identified that R&D net development as a process that consists of both formation and collaboration. Contemporary literature sees e.g., studies focusing on R&D net building (Partanen & Möller, 2012) and R&D network formation (Ring et al., 2005) share the perception that net formation phase is integral part of R&D net development.

The existence of antecedents, i.e., initial conditions that precede R&D net formation are supported in the contemporary literature. Both the empirical results and contemporary literature (see, e.g., Ring et al., 2005) see interdependence, perception of shared interests, or presence of a network webber, i.e., some other active party in the network as initial conditions for R&D net formation. Ring et al. (2005) sees that network formation is dependent on actors’ initial and mutual understanding to start collaboration that is derived from perception of converging business interests, urgency to initiate cooperation and existing social relationships. In addition, in contemporary literature actors bonds or ties i.e., common professional history and social network ties (i.e. close friendship) (Ojasalo, 2008) existing strategic relationships (Ring et al., 2005) are seen as preceding conditions of R&D net formation. Also finding from construction industry R&D nets support (Holmen et al., 2005) notion of antecedents i.e. initial condition and perception of interdependence, thus in context of construction industry actors’ inability to perceive future value of collaboration is seen to prevent net formation. Also Ojasalo (2008) see similarly that the highest authority is required in R&D net, but the role of the central actor should differ from traditional manager role characterized by hierarchies, bureaucracy, centralization, and opportunism.

There are similarities in contemporary literature and empirical results of managing in R&D net formation in terms of the process perceptions. In the empirical results, the R&D net formation was triggered by network webber and formation sub-processes were influenced actively by network webber. In contemporary literature, Ring et al. (2005) consider net formation and the
perception of net formation similarly as an engineered process managed by a
triggering entity which enables independent actors to acknowledge shared interests,
increase understanding of joint converging interests, and increase awareness among
potential cooperating actors.

As seen in the empirical results of this study that see the R&D net development
process as simultaneous, overlapping streams or processes rather than path-
dependent phases. In the context hub-driven, strategic networks formation,
Partanen and Möller (2012) see the strategic network-building model similarly as
a collection of iterative, overlapping, and simultaneous sub-processes. Both the
empirical results of this study and Partanen and Möller’s (2012) model perceive the
development process as being based on teleology (Van de Ven & Sun, 2011) as sub-
processes, leading to a shared end state. Sub-processes appear in overlapping and
iterative structures, not on predetermined paths. Sub-processes may happen
simultaneously, or they may overlap or repeat during the process. For example, it
was noted in the empirical results and in the Partanen and Möller (2012) study that
the process of acquiring actors took place several times during the formation
process. In the empirical results, the acquiring actors appear during formation and
collaboration of the net.

Similarities in relation to the empirical results of managing in R&D net
formation and the perception of the managerial sub-processes and activities during
network formation are also identified. The sub-processes of network formation
based on the empirical results of this study enabling formation, acquisition of actors,
assuring continuity, developing commitment, creating formal structures, and
learning. Negotiated actor acquisition, developing commitment, and assuring
continuity are seen in a similar way to the strategic network-building model in the
empirical results and the contemporary literature (Partanen & Möller, 2012), which
describes net formation from the perspective of a hub firm aiming to develop its
offering to end-users. A central hub possesses sufficient abilities and resources to
analyze the targeted value activities and the ability to compare resources and
abilities internally and externally. It also enables the ability to develop resources
and capabilities, negotiate, develop the commitment of the network under
formation, and delegate activities to other actors formulating the end-user-oriented
value-creating network. Ring et al. (2005) also identify several managerial
activities and tasks that need to be executed during the R&D network formation
process. These activities are developing awareness of environmental
interdependence, discovering converging interests, triggering collaboration,
selecting partners, searching for consensus on vision, mission, goals, and values,
and defining expectations of continuity (Ring et al., 2005). Based on the empirical results, a sub-process called *enabling network formation* is seen similarly with the contemporary literature. Partanen and Möller (2012) and Ring (2005) see activities related to enabling network formation that consist of negotiating targets, defining the domain and scope of cooperation, performance expectations, and preliminary understanding of roles among potential actors. Bessant and Tidd (2007) argue that the set-up phase of a network requires activities of purpose that define and provide momentum for bringing the network together. In strategic value net discussion, agenda creation as a means to reduce uncertainty among actors (Möller & Rajala, 2007), and agenda setting referring to actors’ activities to create and communicate a sufficiently interesting agenda that it attracts actors to join in collaboration and leads to desired end states (Möller & Svahn, 2009) can be seen similarly to enabling a network formation sub-process. Similar activities with empirical results can be identified, such as developing awareness of interdependencies, triggering collaboration, selecting partners, defining expectations of continuity, designing formal structures, and deepening collaboration. (Ring et al., 2005.)

In the empirical results of this study, parallel and iterative activities were related to net formation, in addition to parallel activities of technological offering development, marketing activities, distribution and production activity development. Strategic value net studies (Möller & Svahn, 2009; Möller, 2009) see that in addition to technological aspects of development in business, nets also efficient in marketing, distribution and production systems must be considered in empirical results. That is also seen to influence the composition of the networks (Möller & Svahn, 2009; Möller, 2009). Actors should not focus only on either business model development or technology development rather perceives them essential for understanding the dynamics in the R&D net.

In the empirical results of this study, the sub-process of acquiring actors consists of attracting potential actors, selecting suitable actors to cooperate, and restricting unsuitable actors from cooperating. In the empirical results and in the Partanen and Möller study (2012), the process of acquiring actors took place several times during the formation process. In contemporary literature, net mobilization is seen similarly to actor acquisition and is associated in latter phases with net mobilization activities that aim to identify relevant actors for the emerging net (Möller & Svahn, 2009). In empirical results of this study webbers had an important role in this sub-process. Ring et al. (2005) note similarly that triggering entity have significant role in selecting partners, which leads to activity consisting of selecting partners by choosing who is contacted, and by what logic, and it also consists of guiding and
defining the structure of the network. A central actor is also in control of recruitment and service development activities in the network governance study in the context of mobile service development (de Reuver & Bouwman 2012). Partanen and Möller (2012) see partner acquisition as an active process of hub–actors, but it is seen more as a negotiated process based on analysis of strategic, non-strategic, non-delegated and delegated value-creation.

Within the sub-process of assuring continuity, signs and conditions that increase actors’ reliance on each other seen important, because during formation actors have not [yet] been able to create a joint history that could create trust. Similarly, (Story et al., 2011) the formal structure of a net may have not yet been established. The formation phase is seen to influence the perception of hub actors’ legitimacy to manage the latter phases of the development process (Prince, Barrett, & Oborn, 2014). In the empirical results of this study open communication among actors were used to develop commitment.

In designing a formal structure or other form administrative function is seen in several studies as a central activity of R&D net formation. Formal structuring as a sub-process in the empirical results is seen as actions to create cooperation, decision-making, and communication and learning enhancing activities e.g. contracts, project plans, and research agreements. Features of formal structuring are seen similarly as in contemporary literature. The outcome of designing a formal structure in Ring et al. (2005) consists of a similarly agreed understanding between actors about size, location, and boundaries of the network, as well as the decision-making organization. In addition, network mobilizing activities consist of the creation of an organization forum that is able to decide on work load division, responsibilities between actors, and coordination mechanisms for cooperation (Möller et al., 2005). The contemporary literature notes similarly that managing in R&D net requires an organization forum for sharing the work and responsibilities between the net of actors, as well as creating a co-ordination mechanism for the cooperation (Möller & Rajala, 2007). An organization forum or an administrative board, i.e., a formal structure, is seen to have an influence on innovative performance (Thorgren, Wincent, & Örtqvist, 2009). Ozcan and Eisenhardt (Ozcan & Eisenhardt, 2009) also argue that portfolio management (egocentric network management) consists of activities that define the division of labor and the roles of different types of actors in a net.

Similarly, to the empirical results of this study, early commercialization activities are seen as an integral part of R&D net development process. The empirical results of this study point out that commercialization must be taken into
consideration throughout the whole development process alongside the technological development. Commercialization, marketing and distribution were activities that were performed actively during the whole R&D net development process from formation until the final collaboration actions. The contemporary literature phases of service and product development need to be extended beyond the actual market launch to also include a commercialization phase as studies focusing on radical innovations (Story et al., 2009; Story et al., 2011) or network management mechanisms (see, e.g., de Reuver & Bouwman, 2012) have identified. Studies focusing on R&D net building (Partanen & Möller, 2012) have also regarded commercialization as part of R&D net activities that need to be taken into consideration from the early steps of development. It is suggested that the ability to develop and commercialize offerings is a networking capability (Möller, 2006). Prominent and innovative R&D partners are important in the early development and start-up phases of development (Story et al., 2011), yet networking is important during the commercialization phase of development (Partanen, Chetty, & Rajala, 2014). Commercialization should not be seen as the last phase of development, thus after an invention or innovation has been born, it is not possible to achieve growth purely by commercializing and exploiting it in a linear or sequential manner (Partanen et al., 2014).

The empirical results indicated that the value distribution (appropriation) among actors was not perceived clearly. It caused conflicts when actors realized that overlapping net have emerged that aim to commercialize the offering created. These conflicts may have even caused the separation of several value-creation nets during the commercialization phase of R&D network development. Contemporary literature studies identify this similarly. The ability to comprehend the varied motivations of actors (Ojasalo, 2008; 2012) is required, because motivation to participate varies, as noted in the empirical results and the contemporary literature. Actors may even perceive that developing the offering in the R&D net is separated from commercializing the offering in the net. The different perceptions of actors about commercializing as an integral part of R&D networking had an influence on the reactions of actors when entering the commercialization phase. Actors should be aware and assess the value-creation potential of the actors in net (Möller 2009). In the empirical results, managing in R&D net was found to vary over time. Contemporary literature defines that management mechanisms may vary by type of value-creating system (Möller & Rajala, 2007) and require carrying capabilities. In addition, managing in nets to evolve over time during the development process of an R&D network. Studies focusing on managing in net (Klerkx & Aarts, 2013)
see similarly that the management changes over time during network evolution. Also studies focusing on modes of network management (Provan & Kenis, 2008) and studies focusing on network management mechanism in a service innovation context (de Reuver & Bouwman, 2012) and innovation network context (Ritala et al., 2012) have identified the change over time similarly.

Based on reviews of the similarities with managerial process, this study proceeds to similarities with managerial roles. The following section depicts the similarities in the contemporary managerial role discussion.

How is managing in R&D net conducted via roles for managing supported by contemporary literature

In the empirical results of this study, roles for managing in R&D net are noted. Actors can utilize roles rather than focus on position, central or peripheral, in managing an R&D net. Roles have been long adopted in management literature (see, e.g., Mintzberg, 1973; Snow et al., 1992) as an alternative perspective alongside management functions, tasks and control (Tsoukas, 1994). Contemporary literature builds on this and notes that specific actors exist that have an influential role in an R&D net. Contemporary network literature roles for managing have been studied in varying contexts: e.g., supply networks (Knight & Harland, 2005), R&D networks (see e.g. Nosella & Petroni, 2007), in association with innovation (Rese, Gemunden, & Baier, 2013) radical innovation (e.g., Gemünden et al., 2007; Story et al., 2011), in triple helix contexts (Johnson, 2008), living labs (Nyström et al., 2014), innovation networks (Bessant & Tidd, 2007), product development (Markham et al., 2010), small company service innovation contexts (Gottfridsson, 2014) and in an innovative firm’s network (Öberg & Grundström, 2009). Varying fields of contemporary literature, e.g., strategic value nets (Möller & Rajala, 2007), innovation networks (Ojasalo, 2008), service systems (involved actors, their activities and roles); (van Riel et al., 2013) note that roles provide value for managing or understanding networks (see, e.g., Abrahamsen et al., 2012).

The influence of a central actor is seen as influential both in the empirical results and in Phase II findings of this study. Roles for managing are typically in contemporary literature identified in central positions and hubs of nets (see, e.g., Möller et al., 2005; Partanen & Möller, 2012; Ring et al., 2005). Similarly with the empirical results of this study, there are studies among strategic net discussion that see roles for managing also among actors that have a less visible and powerful role (see, e.g., Järvensivu et al., 2010; Nyström et al., 2014).
Similarly, to the empirical results of this study, the contemporary networks 
(Anderson et al. 1998, Gottfridsson 2014, Knight & Harland 2005, Nyström et al. 2014) suggests that roles for managing are context-dependent. Business networks are perceived dissimilar contexts and as the roles are perceived as context-dependent they are not not applicable beyond their boundaries.

However, it has been possible to identify the context dependencies that have similar roles for managing to those identified in the empirical results and reflected to the contemporary literature. The roles for managing identified in empirical phase of this study are summarized in table 10 and compared with roles identified in relation to contemporary literature.

**Table 9. Comparison of roles for managing.**

<table>
<thead>
<tr>
<th>Roles for managing</th>
<th>Empirical Description</th>
<th>Seen in contemporary literature</th>
<th>Comment</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource provider, Gatekeeper</td>
<td>Manages through resource i.e. technologies, knowledge, connection and other key element of the outcome (offering) possession. Ability to combine resources and thus able to manage towards desired end-state. Influences actors that are approved and disapproved within the net, though fit of resources and potential contribution.</td>
<td>Similarly in living lab and small company context</td>
<td></td>
<td>e.g. Nyström et al. 2014, Gemünden 2007</td>
</tr>
<tr>
<td>Roles for managing</td>
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<tr>
<td>Organizer</td>
<td>Manages through ability to coordinate activities. Possess certain key activity links that used to actions to connect actors towards the goal of net.</td>
<td>Similarly</td>
<td>Like Coordinator with (Nyström et al.), Similarities with technological and market process promoter (Gemünden 2007)</td>
<td>e.g. Nyström et al. 2014, Gemünden 2007</td>
</tr>
<tr>
<td>Instigator</td>
<td>Influences other actor’s decision making process in net level</td>
<td>Similarly</td>
<td>in living lab and small company context</td>
<td>e.g. Nyström et al. 2014, Gottfridsson (2011),</td>
</tr>
<tr>
<td>Advocate</td>
<td>Communicates positive information about the process. Operates in net level and may remain unnoticed with others though providing significant contribution to outcome.</td>
<td>Similarly</td>
<td>in living lab context</td>
<td>e.g. Nyström et al. 2014</td>
</tr>
<tr>
<td>Producer</td>
<td>Active actor performing the tasks in net. Influences significantly to the outcome of the net via though enabling resources for the net.</td>
<td>Similarly</td>
<td>in living lab context, in small company context as &quot;service provider&quot;</td>
<td>e.g. Nyström et al. 2014, Gottfridsson (2011),</td>
</tr>
<tr>
<td>Planner</td>
<td>Actor provides inputs to the development process and thus affecting intentionally to the net outcome. Action focuses on outcome and others perceive action expected an incremental</td>
<td>Similarly</td>
<td>In living lab context and seen as Service provider role (Gottfridsson (2011) in small company context.</td>
<td>e.g. Nyström et al. 2014, Gottfridsson (2011),</td>
</tr>
<tr>
<td>Entrant</td>
<td>Actor that performs action based on the connections of the surrounding network and possession of the resources. Role is perceived as emergent and action may be perceived interfering.</td>
<td>Adding</td>
<td></td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Roles for managing</th>
<th>Empirical Description</th>
<th>Seen in</th>
<th>Comment</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary</td>
<td>Actor that emerges in the network though connection of others to provide significant contribution. Others may perceive as emerging role and that the actor with have no official role in process.</td>
<td>Similarly</td>
<td>In small company context &quot;inspirer&quot;</td>
<td>Gottfridsson (2011),</td>
</tr>
<tr>
<td>Facilitator</td>
<td>Enables whole net with its resource possession, but remains on the background on development process</td>
<td>Similarly, Controversial</td>
<td>Argued to be different in Living lab context (provides only intangible resources) Supporting actor in small company context (Gottfridsson, 2009), Facilitator in triple-helix context (Johnson, 2008)</td>
<td>e.g. Nyström et al. 2014, Gottfridsson 2011, Johnson 2008</td>
</tr>
<tr>
<td>Compromiser</td>
<td>Manages through balancing actions and relationships with others. May retreats own goals to ensure the goals of the net.</td>
<td>Similarly</td>
<td>Mediator/arbitrator seen similarly in Triple-helix context</td>
<td>Johnson 2008</td>
</tr>
<tr>
<td>Aspirant</td>
<td>Actors that express with their actions the aim to participate in the future of the net. &quot;Outsider&quot; role that leads to other actors define fit to net structure</td>
<td>Adding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessory provider</td>
<td>Actor that by its actions aim to seek opportunity to provide offerings (products, services, expertise) to fit whole offering entity developed by the net.</td>
<td>Similarly</td>
<td>in living lab context</td>
<td>Nyström et al. 2014</td>
</tr>
</tbody>
</table>

The roles for managing described in the empirical results of this study have been identified in similarly in number of context. Roles of *webber, resource provider/gatekeeper organizer, instigator, advocate, producer, planner, auxiliary, facilitator, compromiser, and accessory provider* have been identified in living lab (Nyström et al. 2014) and small company service development (Gottfridsson 2014)
contexts. Nyström et al. (2014) were able to identify seven similar roles to webber, instigator, gatekeeper, advocate, producer, planner, and accessory provider in the context of living labs. The roles of webber, instigator, gatekeeper, and planner can be found in the context of small firms’ collaborative new service development (Gottfridsson 2014). Auxiliary and facilitator roles were found to be labeled as “inspirer and supporting actors” and producers were labeled as “service performers” in a small-company context (Gottfridsson 2014).

In the empirical results of this study roles of webber, advocate, and compromiser were categorized as generic roles i.e. roles that contain potential to be identified in other contexts as well. Similarities with roles webber, advocate, and compromiser have already been identified in the earlier literature. In the contemporary literature, the role of webber influences R&D network formation according to both the empirical and contemporary literature review of this study. Role of champion, that is used in contemporary literature (Gemünden et al., 2007; Markham et al., 2010) that originates from earlier organizational innovation role studies (Schon, 1963) can perceived as similarly as role of webber in the empirical finding this study. The role of central actor (champion) is seen as critical in implementing the roll-out of e-health service applications at the strategic, tactical, and operational levels (Joseph, West, Shickle, Keen, & Clamp, 2011). Network webbers are found in the contemporary literature (Gottfridsson, 2014; Johnson, 2008; Nyström et al., 2014), and the role features similar characteristics to several roles noted by Johnson (2008), such as technology broker and resource/management provider. A technology broker facilitates the technology network and knowledge transfer mechanism in a similar way to the role of webber. A resource/management provider is regarded as being similar to a webber.

In the contemporary literature, the role of gatekeeper is acknowledged as a key role innovation management to innovation success (Gemünden et al., 2007). The gatekeeper is seen in both contemporary literature and empirical results as the role that enables other actors with sufficient resources and helps other actors to present ideas in order to initiate actual development. The gatekeeper is seen to perform vital information mediation activities from the individual to the organizational level, and to define the actors that can access the information and resources needed for developing the offering (Markham et al., 2010).

There are similarities with the facilitator role found in empirical results and the contemporary literature in terms of the role of resources provider, as identified in sponsor/funds provider or triple helix contexts (Johnson 2008), sponsors (Markham et al. 2010), and the role of funding in an automotive radical innovation context.
(Story et al., 2011). Both the financier and the sponsor/fund provider provide funds for development activities.

There are also similarities between the roles of consultant (Story et al., 2011) and network webber. Consultants can perform task-oriented roles: provide technical data, act as additional members of the workforce, advice on process, or perform network-oriented roles with different actors. Story et al. (2011) have explicitly noted actors that have created a competitive advantage for combining actors together. In network governance studies, the abilities to combine actors may lead to the utilization of actors whose sole motivation to participate in a network is to act as the network administrative organization (see e.g. Provan & Kenis, 2008), given its mandate by network actors or governmental agencies.

