Managing open innovation processes in large university-industry research programmes

– a case study from the Norwegian energy sector

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This master thesis has been quite a journey! The Master of Technology Management programme at NTNU has been both highly challenging and very rewarding at the same time. I do not think I knew what to expect when I started two years ago, but today I can truly say am very satisfied with that I started the journey, with everything it has given me (which is a lot), and now, finally, with ending this journey today. The final master thesis semester of the MTM programme has definitely been quite a race, and now I'm really looking forward to two things: To use what I have learnt through this thesis and, more importantly (at least with immediate effects), to have some time off without working either at work or with this theses. To my dear family and friends: I'm sorry for not being around the last six months, I'm coming for you all now!

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Abstract

Many companies struggle with developing innovations extending beyond their own knowledge base, and are therefore increasingly relying on external sources of knowledge, as universities or research institutes, for supplementing their innovation processes. One much used collaboration form for supporting this is the research programme, where several universities or research institutes cooperate with several industry companies for promoting technological development and innovation within a specific field of research.

Where several studies have investigated the interplay and processes within university-industry research programmes, few studies have addressed how the research manager can use the position specifically for promoting innovation and innovation processes. The aim of this study is to address this research gap of how research managers can promote innovation in large university-industry research programmes. This has been done following three axes of investigation: Firstly, by investigating how formal organisational structures supported by the research manager can promote a culture for innovation. Secondly, by investigating how relationships between partners influence innovation and how the research manager can affect this. And thirdly, by investigating how the research manager can promote innovation through taking on different leadership roles. The research was done through a case study consisting of six large university-industry research programmes from the Norwegian energy sector, based on a qualitative method using semi-structured interviews for data acquisition.

The findings in the study firstly suggest that formal organisational structures built for promoting innovation can serve as means for establishing a culture for innovation given continuous attention and focus from management to the topic over time. The effect of the implemented structures for promoting innovation are indirect, as lack of management focus highly increases the chances for failure of the initiative. Secondly, the findings suggest that engaged relationships between research programme partners can be promoted by high relational involvement and developed cooperation, and that this will contribute towards reducing the friction caused by opposing logics, and promoting innovation and innovative research. The research manager is in a key position to promote such relationships by taking on the role as a bridge builder between partners. Lastly, the findings suggest, as supported by the last statement, that the research manager stands in a pivotal position for promoting innovation in the research programme by taking on different leadership roles as, in addition to the bridge builder, the change maker or the team player leadership roles.

Seven propositions for emerging theory are given, and a new theoretical model is suggested. Implications of the study and future results are discussed.

Contents

List of abbreviations

CEER	Centre for Environment-friendly Energy Research
EC	European Commission
EI	Environmental Innovation
FME	Forskningssenter for Miljøvennlig Energi (Norwegian)
IP	Intellectual Property
IPR	Intellectual Property Rights
KM	Knowledge Management
KPI	Key Performance Indicator
NGO	Non-Governmental Organisation
PRO	Public Research Organisation
RCN	Research Council of Norway
R&D	Research and Development
RD&I	Research, Development and Innovation
RP	Research Programme
SFI	Senter for Forskningsdrevet Innovasjon (Norwegian)
TRL	Technology Readiness Level

1 Introduction

In a historical perspective, research and science have been pursued mainly for the sake of science itself, for expanding the borders of human understanding, and developing the specific scientific field further. For centuries, this was regarded as the mission of the universities and knowledge institutions around the world (Pirnay et al., 2003). Over the last century, however, research has increasingly been pursued rather for addressing specific societal challenges, as climate change or cancer treatment, than solely for pushing the limits of science further. This has been described as the transition from Mode 1 to Mode 2 knowledge production (Gibbons et al., 1994).

The transition of the universities towards also addressing societal challenges through their research has increased the relevance of cooperation between universities and companies aiming at promoting knowledge production and innovation. For long, research and innovation mainly happened within the borders of each company, and was considered a competitive advantage when adapted successfully (Porter, 2008). Innovation is, however, a challenging task (Katila & Ahuja, 2002) and many companies struggle to develop innovations that extend beyond their current knowledge base (Stuart & Podolny, 1996). Through interplay with external sources of knowledge, as universities or public research organisations (PROs), however, the innovative performance of companies has been showed to improve (Nieto & Santamaría, 2007; Fabrizio, 2009). As a consequence, knowledge acquisition and innovation increasingly relies on cooperation with external sources of knowledge through what has been called open innovation processes (Chesbrough, 2003; Chesbrough, 2004; Chesbrough, 2006). Such cooperation can take on several forms, as alliances, partnerships or research programmes (Youtie et al., 2006). The latter will be the focus in this study.

The research programme is a collaborative effort having partners from both industry and academia, pursuing long-term research, and which is co-funded by one or several external funding agencies (König et al., 2013; Lind et al., 2013). Examples of such research programmes are e.g. the European Commission funded 1st to 7th Framework Programmes (Caloghirou et al., 2001) and currently Horizon 2020. The growing body of research on such collaborative research programmes focuses much on the interaction between the different partners, often referred to as university-industry cooperation, and how to promote effective collaboration, knowledge transfer, innovation etc. from the programmes (Perkmann & Walsh, 2007; König et al., 2013; Lind et al., 2013).

The research manager is the leader of these collaborative efforts, and to lead them successfully she/he needs to balance and maintain a range of managerial tasks as aligning potentially conflicting expectations from different partners or stakeholders, lead and manage a variety of persons with differing backgrounds and skills, lead the research an innovation processes, follow up on administrative

and financial management etc. Overall, the many and often conflicting expectations to and roles of the research manager contribute to making the position challenging (Barnes et al., 2002; Adler et al., 2009; vom Brocke & Lippe, 2015).

The main goal of the research programme is to contribute to technology development and innovation for the participating companies. Their motivation for joining the research programmes is often linked to developing new