Both in empirical results of this study and in the contemporary literature roles are associated with the development process. The contemporary literature acknowledges both theoretically non-elaborated and empirically non-justified claim (Gemünden et al., 2007) that innovator roles (champion, gatekeeper, expert promoter, and process promoter and market promoters) are especially important during the early phases of R&D network development. The findings of the empirical phase acknowledge the importance of network webber in formation and collaboration phase of the R&D net development process. The empirical results describe and elaborate more in detail about the important role of network webber during the formation and collaboration phase.

Contemporary literature focusing on the R&D net formation phase identifies similar roles to the network webber and refers to them as triggering entities (Ring et al., 2005) hubs (see e.g. Partanen & Möller, 2012), champions (Joseph, West, Shickle, Keen, & Clamp, 2011), head hunters, or scouts (Birkinshaw, Bessant, & Delbridge, 2007). According to Ring (2005) a triggering entity initiates, guides and possesses a key design role in R&D network formation. In addition, it is seen to lead to benefits of collaboration visible to others, help actors during the formation process, secure actors’ contributions in a timely and harmonious fashion, reassure actors’ motives, and resolve conflicts. A triggering entity defines the structure of the R&D net and in some cases is seen to be an implicit guarantor of fairness and equity (Ring et al., 2005). Hub actors is noted to be a commercial actor in Partanen (2012) and in the empirical (papers II,III) it was commercial actor (device manufacturer).

Similar role behavior to that of the advocate is identified in the contemporary literature in role behavior of inspirer and supporting actors’ roles (Gottfridsson 2014), which enable network development through the development of a positive
atmosphere among potential and active members of the R&D net and supporting actors with information, knowledge, and mental support.

In the empirical results and in the contemporary literature, the changes in network members, roles of actors, and resources and knowledge is acknowledged. This is defined as role dynamics. The dynamics may be seen as role temporality (Nyström et al. 2014) the roles change when the networks change. In the empirical results, major changes took place in the network during the transition of phases. The mobile service development network underwent significant changes from the network that developed the offering to the network that started the commercialization. The change could be perceived as expected, e.g. university parties withdrawal during the commercialization phase or the content provider’s influential role in commercialization. Some of the changes were emergent and unanticipated, which led to unexpected situations for actors. Some of the changes seem emergent e.g. local media house that assumed that university is in webber and gatekeeper roles during the initiation and planning phases and able to grant access during planning phase to join development of the service. The empirical results of this study suggest that during commercialization, actors and their contributions change, e.g. the governmental actors reduced their participation levels and new actors entered in to the network. The R&D net was seen to disperse to several commercialization nets. The dynamics in the network led to changes in the perception of actors’ resources, capabilities, and expected contribution.

In the empirical results of this study, it is acknowledged that actors perform multiple roles. This role multiplicity is found in the contemporary literature, such as in the context of living lab open innovation (Nyström et al., 2014), the automotive radical innovation context (Story et al., 2011), and the context of a developing firm’s network (Öberg & Grundström, 2009).

Contemporary literature and empirical results of this study share the perception of complexity and change of roles for managing over time and phase of offering development. In the empirical results, roles are performed by actors rather than actors playing the roles or as representations using pre-prescribed scripts. Contemporary literature from radical innovation in the automotive industry (see, e.g., Story et al. 2011) note that “job title” or other structural factors in a network do not define the role of the actor in an R&D net, but the performance of the actor in their role. Roles are similarly seen as not static, rather appearing emergent and therefore actors do not necessarily know the role that they are expected to perform (Story et al., 2011). Both the empirical results of this study and contemporary literature note the process aspect of roles for managing. Actors acting in a
particular role may also vary over time and they can perform different roles in different phases of network development. Nyström et al. (2014) have noted similarly as in the empirical results of this study that roles change during the development of an R&D net. In the empirical results of this study, it is also noted that the same actors can exist in different roles over time, which is seen similarly in the contemporary literature (see, e.g., Gottfridsson 2014, Öberg & Grundström 2009). The temporal variation of roles during the development process is acknowledged in the contemporary literature and “the role the actor plays tends to vary during the process (Gottfridsson 2014, 555). Markham (2010) notes that roles change over different phases of development activities in his study researching roles within organizations. In contemporary literature, Markham et al. (2010) also have a similar understanding of how roles are related to each other and how roles are linked to actual development activities between phases of development, which can help us understand how R&D nets are progressing and developing.

In the empirical results of this study note the actors acting in roles influence in network level. Actors in roles have an effect on the s network in which the R&D net is embedded. Baraldi (2011) notes similarly that actors acting in the roles of network webber and instigator need to take existing network relationships and activities into consideration. They need to be aware of the derived goals from existing network relationships that cause potential matches and mismatches with past network relationships. Also influence of specific roles e.g. technology and market relationship-related boundary spanners are also considered necessary (Gemünden, Salomo et al. 2007). Baraldi (2011) extend that the focus should be on influencing downstream network expansion and being selective toward upstream embedding.

The contemporary literature supports the notion of FRM. In the empirical results of note that the FRM can improve actors’ abilities to interpret their ability to manage and interpret how other actors’ actions are aimed to manage in a net. In the contemporary literature, actor’s action and reaction to these actions are seen to constitute roles (Nyström et al. 2014). Also, the role dimensions of task and net level have been utilized similarly as in the empirical results of this study. Story et al. (2011) identified similarly task- and network-oriented roles, in addition they used similar dimensions of roles in their analysis. Their analysis focuses on focal net-level directed actions, though they argue that analysis is focused on network-level analysis.
2.3.2 Managing in a R&D net; results contradicted by contemporary literature

The following sub-section, reflects contradicting findings of empirical results of managing in R&D net to current knowledge of managing in R&D net. First sub-section discusses process perspective and second from perspective of roles for managing.

How is managing in R&D net conducted as process contradicted by contemporary literature

The perception of the process of R&D net development contradicts the empirical results of this study and contemporary literature. In contemporary literature, R&D nets are seen to be formed through fairly linear progression. Birkinshaw (2007) states that creating new networks requires [only] two distinct activities: finding the right partners and forming relationships with them. Some studies define the formation with more detail. The formation process contains recognition of need for R&D activity, beginning by soliciting among organizations by someone or some company, negotiating and understanding the purpose of collaboration the organizations to form a structure, i.e., an R&D net, and initiating joint R&D activities (Ring et al., 2005). The empirical results see in controversy that the process of R&D net formation is more complex than the simplified, even overly simplistic process models suggest.

In contemporary literature, the R&D net formation process can be seen as a development process based on actors self-organizing, i.e., a bottom-up process (Thorgren et al., 2009) or as an emergent or embedded process (Ring et al., 2005). These processes are based on actors’ awareness of the shared interest, urgency of the perception of need to collaborate in R&D activities. Ring et al. (2005) noticed in addition to an engineered formation process (discussed in Chapter 2.4.1), two types of R&D net formation processes: emergent, based on actors’ self-organizing, and embedded, based on actors’ self-organizing, existing social relationships and their perceived existing strategic relationships. R&D net formation processes are embedded processes that seem to be initiated naturally, based on actors’ perceptions of shared interest, urgency of collaboration, and existing strategic or social networks (Ring et al., 2005). These processes are seen to contradict perception of the R&D formation presented in the empirical results. As the empirical results, R&D net formation is seen to require managerial action of actors during formation...
that are performed by actors in a network webber role like an engineered process in contemporary literature (Ring et al., 2005).

There is controversy in empirical results and the contemporary literature in the perception of different R&D net formation processes. Some contemporary literature (e.g., Markham et al., 2010; Millson & Wilemon, 2008; Ring et al., 2005), implicitly assumes that the innovation development path follows a life cycle: from discovery-innovation-development to offering-commercializing like path-dependent sequential stages or phases of development. The empirical results of this study contradict one another during net formation and view formation as overlapping sub-processes. In contrast, R&D net formation is seen to take place in simultaneous overlapping sub-processes. During the collaboration in the R&D net, there are no findings that would support or contradict the notion of path dependencies. Partanen et al. (2014) have found implications that linear or sequential development processes, from innovation generation to commercializing and exploitation, do not exist. In the contemporary literature, the path-dependent perception is noted as extremely difficult or even harmful to try to follow previously postulated step-by-step procedures in network formation (Partanen & Möller, 2012). It is even argued that it leads to weak networks (Ozcan & Eisenhardt, 2009). The empirical results of this study does not acknowledge challenges related to harmfulness related to the path dependencies on the process model of R&D net formation.

There is a controversy about managing in net in during phases. In the empirical results of this study, managing in net takes place continuously without acknowledging the phases of R&D net. Some researchers argue (see, e.g., Ritala et al., 2012; Thorgren et al., 2009) that managing in net is dependent on the phase of the R&D net and that management is not conducted in the initiation phase, but rather in the latter stages of R&D net development. Also, Ritala’s (2012) definitions of network orchestration, i.e., coordination by enabling (motivating members to join, ensuring vision sharing and knowledge interchange between actors) can be seen to include a similar action that is defined as managing in net in this study. Further, Ritala’s (2012) definition of network management as coordination by commanding seems simplistic and restricting, thus the sub-processes noted in empirical results for managing in the formation of R&D net, e.g., enabling network formation, assuring continuity, acquiring actors, developing commitment and learning containment activities that are included in their perception of orchestration.

Another noted controversy is related to the perception of net dissolution. In the contemporary literature, net dissolution is seen to be part of a natural development
phase of the maturation of the R&D net. Millson and Wilemon (2008) argue that the final stage of the R&D net development process is dissolution, which requires planning, like any other stage. The empirical results contradict this notion, due to R&D net possibly dispersing into several commercializing nets. With regard to R&D net development, the empirical results of this study process relationships ending as a natural development of radical influence of action. Actors’ radical actions during the formation or collaboration during R&D net development may lead to the dissolution of relationships, therefore relationships are assumed to end at any phase. The dissolution as well as new relationship building is implicitly assumed in acting in a role in net. However, the relationship dissolution was not an a priori focus in this study, in general the findings identify that net dissolution is not a phase of the R&D net development process.

The perception of including commercialization activities in the R&D net development process is a source of controversy between empirical results reflected in contemporary literature. In contemporary literature, commercialization activities are seen to take place in separate commercializing networks (see, e.g., Aarikka-Stenroos & Sandberg, 2012; Aarikka-Stenroos et al., 2014). The empirical results of this study point to controversy that commercialization activities are an integral part of the R&D net process. Aarikka-Stenroos (2012) define commercialization nets as a “group of actors involved formally or informally in the commercialization of an innovation.” The empirical results imply that the temporal separation between R&D net developing offering and net commercializing should be considered with careful justification. The actions performed in earlier phases of the R&D net development process during formation and collaboration influence actions and roles performed in latter phases. If the focus of the researcher is only on the time frame of the “commercializing net” rather than the whole development sub-processes or phases of the R&D net, the perception of the influence of action, perceived roles and network structure may be different.

The third controversy related to empirical results and contemporary literature is related to perception of managing in R&D net and how net is managed. In the empirical results of this study, the central actors, i.e., network webber’s actions are approved by other actors in the net. In contemporary literature, action and actor recruitment is assumed to be led by a central actor. Net formation is strongly influenced by a central-hub actor in strategic business net literature (see, e.g., Möller & Svahn, 2009; Ozcan & Eisenhardt, 2009; Partanen & Möller, 2012), active central actors are present in overcoming network formation barriers (Birkinshaw et al., 2007) and mobile service development and actor recruiting
processes (de Reuver & Bouwman, 2012). In strategic network building (see, e.g., Partanen & Möller, 2012), hub actors lead the top-down process of network formation (Thorgren, Wincent, & Örtqvist, 2009), triggering an entity-led engineered network formation process (Ring et al., 2005).

There is also a noted controversy between certain sub-processes noted in the empirical results of this study reflected in contemporary literature. In this study acquiring actors is seen as a continuous, repetitive sub-process of formation and also noted to take place during collaboration. New actors are seen to join to the R&D net during collaboration when piloting offering and planning market launch activities, and therefore actor acquisition can also be seen to continue the sub-process during the collaboration phases.

There is a noted controversy related to formal structuring. In the empirical results of this study, formal structuring is seen as a sub-process of R&D net formation. As a reflection of contemporary literature, Ring et al. (2005) see designing a formal structure more as an outcome of R&D net formation.

In the empirical results of this study, actor connection to actors with connections over the boundaries of the net (i.e., weak links) were acknowledged to influence the innovativeness of the R&D net. In contrast to contemporary literature, a large administrative function (e.g., a network board) was seen to improve innovation abilities via facilitating conditions of exchange, with its ability to match members inside and outside the net (Thorgren, Wincent et al. 2009).

The empirical results of this study identify controversial findings regarding the abilities to achieve goals of the net in a network webber-led formation and collaboration process. In the empirical results of this study, net formation and during collaboration, the offering development pace is seen to increase with actors managing in network webber role. Webbers are described as having a positive influence on net formation and offering a development process. Ring et al. (2005) note in controversy, that in the self-organizing net formation where process based on actors’ self-awareness of converging interests, existing social relationships or strategic relationships between actors, less managerial attention is required and formation happens without the presence of such actors in net. The absence of a lead company may cause no change at all in net, thus the ability to create combined and complementary strategic intentions is the key issue, which implies that the question is not only one of dominance and power (Ford & Mouzas, 2008). In addition, the self-organizing process is even seen to lead to improve innovative performance over a central actor-led process in SME innovation network contexts (Thorgren et
al., 2009). The controversial findings may be explained with context specificity, as Ring et al. (2005) note that forming nets differ by the need for managing in net.

**How is managing in R&D net conducted via roles for managing contradicted by contemporary literature**

This section discusses the empirical results of roles for managing that contradict to contemporary literature.

In the empirical results of this study the roles were based on aggregation of actions the actor is performing. In the contemporary literature the definition of concept of role is free, without careful definition. In contemporary literature concept and role is based on structural position, typically centrality, or location between net or other position. Actors in central position in contemporary literature are defined as hub (Järvensivu et al., 2010; Möller & Rajala, 2007; Partanen & Möller, 2012), mobilizer (Möller & Rajala, 2007; Mouzas & Naudé, 2007), central authority (Rampersad et al., 2010), lead or network administration organization (Klerkx & Aarts, 2013; Provan & Kenis, 2008), designated collaboration firm (Sabatier, Mangematin, & Rousselle, 2010), or champion (Gemünden, Salomo, & Hözle, 2007). The identification of the central actor may be derived from the natural structural position of the actor or their characteristics (Dhanaraj & Parkhe, 2006), or they position actors in the center of the network due to their service orientation or mandate (Klerkx & Aarts, 2013). These central hubs have prominence and power, achieved through position in the net. (Dhanaraj & Parkhe, 2006) Certain studies define actors that exist between networks as R&D intermediaries (Howells, 2006) or brokers (Batterink et al., 2010; Klerkx & Leeuwis, 2008; Klerkx & Leeuwis, 2009; Klerkx & Aarts, 2013), innovation intermediators (Nambisan & Sawhney, 2011), or “spidermen” (Harryson, 2008). In addition, usually roles are considered without the contribution or utilization of concepts from role theory.

It is argued that the managerial motivation of central actors differs in the contemporary literature and in the empirical results of this study. In the empirical results the central actors, e.g., the “network webber”, are actors that direct their action on behalf of the whole net during network formation. According to the contemporary literature, during network formation the hub firm operates with the appropriate form of governance in order to gain strategic resources and activities to maintain its central position during network formation. A hub company provides strategic guidance and competence to develop efficient operations and the
generation of market offers. (Partanen & Möller 2012.) In contemporary literature, a triggering entity [central actor] may define the strategic and operational scope of the net, which suggests that consensus is achieved without collective discovery (Ring et al., 2005).

In addition, the other actors within the net perceive the actions of the webber as being directed toward the net’s goals rather than the webber’s interests. In the empirical results, the role of network webber as a central actor has been identified differently in comparison to contemporary literature. The network webber focuses on is the interests of the whole R&D net rather than just those of the central actor itself. In contemporary literature, managing in net is based on managerial action of one or more hub actors and other actors that have a less visible and powerful role (e.g. Järvensivu et al., 2010). Hub actors are seen to look after their own interests via the net (Partanen & Möller, 2012), and other actors’ contributions are defined by the central actors’ perspective (Özcan & Eisenhardt, 2009). The studies that review strategic nets and the network formation process from the perspective of the hub, e.g., strategic network building (Partanen & Möller, 2012), portfolio management (Özcan & Eisenhardt, 2009), discontinuous innovation network formation (Birkinshaw et al., 2007), R&D consortia formation (Ring et al., 2005), and innovation network orchestration (Dhanaraj & Parkhe, 2006), tend to review R&D net formation and managing in net from the perspective of hub organization, rather than from the focal network perspective. The objective of a central actor can be guidance of strategic net (Partanen & Möller, 2012), or egocentric network, i.e., portfolios (Lavie, Lechner, & Singh, 2007; Özcan & Eisenhardt, 2009) or other structures of several dyadic business relationships. Möller (2009) argues that the net mobilizer is in charge of both R&D net creation and the offering that the network is developing, and commercializing net mobilizing simultaneously creates a specific net responsible for application creation and produces the commercial applications. The task of the hub is to create vision, configure the network (define the network, select partners and define effective cooperation forms (Möller & Rajala, 2007; Partanen & Möller, 2012), create an agenda for the net and mobilize actors to perform accordingly (Möller & Rajala, 2007; Möller, 2009), and organize commercialization activities, such as demand-supply network mobilization (Möller & Rajala, 2007; Möller, 2009)). Success is dependent on the mobilizer’s resources, and the clarity of vision, both technological and business, which are used to attract and select actors to join (Möller, 2009).

The empirical results and contemporary literature contradict one another in terms of certain specific roles. Nyström et al. (2014) note that there is a difference
between network webber and builder. Network webber is seen to possess the ability
to exclude actors from the R&D net. In Nyström et al. (2014), network webber
abilities do not possess the ability to exclude entrants from the net or influence
relationships in a manner that would lead to a relationship ending. Hub actors are
noted as being a commercial actor in Partanen (2012), while in the empirical results,
network webber was a non-commercial actor (a university research organization).

In contemporary literature, the role of the power promoter (Gemünden et al.,
2007), the resources provider (Johnson, 2008), and the sponsor (Markham et al.,
2010)) is associated with providing resources to perform R&D activities and also
managing the net. The extent may vary from providing co-ordination or
management activities, such as budgeting and expenses follow-up or other
managerial tasks that the project leader was not able to cope with at the extremes
of necessary hierarchical power (Gemünden et al., 2007). According to the
empirical results, the actors in the facilitating role providing sufficient resources
for the development activities were not performing day-to-day tasks or net-level
operations. In the empirical results, actors in the facilitator role continued to
perform network-level acts without interfering in tasks, or worked on net-level
development processes. It is also noted that in relation to the role of an actor in a
net, the structure of the network that is being formed must take into consideration
at the extent of matching and mismatching of the goals of the actors in the network
(Baraldi, Gregori et al. 2011).

In the empirical results, the role of compromiser was identified as consisting
of qualities that would be perceived as generic. However, it is noted that a similar
role is not identified in the contemporary literature review. That indicates that the
role is more context-specific than generic. In the contemporary literature, the
closest role definition to compromiser is the mediator/arbitrator role (Johnson,
2008), which mediates conflicts between R&D net actors that are sometimes forced
to collaborate reluctantly. The mediator does not indicate any suggestion of giving
up his or her own goals, which defines the empirically identified compromiser role.
In some studies (Gemünden et al., 2007), roles are perceived to be institutionalized,
such as the role of project manager.

Different approaches of role theory influence the perception of an actor’s
abilities to act in a role and thus manage in the R&D net. Contemporary literature
(Nyström et al. 2014) sees that role reciprocity exists among actors and that actors
should review their roles and positions in the network and review the fit of their
goals to the goals of the network. If they correspond, companies are in the “right
roles”, but if noted discrepancies exist, the company should seek new roles or
transform its current roles to align with the strategy and goals of both the network and itself. This also implies that new entry actors in networks perform preset roles (role-taking) and after the acceptance of other actors in the network, they can assess other roles (role-making) that could better fit their needs and goals.

In their study, Story et al. (2011) found that the role of auxiliary “…is not adequately described by the term ‘auxiliary’, which presents a diminished view of their importance.” The word “auxiliary” usually suggests that the role performance is necessarily about providing an ancillary source of help and support, rather than an increasing role. Story et al. (2011) note that in support roles, actors contribute instrumentally to the development of competence, but not sufficiently for developing an acceleration competence.

The empirical results of this study and contemporary literature contradict in perception of the concept of role. In contemporary literature, there are studies that define managerial roles based on activities that actors perform (see, e.g., Gottfridsson, 2014; Öberg & Grundström, 2009), or the definition of roles and the freedom to act in a role is defined by the position, similarly to the structural functionalistic approach of role theory. That perception of roles leads to an understanding that managing in net is an action aim for a changed position in the net. The contemporary strategic net literature views roles as being dependent on the characteristics of the networks in which the actors are embedded, as well as the required management tasks (see, e.g., Järvensivu & Möller, 2009; Möller et al., 2005). The appropriate resources and capabilities are seen as prerequisites to take certain roles (Järvensivu & Möller, 2009). Möller et al. (Möller et al., 2005) note that a network orchestrator, for example, requires a strong business position and visioning, and strong communication and persuasive skills, with credibility gained from understanding the whole business field. Järvensivu and Möller (2009) see that managerial ability in a network is based on activities and resources that the actors possess, but they do not see an actor’s ability to network as an influential factor in network management. Strategic net definition (see e.g. Järvensivu & Möller, 2009) is closer to the structural functionalistic approach of role theory, assuming that the “designated location in the network structure based on possessed capabilities and activities performed define the role behavior.” Early industrial network studies (see e.g. Anderson, Havila, Andersen, & Halinen, 1998; Montgomery, 1998) adopts a structural approach of roles.

In contemporary literature, roles are described as relative positions and counter-positions forming counter-role partners (Markham et al., 2010), e.g., manager-employee, teacher-student, etc. This is perceived differently in the
empirical results of this study. The actor’s ability to act in a role is not a prerequisite by the resources and capabilities of an actor. Rather, managing in R&D net can be based on roles that are derived from contributions to net and embedded networks via actor bonds, resource ties, or activity links. The roles in this study are seen similarly as symbolic interactionists (Ashforth, 2000) as emergent and negotiable, therefore active actors may change the role behavior from expectations based on an actor’s resource structures or capabilities. In the empirical results, the adoption of a role is seen as situation-specific, i.e., a symbolic interactionist (Anderson et al., 1998; Callero, 1994) construct. In addition, roles for managing in this study are seen as processual and dynamic, and are influenced by actors acting in a specific role, not by the position the actor has gained in the net.

Also in contemporary literature, roles are seen to influence the transformation from the following phase to the development phase of R&D net (Öberg 2010). In the empirical results, there are no implications the roles per se would have an impact on the phase of development or even that a certain role would be more typical for a certain phase.

The following section describes the novel findings based on findings from an empirical case about managing in R&D net compared to contemporary literature.

2.3.3 Managing in a R&D net; results adding to contemporary literature

This section presents the empirical results of managing in a R&D net during formation and collaboration that are seen adding to contemporary literature. Based on the reflection in contemporary literature, this study identifies a number of findings that are adding to current knowledge.

The empirical results of this study are adding to contemporary literature. Firstly, the roles for managing that actors perform are a means of influencing relationships between actors in an R&D net. Roles consist of managerial actions and withdrawal from actions, assumptions of actions related to other actors’ perceptions, and the interpretation of actions by others. Actions can also have an influence on relationships by creating new ones or dissolving existing ones. This influence can be aimed at a varying level (task, net, network) of relationships.

This study is adding to contemporary literature by identifying descriptions of two roles. Interestingly, the roles of unexpected entrant and aspirant are not acknowledged, either similarly or dissimilarly in contemporary literature. Both of those roles not acknowledged in the contemporary literature are categorized as
emergent by the nature of the interpretation of their actions. In the empirical results, an entrant is acknowledged as an actor whose actions are based on the connections of the surrounding network and existing resource base. A role is perceived as emergent and actions may be perceived as interference by the other actors. In the empirical results of paper III, the role of aspirant was associated with most of the actors in the R&D net. However, the contemporary literature does not acknowledge the role.

In the empirical results of this study, it is noted that actors can improve their abilities to analyze the individual actions of others and plan their own actions in a network by utilizing an FRM, which enables an understanding of roles that appear in an R&D net based on the dimensions of managerial roles. The dimensions of roles are based on an evaluation of acting in roles that are perceived to take place in actions that are targeted at the tasks of the R&D net, the net itself or the surrounding network level.

The FRM, which consists of role dimensions, is adding to current knowledge of managing in R&D net. In contemporary literature, a few studies have adopted the dimensions that were used in the case study to define and categorize managing in a business network from the perspective of managerial roles. In contemporary literature, the task-net-network level has been adopted in analyzing roles (Nyström et al., 2014; Story et al., 2011). Story et al. (Story et al., 2011) explicitly state that they distinguish task-oriented roles from network-oriented ones. However, their definition of network-oriented roles consists of both net and network characteristics, in comparison to the dimension of the framework that is identified in the empirical results of this study. The explicit utilization of other dimensions of roles cannot be found in the contemporary literature. The framework has not been extended by expanding the definitions of dimensions of managerial roles, or by creating additional dimensions of roles for the framework based on the contemporary literature review. Nyström et al. (2014) have adopted the task-net-network level further, developing role-theoretic discussion establishing a side structuralistic, symbolic interactionist, resource-based approach to the role of the fourth action-based approach.

Research on roles for managing is seen to develop in two direction (Järvensivu & Möller, 2009), searching for context-specific roles and generic roles that are valid beyond the boundaries of focal networks (Järvensivu & Möller, 2009; Knight & Harland, 2005; Story et al., 2011). In the empirical results of this study the concept of roles for managing are analyzed through theoretical framework that enables more systematic identification based on the categorization and dimension of the
roles. The role framework as systematic analytical tool benefits both directions of research. For the researchers seeking rich description framework provides means to systematize descriptions with conceptual tool that comprehends complexity, dynamics and varying contexts. For researchers that seek generic managerial roles, the role framework can ensure certain level of systemic analysis by ensuring that potential generic roles are analyzed systematically with same dimensions. As new direction of the managerial role discussion could be the further development of the analytical role identification and analyzing tools and concepts.

In general, the frameworks that attempt to depict dynamics and development processes of network management are appreciated and they are seen to provide new understanding (Mouzas & Naudé, 2007). A novel finding of this study is that the roles for managing an actor vary between different phases of R&D net development. Contemporary literature notes that actors may perform several roles during the development process (Öberg & Grundström, 2009; Story et al., 2011). This study suggests that a R&D net can also be managed with a number of central actors. The number of central actors may also vary during the development of the R&D net. Empirical results identify that during net formation, one central actor is identified. The number of actors and the actors themselves changed over phases, because during mobile service development, piloting and commercialization, three actors were perceived as central actors. During the piloting phase, according to empirical results the number of central actors was five.

The empirical results of this study note that during R&D net formation, learning is seen as an essential aspect of managing in R&D net formation. Learning is seen as challenging, thus based on empirical results during the network formation phase, co-operation is not extensive or intensive. However, in the empirical results, indications of learning were identified to be enabled by concrete development activities and co-operation that enabled leading. However, in the empirical results, learning was seen as a sub-process and identified as an ability actors need to be able to benefit from co-operation in an R&D net, and to prevent endangering the continuity of co-operation in an R&D net. In the contemporary literature review, learning was not acknowledged in intentional network formation studies as a sub-process (Partanen, Möller 2012) or an activity (Ring, Doz et al. 2005). Story et al. (2011) also noted the challenges related to networking in the context of radical innovation, caused by a lack of knowledge of capabilities that an actor requires for performing roles. Learning (Möller 2009), knowledge transfer and organization forum creation is seen as a capabilities in strategic net studies, especially in relation to emerging business net mobilization. (Möller et al., 2005; Möller & Rajala, 2007).
Table 10 summarizes the empirical results, reflections to contemporary literature, and the findings adding to contemporary literature.

**Table 10. Empirical results, reflection to contemporary literature and novel findings.**

<table>
<thead>
<tr>
<th>Phase I – Empirical papers</th>
<th>Phase II – Comparing results to contemporary literature:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Empirical results:</strong></td>
<td></td>
</tr>
</tbody>
</table>
| -Managing through actions, actors perform in order to influence the resources and activities of other actors in the net. | Supporting: *Initial conditions: Shared interest, interdependence, network webber during formation and collaboration.*  
-Role of webber focuses on targets of the whole net. |  
-Managing in R&D net should be reviewed as a whole development cycle from formation to collaboration rather than focus on individual phase. |
| **Contradicting:**         |                                                        |
| -Central actor may manage towards net goals. | -Managerial roles can be taken by withdrawing from action, if the goals of the net are achieved. |
| -Sub-processes of network formation: enabling formation, acquiring actors, assuring continuity, developing commitment, creating formal structures, and learning. | -Typologizing managerial roles unexpected entrant, aspirant. |
| -Active central actors | -Framework of roles for managing -Webber not seeking only own the goals, rather goals of the R&D net |
| -Generic roles | -Dynamic roles: actor perform several role and roles may vary over phases of R&D Net |
| -R&D net dissolution not phase of process. | -Learning as sub-process is seen to begin during the formation of R&D net |

The following sub section continues reflecting empirical results related to benefits of managing in R&D net with contemporary literature.
2.4 Phase II-Benefits of managing in R&D net for actors with contemporary literature.

The following sub-section continue reflecting empirical results to the contemporary literature. Firstly, the benefits that are supported by contemporary literature are discussed. Secondly, benefits that are seen in controversy to contemporary literature are identified. Finally, the novel findings of benefits adding to contemporary literature is discussed.

2.4.1 Benefits supported by contemporary literature

There is growing understanding of the benefits that actors gain by managing in R&D net. It is noted in the empirical results of this study that managing in R&D net can be used for achieving planned change in a network structure. The empirical results point out that R&D net cannot achieve their goals without proper managing in net and an understanding of networking, as well as the development process of new offerings in an R&D net. Contemporary literature notes that companies aiming for an emerging business field (Möller & Rajala, 2007) or discontinuous innovation (Birkinshaw et al., 2007) can improve their contextual understanding of the vague, fuzzy, and future-oriented business network. Companies can improve their awareness of emerging technologies and business ideas, i.e., exposure to extensive co-operation networks with broad science networks, R&D projects with interesting SMEs, or multiparty collaborative research projects with more specific application-oriented goals (Möller & Rajala, 2007). With managing in net actors can reduce the uncertainty and ambiguity of new radical innovation by influencing other actors’ sense making and selection processes, in order to achieve a technology trajectory to develop offering for the markets (Möller & Rajala, 2007). In General managing in net is significant to network performance, Yen (2008) notes correlation between networking competence and innovation performance and therefore actors’ networking abilities.

Based on reflecting the empirical results to contemporary literature, managing in net is seen important in developing invention to the final offering in net (e.g. Ozcan & Eisenhardt, 2009, 269) or see it as prerequisite for shifting offerings toward implementation. (de Reuver & Bouwman 2012) In context of radical innovation managing beyond firm or in supply net enhances the successful launch of the offering. (Story et al., 2009) In service innovation context, networking is seen to generate both positive and negative effects. (see, e.g., Mustak, 2014; Syson
As benefit in service development context of managing in net notes increased abilities to understand, shared resources, cost savings and risk sharing, in addition to increased creativity. In addition, with appropriate level managing in net the benefits can be amplified and negative outcomes may be limited (Mustak 2014).

It is argued in the empirical results that a managing in R&D network enables an expanding the scope of the net with larger resource and knowledge base, even with scarce resources and knowledge. Contemporary literature sees similarly as benefit that managing in R&D net enable multiple actor involvement across organizational borders and see ability to utilize complementary resources and knowledge. (Möller & Rajala, 2007; see, e.g., Mustak, 2014) Actors may broaden and deepen the relationship in managed R&D net (Ring et al., 2005). Empirical results point out that a managing in R&D net also enables the combination of actors’ resources and knowledge, which provide the possibility to expand the scope of the offering under development. Faems et al. (2008) see the ability to understand other actors’ competencies as benefit of managing in R&D net. Management in nets can enable actors to utilize other actors’ resources and knowledge more effectively, or enable capital funding (Batterink et al., 2010). Moreover, in service industries the benefits of managing in R&D net include access to resources, shared risks, and reduced costs, in addition to knowledge transfer and organizational learning (see, e.g., Mustak, 2014). A managing in R&D net enables the utilization of other actors’ specialized knowledge and the expansion of the knowledge base through collective learning (Möller & Rajala, 2007). Findings from knowledge utilization in the ready-made meal industry (Cox & Mowatt, 2004) support this.

Empirical results also note that a factor in successful offering development to markets is cooperation between different types of actors in R&D net. Findings from contemporary literature support the notion that managing in R&D net enables an expansion of the scope of development activities. In the context of small technology firms managing in R&D net is used to overcome their liability of newness and smallness, by building a network with customers, research universities, and research institutes (Partanen et al., 2014). Empirical results of this study point out that a benefit of managing in R&D net is the ability to shorten the development time of an offering. Contemporary literature (Möller & Rajala, 2007; Mustak, 2014) sees similarly in that operating in networks shorten R&D development time. The empirical results imply that joint goals, schedules, and agreed upon roles increased the pace of net formation and offering development. Success of strategic nets are linked to strategic cohesiveness, which refers to mutual understanding and
acceptance of vision, targets and frame of action similarly (Järvensivu et al. 2010) and more cohesive net tend to succeed in achieving its goals (Möller et al. 2005). In the empirical results is noted that managing in R&D net enables the utilization of modular offering development. Managing in R&D net enabled perception of effective operations among network members. The modularity shortened offering development time, thus the actor has a clear schedule and role in the net. The modular development is seen similarly in the contemporary literature. In strategic network building framework (Partanen & Möller, 2012) certain non-core value creating activities are delegated to partners to be developed. In a service ecosystem context managing in net is used by actors to coordinate other actors and enable them to define which actors are developing which service (van Riel et al., 2013).

Empirical results identify managing in R&D net increases actors understanding of temporal change. Change in R&D net is seen to happen during phases of innovation: network formation, offering planning, development, piloting, and launch to markets i.e. commercializing in R&D net change. Contemporary literature supports this notion. Managing in net is used to access and mobilize resources via relationships, because individual firms typically lack the competence and resources to overcome the phases of R&D net development (i.e., incubation, acceleration and commercialization;) (Story et al., 2011).

The empirical findings of this study noted that offering development activities may be dispersed into several overlapping collaboration and/or commercializing net activities with different actors. In the contemporary literature (Story et al., 2011) note that sufficient resources required during phases of innovation development are not in the hands of one actor thus managing is needed e.g., mobilizing and accessing resources.

The following section, reflects contradicting findings from empirical results of benefits of managing in R&D net to contemporary literature.

### 2.4.2 Benefits contradicting by contemporary literature

The benefits for actor of managing R&D networking were identified both in the contemporary literature and in the empirical phase of this study. In contemporary literature Möller et. al. (2005) note that strategic net management improves operational efficiency and the ability to leverage existing capabilities through participating in one or several nets. It also improves new capability development. However, findings from the contemporary literature are not unanimous.
Munskgaard et al. (2012) note that leading companies may have both a positive and a negative impact on the joint development effort in NPD networks. In the empirical results this study, it is noted that managing in R&D net enables the expansion of the scope and magnitude of R&D nets in comparison to activities performed individually. In contemporary literature, there is examples that managing in R&D net has enabled to expand the scope of the net excessively. In the contemporary literature, the scope of the net is extended in such extremes that it influences R&D net’s offering development abilities negatively when reaching latter phases of development and market launch. New offering development activities of a R&D net should be extended based on the need of end-customers, as Partanen and Möller (2012) note in their strategic net-building model. Palo and Tähtinen (2013, 799) note that a managed R&D net can extend to development activities that are not seen to provide value from a final business model development perspective. It can be argued that managing in R&D net, does not necessarily benefit from the R&D net’s ability to develop offerings, thus enabling excess R&D activities from the perspective of effective offering development.

2.4.3 Benefits adding to contemporary literature

This section presents new findings related to the benefits for actor of managing in R&D net. Based on the reflection to contemporary literature this study identifies number of benefits that are adding to current knowledge.

Firstly, as a benefit for an actor based on empirical results is noted that managing in R&D net management speeds up and structures the network formation process. The ability to increase the pace and structure of the network formation process is operationalized in a positive way, thus via managing in net makes the process the actors are involved in easier to comprehend. In the contemporary literature, Ring et al. (2005) see that an active hub-actor can trigger a network formation process among actors who would not perceive a need for co-operation in R&D activities.

Managing in R&D net is also seen to increase the pace of collaboration activities and thus increase pace of offering development. Actors are gaining the benefit through improved abilities to organize and cope multiparty R&D net operations. Managing in R&D net increases the abilities of an R&D net to expand the scope of development activities and thus enable the creation of a broader offering. Managing in R&D net enables the utilization of modular development. Modular development is seen to shorten development time, because all actors have
a clear schedule and roles in the network. Via managing in R&D net, it is possible to create a perception of effective operations among net members. In the contemporary literature, there is an implicit assumption of intentionally created networks management literature that asserts that networks need to be managed in order to be efficient (Möller et al., 2005; Möller & Rajala, 2007) or provide effective operations.(Partanen & Möller, 2012), the empirical results of this study support notion.

Thirdly, as a benefit of managing in R&D net, the improved ability to understand is identified. Increased understanding is related to several aspects: the aim and goal of the net, as well as the ability to understand the temporal dynamics for the net and the network it is embedded in. With the FRM, actors can improve their abilities to understand the context of R&D net, i.e., changes in net and in roles and relationships in the focal net, and relationships to the surroundings network. Framework improves abilities to understand changes and the roles actors are acting in during R&D net formation and collaboration. Increased understanding of managing in net enables actors to comprehend change in a R&D net over time, phase of development in net and in roles for managing. With this new understanding, actors are able to comprehend how actions can influence or being influenced by the wider network structures that the net is embedded in.

In addition, a benefit for an actor is the ability to understand roles for managing with role framework and role dimensions. Actors are aware of varying roles for managing they can act in the R&D net as organizational and personal roles, by increased understanding, they are able to identify occupied or unoccupied roles and change or adopt their actions accordingly. Actors are able to attract additional or even missing resources or activities to the R&D net.

Finally, the empirical results acknowledge as a benefit of managing in R&D net the positive atmosphere within the R&D. In the contemporary managing in R&D net literature, leadership within an R&D network is acknowledged as an important aspect (Ojasalo, 2008; Ojasalo, 2012). Comparative research on the effect of soft leadership style vs hard management in R&D networks was also conducted (Westerlund 2009). A manager’s leadership style is seen to influence innovation abilities within an organization. (see, e.g., Barsh, Capozzi, & Davidson, 2008; Bossink, 2007) Therefore, an assumption of improved abilities of R&D net to develop offering arises when managing in net.

The following table 11 presents the empirical results, reflections to contemporary literature, and the findings adding to contemporary literature of managing in R&D net.
Table 11. What are benefits of managing in R&D net for actors?

<table>
<thead>
<tr>
<th>Empirical results</th>
<th>Supported:</th>
<th>Contradicting:</th>
<th>Adding to literature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Enables R&amp;D net to be formed and to perform</td>
<td>- Increased abilities to exposure</td>
<td>- Managing R&amp;D net may lead to expanding the up net formation</td>
<td>- Structures and speeds up net formation</td>
</tr>
<tr>
<td>- Ability to combine resources and knowledge, even scarce</td>
<td>- Ability to influence other actor’s agenda creation</td>
<td>- Managing R&amp;D net may lead to expanding the up net collaboration</td>
<td>- Structures and speeds offering development</td>
</tr>
<tr>
<td>Structures and speeds up net formation and collaboration</td>
<td>- Managing in R&amp;D net required as proceeding to latter phases to ability to manage different type R&amp;D net</td>
<td>- Increased understanding: change, context, embeddedness and roles in net</td>
<td>- Enables modular offering development</td>
</tr>
<tr>
<td>- Enables modular design</td>
<td>- Optimize resource utilization, Identify missing resources</td>
<td>- Enables role planning, enables relationship management</td>
<td>- Managing in R&amp;D net enables positive atmosphere</td>
</tr>
<tr>
<td>- Understanding dynamics in net: phases and roles, comprehend abilities to influence to task, net or network level</td>
<td>- Enables positive spirit among actors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following sub-section continues reflecting empirical results in the contemporary literature and focuses on challenges of managing in net.

2.5 Phase II-Challenges of managing in R&D net for actors

The following sub-section continue reflecting of empirical results to the contemporary literature. Firstly, the challenges supported by contemporary are discussed from the viewpoint of identified similarities. Secondly, challenges identified in controversy with the empirical results of this study are identified.
Finally, the novel findings i.e. challenges adding to contemporary literature are discussed in third sub-section.

2.5.1 Challenges supported by contemporary literature

Both the empirical results and contemporary literature note the challenge of complexity relate to managing in R&D net. This challenge is noted in generic network literature. Managing in nets management in general is regarded as being exceedingly complicated due to its embeddedness and reciprocity in business relationships (Möller et al., 2005; Möller & Rajala, 2007). It is also seen as dependent on the characteristics of the network and the actors involved (Möller & Rajala, 2007). High performing companies have a holistic understanding of their portfolio (i.e., their focal network) and its embeddedness to the surrounding network, as well as an understanding of interdependencies in networks among actors, unconnected actors, and potential industry-related uncertainties (Ozcan & Eisenhardt, 2009). The task of a manager in a network is to continuously clarify and develop the network that the company is embedded in. (Ford et al., 2003, 33) Actors operating as technology and market promoters (Gemünden et al., 2007) are also needed in order to overcome the boundaries of nets to break down the challenges of embeddedness.

According to the empirical results of this study, challenges of managing in R&D net are caused by the complex and dynamic nature of nets and their embeddedness to surrounding networks. Contemporary literature identifies similarly the complex and dynamic nature as challenge for managing in R&D net. (see e.g. Birkinshaw et al. 2007, Möller & Rajala 2007, Möller & Svahn 2009) The complexity is derived from low determination levels of value creation. A net that is developing technological or business idea is characterized as dispersed or vague (Möller & Rajala, 2007), appear ad hoc nature (Birkinshaw et al., 2007), or it may cause change radically and discontinuously to the whole value-creating system. Level of understanding and explicit knowledge of value creation in R&D net are low, because the ability to determine value activities and resources that actors possess in order to create value offerings in the net is also low. In addition, the knowledge within such systems is typically tacit, scarce, and non-transferrable in formalized manner. (Möller & Rajala, 2007.)

According to the empirical results of this study, challenges of managing in R&D net are related to the characteristics of networks as complex structures of multiple heterogeneous actors. This is seen similarly in contemporary literature.
Bringing together an R&D net with different types of actors generates challenges (Ritala, Hurmelinna-Laukkonen et al. 2012) and the that differences are usually derived from differences of university and company actors. (Johnson 2008)

In the empirical results, the interests of R&D net actors were perceived as being (partially overlapping or even in conflict). This is supported in the contemporary literature that see that challenges are seen inevitable in network surroundings due to conflicting interests (Munksgaard, Clarke, Storvang, & Erichsen, 2012). The challenge in managing in an R&D net is then understanding an actor’s motivation, common vision (Möller et al., 2005), and their own and others’ capabilities in order to be able to define potential contributions and responsibilities in the R&D net (Ojasalo, 2012). Contemporary literature acknowledges similarly as challenges partially mutual interests, opportunism and complexity of managing in R&D net (Mustak, 2014). Mustak also notes (2014) that comprehensive understanding of other actors’ targets is required in order to prevent mis-understandings and opportunistic behavior.

The empirical results of this study implied that a comprehensive understanding of motives of other actors prevents challenges related to misunderstanding and perception of opportunistic behavior. It was also noted in the contemporary literature that motivation to participate in R&D net might vary. The contemporary literature identifies challenges related to managing in R&D net related to unreliable, opportunistic or even deceptive behavior, unanticipated economic problems (Ojasalo, 2012), or different levels of motivation among actors. (Baum, Cowan, & Jonard, 2010; Öberg & Grundström, 2009; see e.g. Ojasalo, 2008) Motivation may also not be technology or market related, when actors are seeking government subsidies (Sakakibara, 2002). Actors may have motivations that are not related to economic objectives or product and service related. Actors may be motivated to participate in an R&D net due to non-economic personal aspirations i.e. creativity, artistic self-fulfillment, freedom, friendships, or lifestyle or entrepreneurship motivations (Ojasalo, 2008). The discrepancies between actors can lead to a perception of unreliability (Ojasalo, 2012) or the dissolution of a relationship between actors in R&D net. (Millson & Wilemon, 2008)

Another challenge in managing in R&D net is related to offering is the ability to combine the resources of multiple actors in novel and innovative ways. Co-operation with the best actors and possession of their technologies and resources is not enough. Also, it has been noted in empirical results of this study that the ability to combine technological innovation with marketing expertise is required. Contemporary literature supports these findings and it argues that both
technological and commercial understanding is important (La Rocca & Snehota, 2014; Öberg & Grundström, 2009). In contemporary literature as a challenge of managing in R&D net is identified actors insufficient market and managerial skills.(Öberg & Grundström, 2009) Contemporary literature note that managing in R&D net e.g. application net requires understanding of the technological aspects and value creation logic of the net (Möller & Svahn, 2009). In managing in R&D net, there is also a requirement for balancing internal and external orientation. (La Rocca & Snehota, 2014)

There is a noted challenge in R&D net is related to managerial capabilities, in terms of understanding the specific characteristics of R&D nets, offering development in R&D nets and managing in nets. Contemporary literature note that different types of nets require and enable different types of managing in net, because nets differ by the structure, nature of value-creation logic and management mechanisms (Möller et al., 2005; Möller & Rajala, 2007). Nets developing radical, i.e., discontinuous innovation, namely idea networks, corporate venturing, lead user groups, cross-industry alliances, communities of practice, supplier networks, and open innovation networks (Birkinshaw et al., 2007), require different management approaches as well. In addition to managing in nets, actors must proactively develop new business relationships that aim to relate to those within the focal net as well to the surrounding network, i.e., organizing in relevant networks (Ritter, Wilkinson, & Johnston, 2004).

There are also challenges that can be identified that are caused by the embeddedness in their surrounding networks. The empirical results suggest that the success of a developed offering by an R&D network is not related to its technological superiority, but is rather influenced by its compatibility and adaptability to the surrounding network structure. This relatedness of an R&D net also emerges in the empirical results of this study, as it is seen that existing technologies and business models tend to hinder the diffusion of novel solutions that are too different from existing technologies.

In the empirical results, it is noted as a challenge to apply network management at the appropriate level: Overly active managerial actions during formation may affect innovativeness, whereas an overly passive approach may mean R&D network formation takes longer. One challenge in network management is related to understanding the network as an interrelated entity. Being a member in a network creates both opportunities and restrictions (Håkansson & Ford, 2002). Contemporary literature acknowledges that network management must be conducted without the benefit of hierarchies or ownership in general network
management discussions (Provan & Kenis, 2008). From an INA perspective, the challenge of network management is that extensive control limits network innovation abilities and reduces efficiency (Ford et al., 2003; Freytag & Ritter, 2005), or that control leads to death of the network (Waluszewski, 2004). These have been identified in the context R&D networks. Researchers note (see, e.g., Ojasalo, 2008; Ring, Doz, & Olk, 2005) that too much control may lead to the erosion of the benefits of co-operation and strong social relationships. However, Ojasalo (2012) sees that lack of coordination, control, and leadership in addition to lack of formal agreement among actors are challenging factors in managing in R&D net. The benefits of co-operation in innovation are reviewed ex ante to compare the benefits offered by new innovation to lost individual actor freedoms (Holmen et al., 2005). Too little control is not a good option either, as it enables chaos (Yoo, Boland, Lyytinen, & Majchrzak, 2012), opportunistic behavior of actors leading to doubts about commitment and competence of actors (Ring et al., 2005), and development activities in totally “wild” networks without any control (Ojasalo, 2008). Co-ordination should not be rigid and bureaucratic in order to hinder creativity, but instead it is required to achieve targets (de Reuver, 2009) and it should be applied moderately (Rampersad et al., 2010). Overly rigid control restricts innovation (Yoo et al., 2012). In addition, contractual governance in the development phase of new mobile services may restrict innovative solutions (de Reuver, 2009).

As noted in empirical results, a challenge of managing in an R&D net is the temporal changes. Contemporary literature notes that networks hold the potential to thrive or decline as a major challenge, and the ongoing challenge is to avoid declining (Levén, Holmström, & Mathiassen, 2014). It is noted empirically that managing in nets is that changes over time and shift over major phases of the R&D net development process i.e. from network formation to collaboration are seen to bring changes to network and thus changes in managing in net. Similarly, the contemporary literature argues that network management activities evolve over time (Klerkx & Aarts, 2013). Studies also justify empirically that management mechanisms change over phases of network development (Ritala et al., 2012), in a mobile service innovation context (de Reuver & Bouwman, 2012). The empirical results of this study also note that actors need to understand that management in the formation phase affects later phases of network development. In the contemporary literature, managerial challenges may be related to the implementation phase of a networked solution under the management of an active central actor (Joseph et al.,
2011). In addition, the transformation from phase to phase in an R&D network creates challenges for managing in R&D net (Nikayin, De Reuver, & Itälä, 2013).

The empirical results this study suggest that there are challenges related to the final phase of the collaboration, i.e., commercialization. Empirical results noted that transformation from collaboration to commercializing creates challenges for actors. Actors need to understand while managing in net that the motivation of each actor and changes in motivation and perceive shared interest during the development in net, especially when facing the commercialization. Commercializing may not be a goal for all actors in net. University partners may not wish to participate in commercialization activities, as noted in the empirical results. Empirical results note actors in net that were not able to understand motivation for municipality or university to withdraw from net when closing commercializing. Contemporary literature note similarly that motivation to join R&D net varies even with non-commercial motives such as personal fulfillment or project phase participation (Ojasalo, 2008; 2012). In the contemporary literature, it is noted as a managerial challenge that the actors without sufficient shared interests development is hindered. The net did not proceed to following phases; from development to implementation, or to commercialization, even in case of non-centrally led net. (Nikayin et al. 2013.)

The continuous change of roles and overlapping nature or roles are a noted challenge for an actor managing in R&D net is. Nyström et al. (2014) found that managing in R&D net is challenged by transformation of roles. Similarly, Story et al. (2011) noted that short lasting contribution in role is challenging actor’s ability to understand managing in net in context of automotive industry radical innovations.

In the following section, reflections that contradict the empirical results of the challenges of managing in R&D net are presented.

### 2.5.2 Challenges contradicting to contemporary literature

This section continues reflecting empirical results to contemporary literature. Section focuses on identifying controversies of noted challenges for actor of managing in R&D net between the empirical results and contemporary literature.

First, the empirical results contradict contemporary literature with the perception of the change in R&D net. In the empirical results of this study during network formation, the other actors in the net must approves the actions in order to be able to generate change in the net. The empirical results of this study note that the other actors accept the changes as long as they perceive that the benefit is
mutual, and change is generated in the net. Contemporary strategic net literature assumes in contrast, that the managerial action of the hub generates change in the net (Möller & Rajala, 2007). This noted hub-focused managerial approach may be implicitly assumed to be part of every phase of R&D nets (Möller & Rajala, 2007) or emerging business network development (Möller & Svahn, 2009) or it may be identified during phases of development e.g., formation (Partanen & Möller, 2012). The studies focusing on mobile service ecosystems (i.e. service constellation research;) (see, e.g., van Riel et al., 2013) see that coordination is partly explicit, that a dominant actor defines which actor develops which service in network and partly implicit that evolutionary principles define coordination. (Boudreau, 2011)

One of the challenges noted in empirical results is actor acquisition during managing in R&D net formation and collaboration. Contemporary literature (e.g., Birkinshaw et al., 2007) note actor acquisition challenges that are related to finding suitable actors over geographical, technological, or institutional distance, and forming relationships with the potential actors over ideological, demographic, or ethnic barriers. The empirical results do not note such challenges for actor managing in R&D net.

The continuous change of roles and overlapping nature or overlapping roles are noted as a challenge for an actor managing in R&D net. The challenge of role transformation is also noted in contemporary literature however, the source of challenge is perceived differently. In the empirical results, actors are acting in roles and that are aggregations of the action, reaction, and interaction of other actors in the net. The challenge of managing in R&D net related to roles for managing is the continuous transformation and overlapping roles. Roles in this study are understood as typologies of an actor’s actions and behavior, not as the aims or goals of actors. Due to the emergent and radical nature of actions, the actor performing the role can aim to and (if equipped with appropriate capabilities) even achieve any role available. Nyström et al. (2014) sees that an actor’s inability to “achieve” a certain role is challenging role transition. Nyström et al. (2014) argue that new actors in a net only perform preset roles in relations to other actors and their position. The roles in the new network are then based on stating themselves in relation to others, according to the initial position achieved through personal ties and social capital. By contrast, in the empirical results of this study the acceptance of a role is defined by the perception of others. An individual actor’s perception of a new actor in a net influence via the action, reaction, and interaction of the perception of whether a role is achievable for the new entrant or not. Nyström et al. (2014) see that an actor’s role leads to a position in a network, following the structural functionalistic
approach in the role-theoretic discussion that sees a position leading to a role. In this study roles are seen as a construction of expectations, intentional action and changing role by actor, thus leading to different approaches. There are periods of low determination of ties, such as initial formation of new network (Hallen 2008), therefore more freedom and potential for role-making already exists in the formation phase of the network, which supports the finding noted in this study.

2.5.3 Challenges adding to contemporary literature

This section presents empirical results related to challenges for actor of managing in R&D net that are adding to current knowledge. The novel challenges are identified, geared toward the empirical results on contemporary literature.

The empirical results of this study note that among the challenge of managing in R&D net are an actor’s ability to describe, understand, and analyze the roles, because of the dynamics of the roles. The challenge for actors aiming to understand roles for managing is related to their ability to comprehend how managerial action influences development tasks or interaction within the R&D net or interaction beyond the net. Empirical results note the managerial action is perceived among actors as expected or unexpected, and the influence of action may be interpreted as radical or incremental. Based on understanding of the level of influence, perception, and interpretation, actors may create an understanding of roles as collections of managerial actions. Another challenge related to roles is to understand the dynamics related to them. As a result, roles may emerge and change during the development process of an R&D net. Roles are also in continuous transformation or they may appear overlapping that actors while managing in R&D net.

In the empirical results of this study, it is also noted as challenge of actors “outside the network”. The challenging task for actors is to ensure that all actor in R&D net remain in under network horizon. Action performed by “outsider” actors are influencing the net. Empirical results note that actor needs to be able to widen the network horizon based on actions of these actors.

Table 12 presents the empirical results, reflections to contemporary literature, and the findings adding to contemporary literature.
Table 12. What are the challenges of managing in R&D net for actors?

<table>
<thead>
<tr>
<th>Empirical results</th>
<th>Supported:</th>
<th>Contradicting:</th>
<th>Adding to literature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Understanding complexities of networks: Common vision, shared roles, dynamics and net embeddedness to network -Transformation between the major development phases of formation to collaboration -Apply management at appropriate level -How to embed in the surrounding network -How managerial action influences development tasks at the focal network level -How to cope unexpected role behavior in R&amp;D net -Ensuring visibility of roles</td>
<td>-Understanding complexities of nets, diverse motivations, actor characteristics, roles, -Temporal changes over phases of development -Managing in R&amp;D net at appropriate level</td>
<td>-All actors are influencing in managing in R&amp;D net. Not only hub, or broker -Finding suitable actors and forming relationships -Understanding role transformation: performing in managerial roles are sub</td>
<td>-Managerial roles are challenging to identify -Change in roles change -Ensuring visibility of roles and influence of &quot;outsider&quot; actors</td>
</tr>
</tbody>
</table>

In the empirical results note that actors that have relationships between networks i.e. weak link actors are challenging managing in R&D net thus the ability to weak link actors to influence innovation ability and resource base of the net. In addition, the actors that collaborate in an R&D net must be able to carry out joint decision-making regarding the tasks and goals of the network. That is seen challenging managing in R&D net during formation according to empirical results.
The following section contains the concluding discussion of managing in R&D net, both in terms of roles for managing, process of managing as well as benefits and challenges of managing R&D net.
3 Conclusions

This chapter summarizes and concludes this study. The section describes the results and discuss them in terms of theoretical, managerial and methodological contribution.

3.1 Summary

The present study addresses managing in nets and how actors perform the managing in context of R&D nets. This is because the focus of business network studies has moved from describing the structure, functions and dynamics of networks as more researchers are moving to study management in networks (Järvensivu & Möller, 2009). Firms are increasingly performing R&D activities in networks between firms: customers, suppliers or universities, governmental agencies, research organizations (Rampersad et al. 2010) and co-creating and co-producing new products and services (LaPlaca 2014) rather than within boundaries of organization. R&D networks are used to sharing cost and risk (Johnson 2008), improving innovation performance, decreasing time-to-market. (Gilsing et al. 2007), access missing resources and abilities (Peters et al. 1998) and facing the new needs of knowledge intensive, specialized and globalized industries. (Bessant & Tidd 2007, Möller & Halinen 1999) R&D networks are have become critical among developing industries (Powell & Grodal 2005), practitioners and policy-makers (see, e.g., European Commission, 2002; Roxenhall, 2013) are favoring them and their key role in developing new ideas are in networks. (LaPlaca 2014). The need for understanding management in R&D networks has increased, because management in innovation is important (Ojasalo 2008) even crucial for success. (Ferrary 2003) Thus the objective of this study is to describe, understand and conceptualize managing in R&D nets, by understanding the process of managing, via the action based roles for managing that actors perform, the benefits of managing for actor and challenges of managing for actor in R&D net.

Managing in network is approached in this study from a strategic net perspective (Järvensivu & Möller, 2009; Möller & Halinen, 1999; Möller et al., 2005; Möller & Rajala, 2007) that see managing as relatively determined by the unit of analysis. The present study perceives network on meso-level networks (Möller & Halinen, 1999; Möller et al., 2009; Möller, 2013) i.e as nets. Strategic net discussion is applied in this study to enable abilities to depict and conceptualize managing in R&D net as a process of managing in as well as roles for managing.
Strategic nets is seen applicable in this study, because the discussion focuses on how nets evolve (Möller & Halinen, 1999), which roles or positions actors are able to gain within net and how actors are able to utilize nets (Möller, 2013).

Present study builds understanding and conceptualization of managing in R&D net based research process that consists of two phases. In the Phase I - empirical papers provides empirical results of how is managing in R&D net conducted during formation and collaboration based on single case study. These empirical results are compared to Phase II – Contemporary literature review results. Based on comparison in terms of supporting findings, controversial findings the present study is able to provide results that are adding to the current knowledge of managing R&D networks. The present study describes, understands and provides conceptualizations how is managing in R&D net conducted during formation collaboration.

Understanding process in managing in R&D net is having an understanding action performed by actors, activities, understanding time, context and perceiving change with holistic understanding. Actions generate change and drive process, but happens in contexts that influences actions and their perceptions (Pettigrew 1997) In this study, managing in R&D net is seen as actions performed by managers as representatives of organizations.

- Actors manage by acting and reacting, i.e., by influencing and coping in the relationships between the actors in R&D net.
- Actors can perceive managerial action positively or negatively, and they react to managerial action based on their perception.
- Actions may be perceived as expected or emerging based on whether the action of actor is anticipated or unanticipated.
- Influence of action can be perceived as radical, when influencing in relationships either by enables new relationship formation or the leading to dissolution of an existing one. Influence of action can be perceived as incremental, when shaping tasks that the network is performing based on existing relationships.

The context of managing in R&D net is seen to influence an actor’s abilities to achieve accepted change.

- The action of actors are collections of actions, reactions that are aimed to influence in task, or net i.e., level within the R&D net or network level i.e.,
beyond R&D net in managing in R&D net. Actors can improve the understanding of their actions by evaluating the level of aimed actions.

- Change in net is achieved by approval of other actors in R&D net.

In order to gain holistic understanding of managing in R&D net as a process the timeframe as presented in this study the timeframe of analysis could cover both net formation and net collaboration activities. Rather than focusing on describing separate formation activities in net and/or collaboration activities during R&D net developing an offering the timeframe should cover both. Focus of managing in R&D net should be in both formation and collaboration period not in individual phase of R&D net development or transformation from phase to another. The empirical results of this study point out that the action in R&D net during collaboration are influenced by the actions performed by actors in formation net.

Reflections to contemporary literature by researches viewing in innovation networks as Tidd and Bessant (2009, 305) identify set-up and operating as phases in their network development model. Also in net building (see, e.g., Partanen & Möller 2012) or business field (Möller & Svahn 2009) studies timeframe consists both formation and collaboration.

Proposition 1: Timeframe of managing in R&D net as a process should consist both formation and collaboration

In theoretical discussion and in this study process is seen as sequence of event or activities that describe the development over time (Van de Ven et al., 1999). Managing in this study were seen during formation of managing in R&D net as process of overlapping and iterative sub process, that is consists of enabling formation, acquiring actors, assuring continuity, formal structuring, learning and developing commitment. During collaboration managing in R&D net was consisting of conceptualizing, acquiring actors, allowing resources, mobilizing operations and planning commercializing activities.

To understand the underlying mechanism in managing in net, understanding of different process approaches are needed, thus single conceptualization of change provides only partial view of complex process (Van de Ven & Sun, 2011). Typical conceptualizations of underlying mechanism of change in managing in R&D net studies are life cycle (see e.g. Markham, Ward et al. 2010, Ring, Doz et al. 2005, Millson, Wilemon 2008) the depict change as sequence of phase or paths. Present study provides teleological conceptualization as underlying mechanism to understand change in managing in R&D net as process. Teleology i.e. planned
change sees change as purposeful actions towards joint joint end-state (Van De Ven & Poole, 1995; Van de Ven & Sun, 2011) During net formation managing in this study can be noted as managing in R&D net is seen teleological, iterative and overlapping sub-processes. As joint end-state for the R&D net during formation is the emergence of formal structure of the net. In this present study, the existence of formal structure was seen the end-state during formation, the launch of offering can be reviewed as joint end state for a R&D net.

Proposition 2: managing in R&D net should be perceived as simultaneous, iterative and overlapping sub processes also during network collaboration phase.

The present study describes, understands and provides conceptualizations how is managing in R&D net conducted during formation collaboration via roles for managing. Managerial roles are representations of actions that the actors are performing perceived by other actors in the net. In addition, this study extends the conceptualizations and provides a theoretical analysis model for analyzing roles for managing. Managing in net takes place through the roles in which the individuals, the company and the network actors act. The actors execute acts designed to influence the tasks, the net, and the network. The influence differs, depending on the role the actor assumes over time or during different phases of the development process. The abilities an actor has for influencing the R&D net varies from one role to another. Actors can improve their abilities to analyze the individual actions of others and plan their own actions in a network by using the FRM, which enables systematic topologizing of roles and analytical understanding of roles that appear in the R&D net. Actors can utilize the FRM for understanding roles that appear in the R&D net context. The framework is based on how actors act in the focal net, and on what basis and how others may interpret actions. In addition, the framework also considers the temporal change of roles between phases of R&D network development.

FRM analyses roles with dimensions of roles. Firstly, roles can be understood and analyzed in the level of aimed action. Actions can be perceived to be aimed at tasks and net levels, and on surrounding networks level in R&D net context. The second dimension of the FRM is interpretation of the action. An actor can perceive the performed actions as expected and emerging based on whether the action was perceived to be anticipated from the role expectations of other actors. An action can be perceived as emergent that refers to actions that, were among actors more unanticipated. The third dimension of the framework is the influence of the acting,
whether it is perceived incremental or radical. Influence of action can be perceived as being incremental, when action shape the tasks that the net is performing based on existing relationships. An actor can perceive the influence of an action as radical, when influencing relationships enabling the formation of a new relationship or leading to the dissolution of an existing one.

The role framework influence actors’ abilities to interpret need for coping or its abilities to manage in in R&D net, how other actors’ actions are designed to manage, or why an actor is refraining from managing in a network based on the actions and reactions of other actors in performing tasks, acting in a network, or interacting in wider network structures. A proposition based on both empirical results and contemporary literature review in relation to managerial roles:

**Proposition 3:** The ability to understand the varying roles for managing in R&D that actors perform during the formation and collaboration enables actors to achieve individual and joint goals of the net when the R&D net evolves.

Present study identifies then benefits of managing in R&D net. The benefits of managing in R&D net are related to resource utilization and knowledge of R&D network development. Managing in R&D net is seen in this study to enable the achievement of goals and it also enables the combination of resources and knowledge.

Another benefit of managing in R&D net is the increased pace of the R&D activities. Managing in net enables rapid R&D net formation and during collaboration phase it influences pace of offering development. The ability to increase the pace of R&D net formation derives from network webber’s actions to provide perception of interdependencies and shared interest among potential actors in addition to motivating them to join R&D net. The ability to speed up offering development during collaboration phase derives from two sources modularity and rapid perception of joint goals. Managing in R&D net enables development of the offering in modules, because actors can divide the development activities and tasks during the collaboration phase. In the empirical results, modular development is seen to create benefits in two ways. Firstly, modularity enables the actors to use technologies and resources that they have already developed and combine them to joint offering of several actors. Actors can increase the pace of new offering development using joint resources and activities in a modular sense. The offering can be based on existing resources and activities, or previously developed value offering modules that can be combined as an offering. Modularity enables an innovative combination of partially existing technologies with new combination.
Secondly, modularity enables co-ordination tasks and activities of the actors during the collaboration phase of the R&D process. Actors can divide offerings into development modules. As a result, each actor can focus on their development modules and the offering can be based on existing resources and activities, or previously developed value offering modules that enables rapid pace of development. Managing in R&D net speeds up the collaboration phase based on relationships, perception of the roles among actors and joint history among actors. The pace of the offering development is increased based on rapid joint need recognition of the offering among actors.

The benefits of managing in R&D net are also related to an increased understanding of acting in managerial roles. Roles for managing have mainly focused on the roles of actors in a central or intra-network position, but the other roles are also seen as interesting. Through enhanced understanding, actors can improve their abilities to cope and mobilize their actions and relationships with other actors. Actors can also identify potentially missing roles or activities and resources in the task, net or network level. They can also understand their managerial capabilities and requested managerial resources within the R&D net, and evaluate the influence of the surrounding network.

Another benefit of managing in R&D net is that it enables expanding R&D net scope and magnitude of the offering development. The expansion is possible through the utilization of other actors’ resources and knowledge. This benefit is important, especially for small actors managing in the R&D network. Ability to manage R&D net can be seen as a prerequisite for the progress of technical innovation development and transformation from earlier phases from piloting, to implementation, or finally to commercialization.

Additionally, the benefits of managing in R&D net relate to the ability to expand the knowledge base of a company. Managing in R&D net enables learning that had not been identified in the literature as a significant activity or sub-process. Learning has been acknowledged in latter phases of R&D network development in the contemporary literature. Managing in R&D net enables learning and knowledge transfer of technologies or business concepts, even with vague, fuzzy, and future-oriented emerging business nets. Network management forces companies to expose themselves to new business models and technologies, thus opening up their learning and innovation creation to broader scientific networks and opening up the potential to generate new business from emerging business nets.

There are also identified challenges of managing in R&D net for actors. Challenges of managing in R&D net are related to the nature and characteristics of
the networking itself. Managing in R&D net requires a wide understanding of both technological and commercial even commercialization perspectives in R&D net. Complexity derives from the continuous change in interrelating relationships, both from the perspective of the focal net as well as its interrelations to the surrounding network structure. Also, the vague and future-oriented nature of a new offering and new value-creating systems increases complexity and uncertainty that is seen as challenge for managing in R&D net. In terms of knowledge, managing in R&D net requires an understanding of both technological and commercial relationships and their interrelated interaction in task, net and network level. In terms of knowledge creation, R&D net require managerial action to create an open and trusting culture among actors.

The dynamics of network development constitute challenges for managing in R&D net. R&D nets evolve over time throughout their development, which needs to be considered in terms of both the individual phase and the overall development process. The challenge is related to understanding the whole timeframe of the R&D net, instead of focusing on a single phase in the net. The transition from one phase to another and the influence on the network – from formation to planning, collaboration and finally to commercialization – can be seen as a challenge. The changes in the relationship between actor within the net influences later phases of development. Actions taken by actors in the formation phase influence the latter collaboration phases of the R&D net. Withdrawal from action in certain phases leads to a certain interpretation among actors of the role of an actor in other phases. The focus on a single phase and excluding the earlier influence of actor’s actions and interactions may lead to myopic or inadequate perceptions.

Managing in R&D net requires resources and capabilities. The resources needed for managing in R&D net is typically underestimated in comparison to development activities. R&D net formation activities, R&D net collaboration activities requires sufficient resources and specific capabilities and managing in R&D net should receive sufficient resources, because the ability to create new emerging business nets ensures that the organization can exist now and in the future. In addition, managing in R&D net is seen to require different resources and activities in different phases of R&D net development. In the formation phase, actors that possess the capabilities to find potential actors, mediate over the formation of relationships: assure continuity, develop continuity, create formal structuring and enable learning are required. The collaboration phase requires capabilities for actual offering development: conceptualizing, actor acquisition, allowing resources, mobilizing operations as well as business model development:
planning commercialization activities. The challenge for managing in R&D net is also the understanding the changes in the net relationships beyond just formation and collaboration phase of the developing net. The R&D net development should be seen as temporal frame from formation to collaboration, because shift from one phase to another create changes in net as well the roles of actors.

The findings are summarized and presented in table 13 that provides an overview of the empirical results this study is adding to current knowledge on managing in R&D net.

<table>
<thead>
<tr>
<th>How is managing in R&amp;D net conducted during formation and collaboration?</th>
<th>What are the benefit for managing for actors?</th>
<th>What are the challenges of managing in R&amp;D net for actors?</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Managing in net should be seen with several process conceptualizations</td>
<td>-Structures and speeds up net formation</td>
<td>-Understanding similarly technology, business and</td>
</tr>
<tr>
<td>-R&amp;D net formation should be viewed as teleological process</td>
<td>-Structures and speeds up net collaboration</td>
<td>commercialisation</td>
</tr>
<tr>
<td>-Role of entrant and aspirant</td>
<td>-Enables modular offering development</td>
<td>-Understanding complexity and dynamics</td>
</tr>
<tr>
<td>-Framework for roles for managing</td>
<td>-Increased understanding: change, context,</td>
<td>-Managing in R&amp;D net requires resources and knowledge</td>
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<td></td>
<td>embeddedness and roles in net</td>
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<tr>
<td></td>
<td>-Enables modular offering development</td>
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<tr>
<td></td>
<td>-Managing in R&amp;D net enables positive</td>
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<td>atmosphere</td>
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</table>

The following section reviews the theoretical implications of this study.

3.2 Theoretical implications of the study

This study extends the understanding of managing in R&D nets in three fields. Firstly, this study provides a conceptual understanding to review managing in R&D net as a process. The developed sub-process model of managing in R&D net during formation enables understanding of overlapping, simultaneous and iterative activities in R&D net. Secondly, this study creates a conceptual framework for depicting and topologizing roles for managing in R&D net. The sub-process model is proposed to be extended to managing in R&D net during collaboration. Thirdly,
this study extends the understanding by identifying the benefits and challenges in managing in R&D net.

The contribution of this study is created based on dialogue between empirical results and reflecting them to contemporary literature review. A new understanding of managing in R&D net is based on combination of empirical results from a case study and reflecting the empirical results with current knowledge by using systematic literature review and comparative analysis.

This study contributes to the managing in net discussion (Järvensivu & Möller, 2009; Möller et al., 2005; Möller & Rajala, 2007; Ojasalo, 2004; Ojasalo, 2008) by increasing understanding from the context of R&D nets. The strategic value net (Järvensivu & Möller, 2009; Möller & Svahn, 2003; Möller et al., 2005; Möller & Rajala, 2007) approach have stressed the perspective of single hub, nets that can be expanded by the approach of multi-hub (Lavie et al., 2007) active in managing in net. The R&D net in depicted in the empirical results of this study can identified among the of the ideal types of strategic business nets i.e. emerging business net that are used for new technology, new business concepts and even new fields of business development. (Möller & Svahn, 2009) The characteristics of the R&D net in empirical phase of this study are similar to the characteristics of an application net (Möller & Rajala, 2007). This study is able to contribute to application net research with extended understanding of managing in such nets. Application nets are formed for the development and launch of early commercial applications, they involve a web of complementary components, software, and other technology producers, as well as pilot customers (Möller & Rajala, 2007). Application nets have been researched in similar contexts as used in this study as emerging mobile service development (Partanen & Möller, 2012) in addition to research in modular house collaboration nets. (Munksgaard, Clarke, Storvarg, & Erichsen, 2012) Application nets are organized as multiparty technology projects, with set goals and schedules (Möller & Rajala, 2007) similarly as the R&D net researched in this study with shared targets, schedules and designated roles.

Managing R&D in net requires a wide understanding of research, technologies, and business networks. The contemporary literature (see e.g. Järvensivu & Möller 2009) imply align result of this study that without proper understanding managing in the net as process and the functioning of the net itself, organizations cannot achieve their goals. The process perspective in R&D nets development have been focusing on life cycle process models that this study is able to expand with teleological process approach. Teleological view is growing attention among managing R&D net formation and collaboration studies. In contemporary R&D net
literature, even late studies (see e.g. Markham et al. 2010) implicitly assumes that the development process follow the path of innovation development in a life cycle-type, from discovery on invention to innovation and the development of offering and finally commercializing it. Also R&D net formation studies (e.g., Birkinshaw et al., 2007; Doz, Olk, & Ring, 2000; Ring et al., 2005) tends to create a step-by-step stage-model of R&D net formation. This study contributes to the R&D net formation literature by providing a teleological iterative, overlapping and repetitive model of R&D net formation. This perception of R&D net formation aligns with Partanen and Möller (2012) perception of the overlapping and iterative nature of net formation as sub-processes. In addition, this study extends the understanding of initial factors of R&D net formation with enabling factors noted both in empirical results and the reflection to contemporary literature.

Also, the temporal perspective is expanded to including both the formation and collaboration activities as evident phases of the R&D net development. Evolutionary perspectives on managing in net (or governance) are seen as continuously relevant (de Reuver & Bouwman 2012). Past studies still tend to focus on dyadic behavior rather than seeing the network as a whole. (de Reuver & Bouwman 2012, Dhanaraj & Parkhe 2006, Provan et al. 2007) This study is among the few studies that that view the process on net level (Ozcan & Eisenhardt, 2009; Partanen & Möller, 2012).This study contributes to the discussion by suggesting that there are significant changes within net during and between the phases of developing R&D net. The group of actors i.e. actor configuration of an R&D net changes and the actors that are contributing in development change during formation and collaboration of R&D net. The transformation from collaborative development to commercialization is noted. The change from the development phase to commercialization influences the characteristics of the network. The level of determination increases when the value-creation process is known and codified, and actors, their activities, value appropriation, required resources, and knowledge are known, and actors’ roles are relatively easier to define in comparison to vague and highly complex nets developing businesses. A net is changed, even divided to several net due to the demand for new resources, knowledge, and capabilities related to commercialization itself.

This study contributes discussion of roles for managerial among network studies. The Strategic net discussion acknowledges actors’ roles in managing in nets (Järvensivu & Möller, 2009; Möller et al., 2005; Möller & Rajala, 2007; Ojasalo, 2004; Ojasalo, 2008) and define roles explicitly as a key aspect in all network management discussions (Möller et al., 2005, 1280). This study furthers
the understanding, conceptualizing and analysis of roles for managing in R&D net
by providing conceptual tools for analyzing roles for managing over contextual
boundaries. Among network management metatheory (Järvensivu & Möller, 2009)
and some studies that focus on roles for managing (see, e.g., Knight & Harland
2005, Nyström et al. 2014) research on managerial roles are divided into two
diverging paths. The first path is aiming to identify roles in different contextual
settings, and the second path is searching for generic roles i.e., roles that can be
identified in different contexts. This study contributes on both paths, because it
provides an extension to the typologies of managerial roles, and identifies shared
generic roles as contribution to generic role discussion.

This study provides contribution to the first path of managerial role studies via
providing a typology of in total 13 roles that have been both empirically identified
in context of new service development and reflected to other contexts of
contemporary literature. In contemporary literature roles for managing have been
depicted in contextual setting of supply chain management (Knight & Harland,
2005), living labs (Nyström et al. 2014), radical innovation in the automotive
industry (Story et al., 2011), SMEs developing services (Gottfridsson 2014), roles
as a strategic guide in space system development (Nosella & Petroni 2007), roles
in a triple helix context (Johnson 2008), roles to overcome phases of product
development life cycles (Markham et al., 2010), roles in developing an innovative
firm’s network (Öberg & Grundström, 2009), and roles from an markets as
networks level (INA approach). (see e.g. Abrahamsen, Henneberg et al. 2012) The
present study provides descriptions of roles of entrant and aspirants for managing
that are not noted in the contemporary literature. Story et al. (2011) note that
especially task-oriented roles are related to the context that they are created in, and
are thus unlikely transferred to other contexts.

This study implies that certain roles are transferable to other contextual settings.
Even the role theory researchers that see roles as resources (see, e.g., Baker &
Faulkner, 1991; Callero, 1994) see that roles are transcending over contextual
boundaries (see, e.g., Callero, 1994). In total 11 role typologies out of 13 identified
in this study were identified over the boundaries of contextual setting. Namely role
typologies of webber, gatekeeper, organizer, instigator, advocate, produce, planner
auxiliary, facilitator, compromiser and accessory provider were identified in living
lab, small company service innovation or triple helix context.

This study is also able to contribute strategic net role discussion that see certain
roles for managing are perceived as generic (e.g., Järvensivu & Möller, 2009;
Knight & Harland, 2005; Nyström et al., 2014). As contribution to generic role
discussion this study identifies three roles that are perceived as generic. This study defines, based on the empirical results, three roles for managing of webber, advocate, and compromiser, that are seen as generic roles. The role of webber identified in this study, consists of similar features with business opportunity owners from the context of a supply chain development network (Knight & Harland, 2005) that was identified as generic role. In contemporary literature, the platform host, that corresponds in the empirically identified advocate, and the organizational representative, which equates with compromiser (Weichhart et al., 2010). In addition, in the context of SME service development, the webber and advocate roles were identified as ones that inspired or supported actors (Gottfridsson, 2014).

R&D nets are a challenging environment for research, due to several sources of complexity. The Actors are challenged to understanding the complexity and dynamics related to roles. Roles are seen as vague; thus actors may be vague to the network in the extreme, in that they do not even realize being part of the development process (Gottfridsson 2014). Story et al. (2011) note that role scripts are neither clear nor static, and that the identification of role perception between actors and roles is not always obvious. As a contribution to discussion of challenges of managing in R&D nets, this study provides the actors that appear “outside the net”. Actors are linked with embedded networks “outsider” actors are oxymoronic. The challenging task for actors is to ensure that all actors in R&D net are perceived within network horizon and the challenge is more related to network visioning abilities and setting the boundaries of net at relevant level. Actors that are not able to perceive the action of all the relevant actors in their R&D needs adjust the network horizon accordingly. Role performance is also seen as being performed in short periods or that actors simultaneously perform similar roles (Story et al., 2011), which challenges the perception of roles even more.

More over this study enables analytical tool for understanding managing in R&D net providing a framework for interpreting the actions of actors that constitutes managerial roles i.e., role framework. Role framework can be used for analyzing the actions in net based on the level of aimed influence: task, net, network, based on interpretation of actions: expected or emergent and finally based on interpretation of the influence of the action in: radical or incremental. Role framework is an analytical conceptual framework for systemic analyzing an actor’s action-based roles founded on dimensions of roles for managing in R&D net(work).

The ability to review roles analytically and systematically based on dimensions of managerial behavior, perception of the managerial actions and the level of
influencing, like in the framework provided by this study, is rarely used in managing in networks discussions. Story et al. (2011) have utilized task network-level analysis in their role definition. Nyström et al. (2014) extended role characterizations and created number-rich descriptions of roles in the context of living labs, and Järvensivu and Möller (2009) acknowledge roles as a contingency of management. But systematic frameworks for analyzing networks remain scarce.

FRM improves the understanding of how actors within an R&D net, i.e., involved actors, can influence and are influenced by acting in managerial roles. Roles capture the dynamics of acting in a net, thus enable easier analysis of managing in a net, and therefore roles are defined by a level of interpretation and the scope of actions of the actors within and beyond the boundaries of the focal net. The actors acting in a network can be described based on the roles for managing framework, on what basis they act in, and how the acting is interpreted among others in the net(work). Studies that use roles for managing R&D net tend to settle for providing a rich description of roles for managing in from their context. For examples studies from supply network context (Knight & Harland, 2005), triple helix (Johnson, 2008), small company innovation network (Gottfridsson, 2014) and automotive industry (Story et al., 2011) Typically, managerial role-related studies tend to define the role descriptions, or “scripts”, as context-specific, tentative, or particular to the industries or case networks they originate from (Nyström et al., 2014; Story et al., 2011), thus challenging the ability to review findings in other contexts in generic terms. Role framework can be used for systemizing analysis of the studies that otherwise would provide a rich description of roles as positions in structures from a structural functionalist approach perspective or roles as behaviors, as per the symbolic interactionist approach, or roles as resources, as the resource approach suggests.

The empirical results of this study note that there are changes in the roles for managing of actors. With these results, this study contributes to the managing in R&D net studies that search for a deeper understanding of roles and their transition over time. Little research has examined how roles change and interact as R&D network activities progress (Markham et al., 2010). This study continues the discussion of emergent roles. It notes in the context of new mobile service development, in a similar way to Story et al. (2011), that roles are continuously in flux. Story et al. (2011) states that role scripts are neither clear nor static. They also see that role scripts appear to be emergent, with actors not necessarily knowing the role that they are expected to perform (Story et al., 2011).
This study expands the understanding of benefits and challenges of managing in R&D net. The benefits of managing have not received as wide interest as challenges related to managing in R&D net. However studies that review R&D networks benefit and challenges exist (see e.g. Mustak, 2014; Öberg & Grundström, 2009) in addition to studies that focus on just challenges of R&D networking (e.g. Ojasalo, 2012) Certain studies focus on identifying benefits of R&D network (Thorgren, 2007) or benefits in triple helix networks. (Johnson, 2008) The benefits of managing in R&D net should be researched with careful attention. This study notes the ability to increase pace of development activities by managing R&D net. The benefit increasing the pace is both available in during formation activities and during collaboration i.e. while planning, development, piloting and commercialization phase. During net formation, as benefit of managing in R&D net, network webber were noted to increase the speed of network formation. During collaboration phase the as benefit of managing in R&D net is noted the ability to utilize modular development activities. This modular development i.e. ability to utilize existing resource combinations, already developed offering component is related to increasing the pace of development.

In the empirical results were positive atmosphere among actors noted a benefit of managing in R&D net. In the contemporary literature, also leadership within an R&D net context is acknowledged (Ojasalo, 2008; Ojasalo, 2012) There is also comparative research on the effect of soft leadership style vs hard management in (Westerlund, 2009). A manager’s leadership style manager is seen to influence innovation within an organization. (Barsh et al., 2008; see e.g. Bossink, 2007) Therefore, an assumption of improved R&D network abilities arises together with leadership applied among representatives of actors.

The R&D net as a context also creates additional challenges for understanding network structures and their dynamics. The emerging nature of value creation, the radical nature of innovation, and vagueness for manageability in a network, are noted in the strategic value net (Möller et al., 2005; Möller & Rajala, 2007) discussion, especially when related to studies focusing on new emerging value network building (Möller & Svahn, 2009), and sense-making in new business fields (Möller, 2009). In Addition, ensuring sufficient managerial resources are seen to challenge managing in R&D net. In comparison to R&D investment the managerial capability requirement and effort to managerial action is underestimated (La Rocca & Snehota, 2014).

As challenging factor of managing in R&D net in this study is noted the complexity and vagueness of managerial action, that challenges the identification
of roles (Gottfridsson 2014). This study furthers this notion of complexity with identification of actors refraining from managerial action. If the actor withdraws from managerial action that might lead to misinterpretation of the abilities of that actors and other can mis-perceive the role of that actors. The actions (and withdrawal from action) of actors acting in roles of compromiser, advocate and auxiliary may be challenging to identify, thus their managerial contribution may be perceived while the R&D network is developing and the role may not be transparent in the early phases of development in R&D net.

Strategic value net models in contemporary literature (Möller & Rajala, 2007) provide perspectives in order to define the type of management and managerial capabilities required based on level of the value-creating system determination and types of networks. Also the contemporary literature different public network governance methods: participant, lead-organization and network administration organization governed networks and the change over time while network evolves have been discussed in relation to effectiveness of the network. (Provan & Kenis, 2008) The influence of choice of governance type (authority, contracts, trust) in relation to R&D network development phase have been studied (de Reuver & Bouwman, 2012). All in all, the answer for appropriate level of management used in R&D net remains unclear, but by understanding the contingencies of the phenomena may increase the understanding of the actors and leading them to perform appropriate amount of managerial actions.

In general, the question of the discussion of managing in networks is not about whether the networks are manageable or unmanageable, not about what governance form is taken by actors or formed in the network or what is the governance form (trust, authority, contracts) within the network applied, what roles actors act in. Most certainly, the question is not what is the most effective of one of the chosen above mentioned. Managing in networks is relative context sensitive phenomena, that can be understood by certain conceptual frameworks, but note determined by choosing most effective network management combination.

The following section is managerial contribution which discusses the practical findings this study could provide to managers.

### 3.3 Managerial contribution

The managerial contribution is based on combination of the empirical results and reflection to contemporary literature. R&D activities require resources, relationships and understanding of research, technologies, and business networks.
By understanding process and roles in managing organizations could find themselves achieving their joint or individual goals in R&D nets.

This study points that development of a new offering from idea generation to ready offering to markets requires an understanding of the development process in network context as a whole. R&D nets require an understanding of the core technologies and the abilities to evaluate technologies that could contribute as a complementary element to value creation. It also requires understanding of the development processes as whole, i.e., the formation and collaboration phases of the R&D net.

Managers and practitioners could consider the sources of dynamics and complexity in networks. Managers may benefit from understanding that the whole business environment forms market wide network, that can be defined smaller net focusing on various perspectives: e.g., supply, sales, distribution or R&D activities. Managers in a R&D net could benefit from understanding the implications beyond the socioeconomic-technological network in which the R&D net is embedded. The challenge for practitioners is the limited abilities, time, monetary resources and understanding of global networks or even within national industry networks that define the ability to succeed and ability to create value by the new offering. Even the best technological or business model development is insufficient if the developed offering or the new emerged business ecosystem does not fit the surrounding networks.

A manager may be useful to be able to evaluate that the other actors in net are able to provide the resources and perform the activities during the whole R&D net process timeframe. Analysis timeframe covers from the first moments of net formation, during collaboration including application development, piloting and early commercialization and beyond, when the offering is competing for market share against other offerings. A manager may benefit for being able to envision the whole development process and prepare for the potential changes the net will face. Managers could benefit from ability to evaluate the capabilities of actors in each phase of the development with realism, thus an actor’s ability to provide resources: financial, HR, technological, market understanding, net managing abilities and commercialization expertise, influences the whole net’s abilities to success.

Manager can benefit acknowledging that temporal development and changes in R&D net development phases or process in general, lead to the creation of new relationships and the dissolution of existing relationships in a network. That in turn leads to evident changes in the interactions of other firms and parties in the R&D net. In addition, transformation from the collaboration to market launch and
commercialization may cause challenges. Managers find useful to start considering net that will operate market launch already during formation phase of the R&D net. They find useful to consider activities and resources are required to produce value for the end-user, which actors are needed in each phase collaboration phase of R&D net. Especially Managers could find useful to focus actors are able to contribute to the offering development and perform the required roles in terms of technologies, distribution, marketing and business model development. Managers would find useful to note that the scope of offering developed in the net may also change or the offering may be divided into several ones that are to be commercialized by number of different nets.

Managers could benefit for evaluating their roles in R&D nets. Actors in a net an organizational entity are interdependent on others’ performances, therefore they formulate an expectation of the behavior and performance of others based on their position and capabilities in the network. Managing in R&D net though roles opens new perspective for the managers. By defining roles for each actor in an R&D net in co-operation, the expectation would be communicated directly, thus conflicts or misunderstandings would be avoided and the ability to meet goals of net could be increased. Managing in R&D networks is not dependent on the actors’ positions (central or peripheral, between networks) rather based on the actions performed and resources possessed. The managers could influence in net by acting towards desired, reaction(s) to other manager’s action. This action is perceived by other organizations as acting in a role. When becoming aware of varying managerial roles, managers could help their managing by planning their organizational roles in the R&D net. In addition, an ability to identify occupied and unoccupied roles in the net, could benefit manager to optimize its resource utilization or begin attracting additional, or even missing resources to the R&D net.

However, the understanding of the roles has to be renewed according to empirical results of roles for managing. Firstly, managers could benefit of being able to acknowledge roles for managing in R&D net that are perceived generic i.e. webber, gatekeeper/ compromiser, advocate roles. The ability to identify generic roles for managing in an R&D nets could be seen as a starting point and an early gateway to a deeper understanding.

Managers could benefit for understanding that that roles for managing change in net, that the constant awareness and analysis of actors performing action in roles is required. The evaluation of roles needs to be a continuous process during the different phases of network development, and thus they are constantly changing. The whole timeframe and all the development paths could be taken into
consideration while managing R&D net. As roles are not static and they may change over the different phases of the evolution of a network. While being able to identify key roles in early co-operation, an actor can behave in order to assure others of its compatibility and ensure its access to the co-operation network. With a better understanding of roles, an actor can also improve its abilities to comprehend roles and relationships in a focal net and the embeddedness of focal net and the surrounding network it is embedded in.

For gaining such understanding managers can use FRM. Managers could gain improved understanding with the framework roles for managing of the temporal dynamics of the networks. The roles are easier to identify by evaluating them according to the dimensions of managerial roles. One useful approach is to review the level of actions. Do the actions of the role influence the development of the task, the R&D net, or the surrounding network i.e. cluster, industry, business field? If so, attempts should be made to perceive the change that is caused by acting in roles from one angle or another. Is the perceived change expected or emergent and will it be perceived to have a radical or incremental influence on the network relationships?

The understanding the difference of emergent and expected roles could benefit managers. For example, this study notes that actors may seem to act in emergent roles like entrants, auxiliaries or facilitators that contribution is perceived even surprising in the R&D net. By understanding the emergent nature of roles the managers may anticipate or cope better with action of others actors and thus help gaining individual or shared goals.

Manager can benefit acknowledging that transformation from formation to collaboration change roles for managing in R&D net. Actor contributions can increase e.g., a platform technology provider that may experience an increased desire to manage in the net or non-profit actors, such as universities are withdrawn when facing commercialization, thus being not interested in incubation. Managers benefit from noting that new capabilities are required, leading to new actor roles or new actors joining the network.

The fit for the environment becomes easier if the manager in R&D net understands technologies of the developed offering (product and or service), its business networks and the chosen business model for market launch by the actor or network actors in joint offering. The organizations require then wide array of exposure networks developing net product or production technologies and new business model. This exposure is often achieved and could be possessed by the persons that acting in net level roles (webber, instigator, gatekeeper, advocate) or
network level roles (Facilitator) or in traditional R&D organizational roles (sponsors, gatekeepers and champions) The appreciation of the exposure could be seen as potential for the future asset generation and potential for the emerging business ideas. The managers in such roles could be professionally developed to identify and harvest from various networks they are embedded.

Managers could also benefit for understanding the importance of participation in R&D net events: e.g., meetings, steering groups, workshops, seminars or other networking events. It is hard to identify beforehand which occasion is the critical one for the future of the collaboration in R&D net. Being absent in critical events (meetings, planning workshops) may lead to that during another phase of R&D net actor is excluded. One could see useful to note that the process of collaboration provides benefits, such as the ability to learn during the process of networking itself. If the network ceases to exist or fails to deliver the promised value, learning and exposure to the group of people and their expertise may be the only value provided by the networking.

### 3.4 Methodological contribution

This study also provides methodological contribution. The longitudinal research approach used in this study enables analyzing dynamics in managing in R&D net. Longitudinal data enables addressing how process unfurls over time (Langley et al., 2013, 6). Understanding of temporality is required in order to understand the dynamics of process in relation to the interdependent effect of context and action and the relationship between the past, present, and future, as well as the relationship between contexts at different levels (Pettigrew 1990).

The utilization of longitudinal methods in empirical research was already seen by the early INA researchers (Halinen & Törnroos, 1995) as an enabler to sound theoretical perspectives and improved understanding. This study contributes to progressive follow-up studies (Halinen & Törnroos, 1995) and flow mapping (Halinen, Medlin, & Törnroos, 2012). It supports that the longitudinal follow-up studies are purposeful and useful method for understanding and analyzing R&D nets during net formation and collaboration. The ability to follow the actions of actors, events and development in real-time within the net enables understanding action-based roles that consists of action, reactions and re-reactions, and the perception of other actors.

This study has benefits that derive from its time-frame compared to existing research on managing in strategic nets (Gulati et al., 2000; Möller et al., 2005;
Ritter et al., 2004) and studies focusing specially to the early stages of net development (Doz, Olk, & Ring, 1999; Doz et al., 2000; Partanen & Möller, 2012; Ring et al., 2005) Typically, the studies in the field is based on historical data (see, e.g., Oliver & Ebers, 1998; Ozman, 2009; Pittaway, 2004). In this study, it was possible to study management in a R&D net throughout the whole of its development process from network formation, to collaboration until the offering ready to launch to markets.

The extensive time and resource demand (Halinen & Törnroos, 1995) is seen as a drawback for processual research. The offering development period in this study, from net formation to the collaboration of R&D net, lasted for a relatively short period, and therefore researchers’ investment in relationships in monetary or personal and professional time terms were seen as understandable. The R&D net development cycle, from initial formation, takes months, and therefore close progressive follow-up studies may be considered time-consuming, overwhelmingly laborious, or inefficient in terms of a researcher’s career. The ability to contribute to task-level development activities and participate in key network decision-making as an observer has a positive influence on the abilities to gain acceptance among actors. The ability to contribute with development activities within the R&D is noted to help also trust generation. This trust is required during the various phases of empirical research. The actors that researcher were collaborating are also representatives of the research object. As they trust the researcher from collaboration and operational development activities, they feel less uncomfortable while being interviewed, observed in meetings. As in this study in addition to the follow-up study methodology, were utilizing the historical data, archival material, and correspondence. The generated trust is also required in order to ensure that the actors feel comfortable to granting access to archival material, or their email correspondence.

3.5 Limitations

This section provides a description of the limitations of this study. The limitations of this study are derived from the perspective of the empirical phase I part as well as Phase II – the contemporary literature review of this study. The limitations of that are related to the empirical results of this study are related to context specific of a case study, process research approach and follow-up timeframe.

The limitations of the empirical results of this study in Phase I relate to the context specificity of the empirical phase of this study. The empirical case is a
single case study on R&D net that developed new mobile services. Therefore, the activities the network is performing, the actors it consists of and the capabilities it possesses are related to the network. The R&D network in the case study consisted of different actors and enabled us to detect varying roles during net formation and collaboration. The empirical results of this study are context-specific in R&D net; however, researchers (see, e.g., Gottfridsson, 2014; Johnson, 2008; Nyström et al., 2014) have been able to find similar findings to those identified, e.g. similar roles in varying contexts, as well as assumed generic roles in the contexts.

Process research in general terms has some limitations by its nature. As Pettigrew identified (Pettigrew 1997), process research focuses on the dynamics of the quality of organizational life, and a drawback emerges in its inability to see the wider terrain of the case study under focus. In this study, the ability to understand great detail of the dynamics of the research object were seen to overcome this limiting factor of seeing the wired network perspective. By choosing single case study in this study enabled utilizing follow-up approach for data gathering. Follow-up nature enabled data gathering and analysis of the network development process and dynamics of roles for managing during the formation and collaboration phases of development. During the research design the unit of analysis was chosen to net level and as research object were chosen a R&D net with follow-up research method were seen to provide sufficient level of detail of data. In addition to follow-up also archival material and participant observations were used that enabled improved abilities to relate great detailed findings from follow-up research to its wider context.

One specific limitation of this study is related to the selected timeframe. Pettigrew (1990) notes that the challenge related to longitudinal research is the ability to identify the beginning and end of a change process in context, rather than focusing simply on one episode of change or a project. In this study, the timeframe must be considered individually by phases of research. The timeframe of the empirical phase I considers the development phases of the entire R&D net, from formation and collaboration. The empirical time frame could have been extended beyond the launch of the product to the markets in order to be able to identify the extent of adoption of the offering, or to identify the success or failure of the results of the development process and the changes among the net of actors.

Phase II of this study consists of a contemporary literature review, which comprises of a systematic literature review on current knowledge (years from 2004 to 2014) of managing in R&D net. This has a number of identifiable limitations. As a systematic database review, it includes articles from specific scientific databases.
If essential research reports or academic journal publications exist that are not available in those databases, then they are missing from this review. The review conducted in Phase II consists of only peer-reviewed articles, published in journals in the English language. Therefore, publications in other formats, e.g., conference proceedings, books, white papers or theses, or items published in other languages, are missing. Using other review method could also provide interesting insights. With citation analysis most influential R&D network studies could be identified and with correlation analysis could provide for example relationships between network studies, network management studies, new service or product development studies.

The following section provides insights for future researchers to extend the understanding and knowledge base of managing in R&D net.

### 3.6 Future research venues

The following section opens discussion for future researchers.

In general, the theme of network management and modes of network mechanisms has been approached from various theoretical approaches. The domain of network management research has become scattered and it requires clarification. Network management research is based on a variety of theoretical disciplines and backgrounds. Social network-based strategic network studies seek to optimize the number of network ties, the number of redundant ties, and tie strengths with network effectiveness or other structural characteristics with deterministic ontologies. INA research provides more voluntaristic ontologies, to the extent that it is perceived network management to be impossible and for it to be undesirable. In between these extremes, where one finds strategic business nets or strategic value-creating network researchers (Järvensivu & Möller, 2009; Möller et al., 2005; Möller & Rajala, 2007) and orchestrating innovation network approaches (Dhanaraj & Parkhe, 2006; Gausdal & Nilsen, 2011; Klerkx & Aarts, 2013; Prince et al., 2014), for example, approaches exist that accept the idea of networks being manageable. Network management approaches are becoming fragmented and each approach reviews the research phenomena of management activities from their specific viewpoints, and with basic assumptions of ontology, epistemology, and methodologies. A review of the theoretical roots and their implications, such as those conducted on business network research (Möller & Halinen, 2000; Möller et al., 2009; Möller, 2013), and the continuation of meta-theoretical studies, like (Järvensivu & Möller, 2009), would enable us to identify implicit and explicit
assumptions of the research approaches, and improve the positioning of the basic theoretical approach in order to gain more focused research in the future. Innovation network orchestration approach (Ritala et al., 2012, 405) see that Managing in net is not suitable for initiation phase of R&D net management. The Empirical results used in this study see it is fruitful for managing in R&D net. Both Ritala et al. (2012) and this study have a justified reasoning to depict the managerial actions with the chosen terms, however metatheoretical analysis could increase the understanding and justify why studies with chosen theoretical background, ontologies an epistemologies end-up potentially controversial findings.

Managing in R&D net structures and speeds up the R&D net formation and collaboration process. Findings from different contexts, such as supply, sales, and distribution networks, and empirically justified or measured comparison data would be welcome and would provide extended insights into the findings of this study or provide justification for the findings. The empirical results of this study notes that research on nets that develop offerings and commercialize should be separated, thus actors differ by their nature. The effect of a net’s structural change from an offering development net network and commercializing net aspect would be interesting to justify empirically. The emerging business nets approach provides a plethora of interesting concepts for creating variables for innovation performance and profitability performance for such research.

Actor-based characteristics of managing in R&D net suggest that roles can be utilized to characterize the network relationship structures as well as management expectations. In this study, roles for managing have been identified with duality in their nature, thus the roles appear to be context-specific and also seen generic. (Järvensivu & Möller, 2009). Research both roles for managing in specific context are required in addition to generic roles.

Firstly, more focus is needed to studies providing rich descriptions of roles for managing. Contemporary literature note (see, e.g., Story et al., 2011), the need for research on specific roles e.g. role of funder, facilitator, prototyper, designer, and tour guide is required. More research on the varying contexts of actors acting in roles could be useful. Noted roles for managing in R&D net and their influence on R&D net development and innovation success would be appreciated in future research. Managerial role studies have not been extensively approached in the explorative research setting in relation to network or innovation success. Some studies have explored the influence of certain defined roles (Rampersad et al., 2010a), and organizational innovation role studies (see, e.g., Gemünden et al., 2007; Rese, Gemunden, & Baier, 2013) on innovation success, but there is a need for
research that would provide more understanding on efficiency in relation to network success or innovativeness. Rampersad et al. (2010a) have explored the influence of roles for managing on innovation success using Australian data, but they found no correlation between roles for managing in R&D net and innovation success. The empirical justification of the relation of innovativeness, innovation success and influence on the managing in a R&D net would require additional research.

Secondly, more research of generic roles for managing is required. This study is see similarly with the managing in net studies (e.g., Järvensivu & Möller 2009, Knight & Harland 2005, Nyström et al. 2014), and innovation network studies (see, e.g., Howells, 2006) that see a certain generality of roles is identifiable, to the extent that general or meta roles in nets can be identified. Based on the context-specific nature of the new service network in the papers, it is argued that similar analysis could be conducted in other types of R&D net contexts. However, some identified roles, e.g. webber, advocate, and compromiser, were highlighted as generic roles in a net. Especially focus on the advocate role in R&D nets is needed. In general, more research on generic roles, their descriptions, their transformation, and the influence at the net, network or task level, would be appreciated. Also, research on the generic roles in managing in nets in different context or regions could interesting results.

In addition, studies that include explicit utilization of role theory in combination of managing in R&D net literature is appreciated. The focus of future studies could be on the systematic analysis of FRM. It could provide analytical help for evaluating varying roles. Currently, theoretical discussion of roles for managing in derived from hub-actor-based formation processes, i.e engineered formation process studies (Ring et al., 2005), with focus on triggering entity roles and strategic network studies (Partanen & Möller, 2012), orchestration studies (Prince et al., 2014), or intermediation and brokering roles. (Howells, 2006) The network webber in this study was seen as “neutral”, because it was a governmental organization perceived to be acting towards goals of the net. Also, studies that describe and discuss roles within network using non-central actor-led approaches would extend understanding.

Research on roles for managing during commercialization net is scarce. Framework of roles for managing could be a useful tool for conceptualizing roles during the formation phase. Also roles for managing in commercialization of networks would provide interesting insights for future academics. The empirical results of this study point out specific roles (webber, advocate, instigator, gatekeeper, planner, producer, and entrant) that can be associated to exist also
during the commercialization phase of R&D net. More research from varying contexts, e.g., living labs, application nets and open innovation networks, and, would enrich the understanding.

The research of managing in R&D net is mainly conducted among network development processes that have continued until the planned successful conclusion. There are studies (e.g., Lavie et al., 2007) that identify that the benefits of managing in net is also achievable from unsuccessful collaboration. More research on failed experiences in managing R&D net, failures in managing in R&D net or in general approaching failed or unsuccessful co-operation would also be interesting. The unsuccessful or failing R&D net could be defined via inability to form a collaborative R&D net however noted shared interests or interdependencies among actors, R&D net dissolution during collaboration, interruption or discontinuation of development activities or inability to achieve stated goals of the net. Managing in an unsuccessful R&D net would provide interesting insights into managing in R&D net. In addition, research could be focused on describing roles and processes in the management of unsuccessful R&D nets. The role framework could be developed based on experience from networks that have resulted in failure.

More knowledge of R&D net formation processes is needed. The early phases of R&D net formation influence on all latter phases of R&D net development as noted on this study. Understanding early phases of development of R&D net could enhance understanding managing in R&D net. There is a growing number of R&D net formation studies (Partanen & Möller, 2012), that are managed by active central actors, that are mandated or economically motivated to act as central actor. (Prince et al., 2014; Provan & Kenis, 2008). However, the formation may be conducted using different paths than lead by central actors (Ring, Doz, & Olk, 2005).

Networks, nets and managing in nets and networks will most certainly continue to interest research communities also in the future. To shake off the accepted views or to create new theoretical models and tools of for managing in or managed R&D networks, more multidisciplinary meta-theoretical research is required.
4 Bibliography


## Appendix

### Table 14. Appendix 1. How is managing in R&D net conducted as a managerial process-analysis sheet.

<table>
<thead>
<tr>
<th>R&amp;D network management literature 2004–2014</th>
<th>Source</th>
<th>Similar findings</th>
<th>Controversy</th>
<th>Beyond scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D network formation can be managed as process of emergent, engineered or embedded network formation. Engineered process is based on triggering entity combining actors. Embedded process is based on existing strategic relations or strong social relations among actors. Embedded process is based on over time converging mutual interests of actors.</td>
<td>Ring et al. 2005</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Develop awareness of environmental interdependence, discover converging interests, Trigger collaboration, selecting partners, searching for consensus on vision, mission, Goals, Values; Defining expectations of continuity, Design formal structure and Broaden and deepen cooperation</td>
<td>Ring et al. 2005</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building of strategic hub-driven network should consists of parallel, not necessary simultaneous activity-based sub-processes. Step-by step stage wise mode would even be harmful.</td>
<td>Partanen &amp; Möller 2012</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network development is not following phase model. Formation of R&amp;D network is overlapping and iterative nature of formation sub-processes.</td>
<td>Partanen &amp; Möller 2012</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding the process of network formation, offering development and fit to surrounding value networks</td>
<td>Partanen &amp; Möller 2012</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic choice of partners depending on capabilities or resources they are lacking. Can be conducted with close customers and key suppliers, not in specific R&amp;D network. Developing skills to bear Uncertainty, develop multiple relationships</td>
<td>Partanen &amp; Möller 2012</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-understanding &quot;Network formation is sequential stage-wise process“. Actually, contains parallel, not necessary simultaneous sub-processes: 1. Analyze internal target activities, 2. to be delegated activities</td>
<td>Partanen &amp; Möller 2012</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of inter-firm relationship is overlapping and iterative sequence of stages: gathering information, negotiation, commitment and execution.</td>
<td>Partanen &amp; Möller 2012</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity-value analysis, partner selection and negotiations are not linked to each other and can be handled independently, advisable is value activities are not interdependent. Used when complimentary value elements and when easy to integrate to overall offering.</td>
<td>Partanen &amp; Möller 2012</td>
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<tr>
<td>In Emerging markets, it is unlikely that hub can evaluate all parties simultaneously, organize joint negotiations and partner simultaneously and set up co-launch for interfim collaboration. Instead use relative priorities with required partners by examining potential interconnectness of activities in the VCS.</td>
<td>Partanen &amp; Möller 2012</td>
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<tr>
<td>Identify characteristics of R&amp;D network management: perception of duration, primary reward, fundamental meaning, and nature of network organization, planning, control, trust, hierarchy, authority and coordination.</td>
<td>Ojasalo 2008</td>
<td></td>
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<tr>
<td>Contingency for actor relations strength and innovation success. Tight relation with existing beneficial (Cliques) when innovation incremental and with disruptive innovation more boundary spanning required.</td>
<td>Baum et al. 2010</td>
<td>1</td>
<td></td>
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<tr>
<td>Define industry architecture: as division of labor, roles of different types of firms and their interdependencies.</td>
<td>Ozcan &amp; Eisenhardt 2009</td>
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<tr>
<td>Clarifies roles of actors and mobilizes action and provides blueprint that structure and motivates interaction among others.</td>
<td>Ozcan &amp; Eisenhardt 2009</td>
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<tr>
<td>Coordinate unconnected partners or “prospect ties”, extends portfolio to distant part of industry networks, enables long jumps within industry</td>
<td>Ozcan &amp; Eisenhardt 2009</td>
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<td></td>
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<tr>
<td>Create multiple ties around critical industry uncertainties: Ensure positions with multiple solution, increases likelihood to receive multiple indications of information, risk of wrong partner locking in ties</td>
<td>Ozcan &amp; Eisenhardt 2009</td>
<td>1</td>
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<tr>
<td>Negotiation training to articulate opinion, ensure equality.</td>
<td>Rampersad et al. 2010</td>
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<tr>
<td>Key factors leading to effective management of innovation network. Power distribution, trust, coordination and harmony have significant impact on achieving network outcomes.</td>
<td>Rampersad et al. 2010</td>
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<tr>
<td>Sense making and Development agenda creation are key capabilities in successful new business field management</td>
<td>Möller 2010</td>
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</table>
Service innovation network management involve multiple actors with diverse set of organizational cultures, values and individual backgrounds, therefore firms should create specific strategies and managerial tools and techniques to manage interactions and direction within the network to accrue preferred outcomes. The requires understanding of determinants of success of service innovation networks.

Actor can choose when to lead and when to be led by Ford & Mouzas 2008

Network mobilizing: ability to create strong position in the field in order to be able to mobilize others. Ability to provide specific resources and knowledge in order to appear attractive actor, ability to select partners. Ability to organization wide network-player orientation, ability to create organization forum for sharing work and responsibilities between actors, ability to create coordination mechanism for the net cooperation Möller et al. 2005

R&D network management requires knowledge management, especially mastering joint knowledge creation and ability to create learning environment that empower explication, tacit knowledge utilization and help new knowledge sharing. Möller et al. 2005

Network orchestrating ability to influence whole new business network. Ability to envisage emerging business fields its key actors and potential trajectories, Ability to participate various parts of net in order to gain sense making, Ability to develop agenda for influencing field to move preferred direction, Ability to agenda setting involves communicating beliefs, visions where development is heading. Möller et al. 2005

Innovation networks: Relatively loose scientific or technology based multi-actor research networks. Mainly professional networks, but not business networks, guided by ethos of scientific discovery. Cannot managed by single actor (company or institution), Open source or open innovation communes present this type of non-economic motivated organizations. Managerial challenge is sense making and identification of ideas. Exposure in these types of networks essential for understanding new emerging business areas. Möller & Rajala 2007
Dominant design network management: Target orientated mobilization of coalition or net aiming to establish dominant technological design to emerging business field. Requires setting and mobilization of development agenda and coordinating network activities. Ability to set agendas: AGENDA Setting: influence sense making and selection process of other actors and guide lock in investment. Necessary for mobilizing other actors. AGENDA CONSTRUCTION: Idea is to reduce uncertainty and ambiguity in radical emergence. Enables ability to influence relevant actor’s sense making process and the way they frame and interpret emerging business. Mobilization: ability to provide solution design and roadmap of technology development. Management: Technological development work managed with explicit goals and timetables with several interrelated multifactor projects. Enables resource and competence pooling and regress mutual understanding on involved expertise as well as abilities for joint learning and reciprocal problem-solving and Strategic management of the network, establishing formal organization where actors are represented, development carried through working groups aiming to arrive at shared unidirectional decisions.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Source</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>Creating an organizational forum is required as coordination of co-operation and division of workload</td>
<td>Möller &amp; Rajala 2007</td>
<td>1</td>
</tr>
<tr>
<td>Strategy matrix for innovation creation in Supplier-Buyer relationship: Buyer driven, Supplier driven or co-operation</td>
<td>Möller 2006</td>
<td>1</td>
</tr>
<tr>
<td>Activity: Perceiving and interpreting emerging ideas and concepts. As capability influenced by firms exposure to new ideas, being function of firms relationships. Variety of strong and weak ties requrired. Position between networks have better sense making potential.</td>
<td>Möller &amp; Svahn 2009</td>
<td>1</td>
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<tr>
<td>Prioritizing, choosing and legitimizing a concept for application development, Conscious lock-in effect</td>
<td>Möller &amp; Svahn 2009</td>
<td>1</td>
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<tr>
<td>Agenda Setting: Creating and communicating agenda for the application development network. Influence beliefs, thinking, desired objects (Technology providers, process and manufacturing partners, marketing and channel companies, pilot customers, financiers, institutional agencies)</td>
<td>Möller &amp; Svahn 2009</td>
<td>1</td>
</tr>
<tr>
<td>Net mobilisation: Creation of a net of actors that can develop a competitive application for commercial use: coordinate development work and ensure strong value appropriation position</td>
<td>Möller &amp; Svahn 2009</td>
<td>1</td>
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<tr>
<td>Demand-supply net mobilisation: creation of efficient net of actors ensuring production and distribution capacity for the offering</td>
<td>Möller &amp; Svahn 2009</td>
<td>1</td>
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<tr>
<td>Net management: Development and coordination of an efficient demand-supply net from competing market share</td>
<td>Möller &amp; Svahn 2009</td>
<td>1</td>
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<tr>
<td>Conflicts are inevitable thus they are caused by multiple partners conflicting interests. Conflicts are dealt in NPD network with continuous formulation of strategies, renegotiation and adjustment. Partners do not need uniform strategy rather willingness to accompany each other’s on an overall joint goal. Companies may utilize relationships as temporary devices for developing their own strategic intentions. Utilizing relationships and following lead of others may create positions to lead.</td>
<td>Munskgaard et al 2012</td>
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<tr>
<td>Formulation of strategies in R&amp;D network needs to be continuous process.</td>
<td>Munskgaard et al 2012</td>
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<tr>
<td>Creating new networks requires two distinctive activities finding right partners and forming relationships with those ones.</td>
<td>Birkingshaw et al. (2007)</td>
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<tr>
<td>Managing in network changes over time</td>
<td>Klerkx and Arts 2013</td>
<td>1</td>
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<tr>
<td>Managing in network changes over time: mechanism change over phases</td>
<td>Ritala 2012</td>
<td>1</td>
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<tr>
<td>Managing in network: mode of governance changes over time</td>
<td>Provan &amp; Kenis 2006</td>
<td>1</td>
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<tr>
<td>Manage knowledge mobility, manage innovation appropriability, Manage network stability</td>
<td>Dhanaraj &amp; Parkhe 2006</td>
<td>1</td>
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<tr>
<td>Competences for radical innovation (Discovery, Incubation, acceleration and commercialization) mobilized through interaction with network of relationships beyond firm, or even beyond supply chain</td>
<td>Story et al. 2009</td>
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<tr>
<td>Network management changes over time during phases of service innovation, Governance mechanism changes</td>
<td>de Reuver &amp; Bowman 2012</td>
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<tr>
<td>Phase of mobile service innovation explain the choice of governance mechanism to significant extent.</td>
<td>de Reuver &amp; Bowman 2012</td>
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<tr>
<td>Function of innovation brokering: Demand articulation, network composition and innovation process management. Demand articulation is analysing and diagnosing latent or explicit problems and articulating needs. Network compositioning, refresh making external relations available i.e. scanning, scoping, filtering and matchmaking resources such as knowledge, funds and materials. Innovation process management refers enhancing communication, learning or other interaction, aligning partners, facilitating IPR attribution and commercializing innovation outcomes.</td>
<td>Batterink et al. 2010; Klerkx &amp; Arts 2013</td>
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<tr>
<td>Network process championing is required for bridging and brokering relationships within networks. Intermediation can be side-activity or by product of technology or R&amp;D competence or core-identity of and organization.</td>
<td>Klerkx &amp; Arts 2013</td>
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<tr>
<td>Challenges may arise if the different broker champions are not perceived. Role of broker may be derived from natural the structural position of actor or actor may position themselves in broker position due service orientation or mandate i.e. NAO.</td>
<td>Klerkx &amp; Arts 2013</td>
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</tbody>
</table>
In management of R&D networks should be learned from Strategic community research. Actors should exhibit also creative leadership, based on autonomous de-centralized leadership that can enhance creative thinking and behavior among network members. In addition, management should exhibit collaborative leadership and non-forceful leadership, become listeners, recipients and collaborators within network.

Commercialization as distinctive competence
Identify and motivate relevant actors for commercialization, with varying abilities to contribute. Actors both commercial and non-commercial, with knowledge, relations another resource have impact on commercial success.

Table 15. Appendix 1: How is managing in R&D net conducted via roles-analysis sheet.

<table>
<thead>
<tr>
<th>Key findings</th>
<th>Source</th>
<th>Similar findings</th>
<th>Controversial findings</th>
<th>Beyond scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D network formation can be managed as process of emergent, engineered or embedded network formation. Engineered process is based on triggering entity combining actors. Role of champion is critical in implementing eHealth service application roll-out on strategic, tactical and operational level. From management perspective local network organization is necessary for support and finding long term continuity. Leading companies in NPD networks (Broker, hub, and facilitator) may have positive or negative impact on the joint development effort in the network. When strategic intentions of multiple parties are complementary and a larger influential company initiates the joint effect, changes may be attained. Also, absence of lead company may cause no change at all, thus it is not only question of dominance and power. Ability to create combined and complementary strategic intentions is the key issue.</td>
<td>Ring et al. 2005</td>
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<tr>
<td>Role of champion is critical in implementing eHealth service application roll-out on strategic, tactical and operational level. From management perspective local network organization is necessary for support and finding long term continuity.</td>
<td>Joseph et al. 2011</td>
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<td>Leading companies in NPD networks (Broker, hub, and facilitator) may have positive or negative impact on the joint development effort in the network. When strategic intentions of multiple parties are complementary and a larger influential company initiates the joint effect, changes may be attained. Also, absence of lead company may cause no change at all, thus it is not only question of dominance and power. Ability to create combined and complementary strategic intentions is the key issue.</td>
<td>Munskgaard et al. 2012</td>
<td>1</td>
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</tbody>
</table>
Intermediation relationship and technologies in networks

Howells 2006

In Emerging markets, it is unlikely that hub can evaluate all parties simultaneously, organize joint negotiations and partner simultaneously and set up co-launch for interfirm collaboration. Instead use relative priorities with required partners by examining potential interconnectness of activities in the VCS.

Partanen & Möller 2012

Creating an organizational forum is required as coordination of co-operation and division of workload

In radical innovation role performance acknowledged.

Role performance can last short period of time

Actors with short lived focus on specific capabilities, to ensure that they are needed next time

Where actor perform multiple roles need to ensure adaptability and avoid single-role single-performance associations. When performance delivers network oriented role, development and honing networking capabilities must be in priority

Möller & Rajala 2007

For the development driving actors: be aware that there are multiple actors who can bring nuance and interactive additionalities to development.

Story et al 2011

Role scripts are not clear nor static. They appear emergent, with actors not necessary know the role thy might be expected to perform

Story et al 2011

Actors can manage in R&D network by role ambidexterity, i.e. role taking and role making

Nystöm et al. 2014

Actor can manage in network by role taking and role making i.e. Actors role lead to position and vice versa, position leads to certain role

Nystöm et al. 2014

Actors’ roles change with adaptations to network change.

Nystöm et al. 2014

Actors can increase their understanding of R&D net by identifying each actor’s roles in network and revealing its role-sets.

Nystöm et al. 2014

Actors should review its roles and position in network and review the fit of the goals to the goals of network. If they correspond, companies are in "right roles”. If discrepancy company should seek new roles or transform its current roles to align with the strategy and goals of both network and itself.

Nystöm et al. 2014
Hub-firm can act as Innovation integrator, that defines the basic architecture of innovation and invites then network members to design and develop the different components. Hub integrates different components to build the core-innovation and then markets it.

Hub firm can act as Platform leader, an actor that defines and offers basic innovation architecture, that then becomes the foundation or platform for the network members to build through their own complimentary innovations.

Hub firms perform innovation network management processes such as managing innovation leverage, coherence and appropriability.

Leading companies in NPD networks (Broker, hub, and facilitator) may have positive or negative impact on the joint development effort in the network. When strategic intentions of multiple parties are complementary and a larger influential company initiates the joint effect, changes may be attained. Also absence of lead company may cause no change at all, thus it is not only question of dominance and power. Ability to create combined and complementary strategic intentions is the key issue.

There are several champions in innovation network. Technology champion starts the innovation process, power champion creates support followed by gatekeeper that approves or dismiss project network. Roles are unified to one person (Champion) or actors may change their role and position, thus function overlaps between different champions may create confusion due role divisioning.

Network process championing is required for bridging and brokering relationships within networks. Intermediation can be side-activity or by product of technology or R&D competence or core-identity of and organization.

Challenges may arise if the different broker champions are not perceived. Role of broker may be derived from natural the structural position of actor or actor may position themselves in broker position due service orientation or mandate i.e. NAO.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Author(s)</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Hub-firm can act as Innovation integrator, that defines the basic...</td>
<td>Nambisan &amp; Sawhney</td>
<td>2011</td>
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<tr>
<td>Hub firm can act as Platform leader, an actor that defines and offers...</td>
<td>Nambisan &amp; Sawhney</td>
<td>2011</td>
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<tr>
<td>Hub firms perform innovation network management processes such as...</td>
<td>Nambisan &amp; Sawhney</td>
<td>2011</td>
</tr>
<tr>
<td>Leading companies in NPD networks (Broker, hub, and facilitator) may...</td>
<td>Munskgaard et al 2012</td>
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<tr>
<td>There are several champions in innovation network. Technology champion...</td>
<td>Klerkx &amp; Arts 2013</td>
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<tr>
<td>Network process championing is required for bridging and brokering...</td>
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<tr>
<td>Challenges may arise if the different broker champions are not...</td>
<td>Klerkx &amp; Arts 2013</td>
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</table>
Research studying service systems (involved actors, their activities and roles) may want to use role theory. Role rhetoric framework may be greatly helpful in understanding functioning of service systems.

Supporting actor: informal role of actor that directly or indirectly supports network. Ensures dialogue of ideas with actors. Similarity noted with with webber, facilitator, advocate and accessory provider roles

Innovation roles have positive influence on innovation success. Identifier technology and market related relationship prompter share qualities

Innovation roles are defined too narrowly to depict the position on company hierarchy.


<table>
<thead>
<tr>
<th>R&amp;D Network management literature 2004–2014</th>
<th>Source</th>
<th>Similar findings</th>
<th>Controversial findings</th>
<th>Beyond scope</th>
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</thead>
<tbody>
<tr>
<td>Key findings</td>
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<tr>
<td>Lower R&amp;D cost, Improved innovation performance via knowledge transfer, reduced time to market</td>
<td>Gilsing et al 2007</td>
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<tr>
<td>In general, relationships are not only asset in generating change in network, in addition effective mobilization is critical to success in initiating changes.</td>
<td>Mouzas &amp; Naude 2007</td>
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<td>Increased flexibility, innovation speed, abilities to adjust environmental changes and strategic opportunities</td>
<td>Dittrich &amp; Duysters 2007</td>
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<td>Access to essential complementary resources</td>
<td>Mustak 2014</td>
<td>1</td>
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<tr>
<td>Network management enhances positive influence and restrict the effect of negative influence in R&amp;D network. Network management enables network resource and knowledge complementariness facilitates commercialization and innovation diffusion.</td>
<td>Mustak 2014</td>
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<tr>
<td>Networking competence is correlating with innovation performance</td>
<td>Yen 2008</td>
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<tr>
<td>Not only shorten R&amp;D development time, reduce costs, but enable multiple actor involvement over organizational or functional boundaries.</td>
<td>Möller &amp; Rajala 2007</td>
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<tr>
<td>Ability to utilize specialized knowledge of other actors and expand knowledge base through collective learning</td>
<td>Möller &amp; Rajala 2007</td>
<td>1</td>
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<tr>
<td>Improves understanding as economic value potential of emerging business networks is realized in future. Ability to endure uncertainty and ambiguity related to value activities and other actors.</td>
<td>Möller &amp; Rajala 2007</td>
<td>1</td>
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<tr>
<td>Improves understanding as understanding of different types of specific types of emerging new business networks and their management. Via Business net framework new emerging business network can be managed.</td>
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<td>Network management influences offering transformation (from development to commercialization)</td>
<td>Ozcan &amp; Eisenhardt 2009</td>
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<tr>
<td>Network management enables offering development towards implementation</td>
<td>De Rond 2009</td>
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<tr>
<td>With R&amp;D network management innovation in industries with dis-integrated value chains or with external alliances, involving high level of transactional uncertainty and tacit knowledge exchange can be accomplished successfully.</td>
<td>Dhananjai &amp; Parkhe 2006</td>
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<tr>
<td>Dealing with parallel sub processes: Internal target activates and to-be delegated activities saves time</td>
<td>Partanen &amp; Möller 2012</td>
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<tr>
<td>Network management help to coordinate actors and help defining service development responsibilities.</td>
<td>Allard 2013</td>
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<tr>
<td>R&amp;D Network management increase ability to overcome the liability of newness and liability of smallness for small companies.</td>
<td>Partanen et al. 2014</td>
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<tr>
<td>R&amp;D network management have positive influence. Networking ability correlates with innovation performance.</td>
<td>Yen 2008</td>
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<tr>
<td>Ability to create that meet the future needs and ability to harvest latent value of network of actors not in the pay roll of company or not providing actively on-going services to company. E.g., P&amp;G Connect &amp; Develop Model</td>
<td>Birkingshaw et al. 2007</td>
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</tbody>
</table>
Managing in R&D network in co-operation with innovation brokers can help SME’s to overcome barriers of inexperience of networking, profit from knowledge and resources of other organizations. Innovation brokers can make large capital funding available for administering the subsidies. Innovation broker can establish new culture of openness for the SME and learning from the inter-organizational setting.

Network management (power-based governance) seen as prerequisite for network of small actor to proceed from formation to implementation phase of development.

Resource dependencies between actors and expectations of competencies possessed by actor may over the negative experiences in past relationships

Enable more effective resource and knowledge utilization

Leading companies in NPD networks may have positive or negative impact on the joint development effort in the network.

Networked development may lead to network extension at certain phase of development, that will lead to relationship dissolution in latter phases

Managing in R&D network enables actors to overcome phases of radical innovation development

Managing R&D network that enables absorptive capacity and enable stability correlate innovation alliance success at network level, Absorptive capacity enabling correlates with innovation success in firm level as well.

<table>
<thead>
<tr>
<th>Key findings</th>
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<th>Similar findings</th>
<th>Controversial findings</th>
<th>Beyond scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>New innovation management requires balancing internal and external orientation as well as focus on technical and commercial aspects.</td>
<td>Larocca, and Snehota 2014</td>
<td>1</td>
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<td>Innovation process is seen more challenging in network context</td>
<td>Bessant 2007</td>
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<tr>
<td>R&amp;D networks holds the potential to thrive and decline and ongoing challenge in managing them is to avoid declining.</td>
<td>Leven 2014</td>
<td></td>
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<tr>
<td>Network management need to overcome challenges related to building and leveraging innovation network. Firstly, finding the right partners to interact in network, forming collaborative partnership collaboration with prospective partners, performing effective and efficient innovation process in the emerging partnerships.</td>
<td>Leven 2014</td>
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<tr>
<td>There may be negative experiences that influence expectations of actor behavior in relationships.</td>
<td>Faems et. al. 2008</td>
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<td>Negative trust influence on required contract based governance.</td>
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<tr>
<td>Complex network structure and difference of actors</td>
<td>Gilsing et al. 2007; Möller et al 2007</td>
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<tr>
<td>Complexity: individual customer adoption, customer communities</td>
<td>Birkingshaw et al. 2007</td>
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<tr>
<td>Complexity: different nature of actors in triple helix context</td>
<td>Johnson 2008</td>
<td></td>
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<tr>
<td>Complexity due heterogeneous actors. Challenging misunderstandings and opportunistic behavior</td>
<td>Mustak 2014</td>
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<tr>
<td>Difficulties to transform from development to implementation and commercialization</td>
<td>Nikayin et al., 2013</td>
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<tr>
<td>Network actors can contribute only relatively short period of time,</td>
<td>Story et. al. 2009</td>
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<tr>
<td>R&amp;D networking arrangements can encompass short or long duration agreement to achieve desired results. The following development project might require different set of knowledge and skills thus a different set of networking partners</td>
<td>Millson &amp; Wilemon 2008</td>
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<tr>
<td>Network managers need to be able deal differences in corporate cultures and differences caused by ethnic, regional or country cultures.</td>
<td>Millson and Wilemon 2008</td>
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<tr>
<td>With managing innovation network internal coherency hub firm can cope increasing number of members and their diversifying activities. Managing internal coherency becomes also when significant changes among actors and technologies occur.</td>
<td>Nambisan &amp; Sawhney 2011</td>
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<tr>
<td>With managing innovation network external coherency hub firm can ensure that value of network output is meeting the requirements stated by external technological and market context</td>
<td>Nambisan &amp; Sawhney 2011</td>
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<td>Understanding network formation: may appear ad hoc nature, SME actors have seen limited in their capabilities and resources in in-house innovation activities that innovation brokers can support by identifying innovation needs, articulating knowledge demand, setting up relationships a managing interorganizational cooperation processes.</td>
<td>Biringshaw et al. 2007 Batterink et al. 2010</td>
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<td>Network management changes over time during phases of service innovation</td>
<td>De reuver &amp; Bouwman 2012</td>
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<tr>
<td>Managing in innovation networks require balancing between new relationships (openness) and existing relationships (closeness). Challenge is related to balancing between openness and closure of network i.e. balance between new and existing relationships, thus exploitation of weak ties vs. ensuring strong relationships.</td>
<td>Klerkx &amp; Arts 2013</td>
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<td>Managing in innovation networks require both formal and informal relationship management, thus combine both formal (hierarchy, contracts) and informal (trust) interaction mechanism are utilized in relationships management.</td>
<td>Klerkx and Arts 2013</td>
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<td>Innovation broker’s key task is to manage dynamic stability and creatively destruct the existing innovation network in order to maintain innovation coherency of the network.</td>
<td>Klerkx and Arts 2013</td>
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<td>Generic notion Network management is challenging due embeddness and reciprocity</td>
<td>Möller et al. 2005, Möller &amp; Rajala 2007</td>
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<tr>
<td>Network actors can mobilize and coordinate value activities of other actors: Networking demands partnering orientations and personnel who have strong interaction skills that are essential in multiactor networks. Ability to share privileged information and knowledge as well as be able to view value creating activates and changes in them.</td>
<td>Möller et al. 2005</td>
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<td>Ability to evaluate which nets provide optimal value for actor, which available net to enter, evaluate which emerging net to enter.</td>
<td>Möller 2005</td>
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<td>Challenges of understanding. Visioning ability to whole business field wide network development. Abilities to evaluate partners. Ability to create attractive agenda for the net. Ability to organize multilevel and multifunctional contacts, ability to involve several actors and support vie integrated information system.</td>
<td>Möller 2005</td>
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<td>Ability to identify and make sense of dispersed or inherently local nature technological or revolutionary business ideas.</td>
<td>Möller &amp; Rajala 2007</td>
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<td>Hub-actor as source of the change in the net</td>
<td>Möller &amp; Rajala 2007</td>
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<td>More adjustment and new solutions required, more critical joint knowledge creation becomes. Knowledge is embedded in people partly tacit and elicit and routines.</td>
<td>Möller &amp; Rajala 2007</td>
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<td>Actors should avoid being product centric and focus on complementing ready-made elements, thus focus should be on engagement of relationships and investment on relationship building. To secure innovation venture survival and foster innovation process focus should be on building network interdependencies.</td>
<td>Larocca &amp; Snehota 2014</td>
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<td>Underestimated resources invested on network management.</td>
<td>Larocca &amp; Snehota 2014</td>
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<td>Network recruiting may affect network management.</td>
<td>Dhanaraj &amp; Parkhe 2006</td>
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<td>Hub actors as source of change in network formation phase</td>
<td>Partanen &amp; Möller 2012</td>
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<td>Dealing with parallel sub processes: Internal target activities and to-be delegated activities requires resources and capabilities. If Hub do not match targeted value activities: Choose, develop or acquire necessary resources and capabilities or delegate to partner.</td>
<td>Partanen &amp; Möller 2012</td>
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<td>R&amp;D network can be perceived as project specific, hence short-term in duration or continuous</td>
<td>Ojasalo 2008</td>
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<td>Actor’s motivation to participate R&amp;D network can be non-profit related: Personal creative and artistic fulfillment, lifestyle desires, freedom, social networking</td>
<td>Ojasalo 2008</td>
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<td>Virtual organization poses challenges to managing R&amp;D network. Require explicit attention to informal contacting, require sophisticated management and communication tools.</td>
<td>Ojasalo 2008</td>
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<td>There are fundamental views of appropriate network management, other originations prefer controlled and structured management, and others prefer free management approach.</td>
<td>Ojasalo 2008</td>
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<td>Degree of freedom of planning, controlling and trust varies from controlled and structured management to freedom of actors.</td>
<td>Ojasalo 2008</td>
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<td>Coordination is partly explicit i.e. dominant actor define division of development activities. Coordination is implicit based on evolutionary coordination</td>
<td>Allard et al. 2013</td>
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<td>Problems estimating shared interests: overestimating interest, due close social relations, underestimating due issue having strategic importance, focus on organic growth, or M&amp;A, Collaboration not seen as 1st option. Is the formation process type correct for the R&amp;D process?</td>
<td>Ring et al 2005</td>
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<td>In open innovation world, internal competences are not sufficient. New knowledge required from radical innovation context, how relationships feed in to innovation process, for which actor providing which skills and roles. In case of absence of history, knowledge of firms and their key actors and requirement of intense collaboration without trust have been developed.</td>
<td>Story et al 2009</td>
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<td>Unwillingness of actors to engage change. Lack of communication, degree of mutual understanding and insights to others business</td>
<td>Munksgaard, et al. 2012</td>
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<td>Understanding interdependencies among actors, interdependencies of indirectly connected actors and industry related uncertainties</td>
<td>Ozcan &amp; Eisenhardt 2009</td>
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<td>Too extensive control lead to lowered innovation abilities and reduces efficiency</td>
<td>Ford 2003, Freytag 2005</td>
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<td>Too much control leads to reduction of benefits of R&amp;D networking</td>
<td>Ring et al., 2005, Ojasalo 2008</td>
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<td>Overly rigid control restricts innovation and too little control in network leads to chaos</td>
<td>Yoo 2012</td>
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<td>Network management should be applied in moderation</td>
<td>Rampersad et al. 2010</td>
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<td>Network holds potential to thrive or decline.</td>
<td>Leven 2014</td>
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<td>Challenge is to avoid declining</td>
<td>Ritala et. al. 2012</td>
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<td>Governance mechanism vary over time</td>
<td>De Reuver &amp; Bouwman 2012</td>
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<td>Challenges for R&amp;D network to evolve from development to implementation and commercialization, if joint interest not perceived sufficiently</td>
<td>Nikayin et al., 2013</td>
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<td>Network management evolves over time. Network evolution over phases challenges network management.</td>
<td>Nikayin et al., 2013</td>
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<td>Orchestrating networks aims to contribute specific network situations that hub firm does not possess authority to command network</td>
<td>Dhananaj &amp; Parkhe 2006</td>
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<td>Literature innovation network orchestration, “as set of deliberate and purposeful actions undertaken by hub firm as it seeks to create value and extract value from the network”.</td>
<td>Dhananaj &amp; Parkhe 2006</td>
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<td>Challenging in innovation network orchestration research field thus no hierarchical control is not achieved.</td>
<td>Prince et al 2014</td>
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<td>There exists evolution over time in network orchestration. Role of network process champions (broker) may vary according to nature of networks or its evolution</td>
<td>Klerkx and Arts 2013</td>
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<td>Role transitions are challenging in R&amp;D networks, thus initial position achieved through personal ties and social capital, late entrants achieve through organizational achievement</td>
<td>Nyström et al 2014</td>
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<td>Networks can be consciously orchestrated rather than managed in traditional sense. Orchestration deviates from management, but no empirical findings yet.</td>
<td>Hurmelinna-Laukkanen et al. 2012</td>
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Orchestrating networks aims to contribute specific network situations that network takes fuzzy or vague form like innovation communities.

Business model development of R&D network becomes challenging in emerging network, there is no focal central actor with vision of the network and according skills.

Challenges of innovation networks are conflict of interest and opportunism, education/learning in network, unforeseen gain to competitors, networks partners economic problems, defining responsibilities and roles, lack of coordination and Leadership, holding schedules, lack of written contracts, unreliable partners, ability to tackle owns errors and exaggerating skills and capabilities.

Challenge is to create a large enough network in order be innovative, in SME context

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<th>Challenge</th>
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<tr>
<td>Orchestrating networks aims to contribute specific network situations that network takes fuzzy or vague form like innovation communities.</td>
<td>Hurmelinna</td>
<td>2012</td>
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<td>Business model development of R&amp;D network becomes challenging in emerging network, there is no focal central actor with vision of the network and according skills.</td>
<td>Palo and Tähtinen</td>
<td>2014</td>
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<td>Ojasalo</td>
<td>2012</td>
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<td>Challenge is to create a large enough network in order be innovative, in SME context</td>
<td>Thorgren</td>
<td>2009</td>
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<td>Challenge is to create a large enough administrative board</td>
<td>Thorgren</td>
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</table>
PART II Original research papers

This thesis is based on the following publications, which are referred to throughout the text by their Roman numerals:


Reprinted with permission from World Scientific (I), RADMA (II), Elsevier (III), and Springer (IV).

Original publications are not included in the electronic version of the dissertation.
79. Keränen, Anne (2015) Business leaders’ narratives about responsibility in leadership work
80. Ruopsa, Leena (2016) Kerrottu identiteetti organisaationmuutoksen kontekstissa
82. Lehto, Irene (2016) Narratives of international opportunities in entrepreneurial selling
83. Nuutilainen, Rikka (2016) Essays on monetary policy in China
84. Ilvaniemi, Marika (2016) Exploring business models in ecosystemic contexts
85. Nadeem, Waqar (2016) Examining consumers’ acceptance of social commerce in clothing e-retail
86. Nykänen, Risto (2016) Emergence of an energy saving market: the rise of energy service companies
87. Wang, Fan (2016) From relational capital to venture capital: financing entrepreneurial international new ventures
88. Rantakari, Anniina (2016) Strategy as ‘dispositive’: essays on productive power and resistance in strategy-making
89. Henttu-Aho, Tiina (2016) The emerging practices of modern budgeting and the role of controller
90. Koivuranta, Mati (2017) Studies on macroeconomics and uncertainty
91. Myllykoski, Jenni (2017) Strategic change emerging in time
92. Conlin, Andrew (2017) Essays on personality traits and investor behavior
95. Haapanen, Lauri (2017) Firms’ resource allocation between R&D and marketing in their international expansion: a functional level analysis

Book orders:
Granum: Virtual book store
http://granum.uta.fi/granum/
Marko T. Heikkinen

MANAGING IN R&D NETS

ROLES, PROCESSES, BENEFITS AND CHALLENGES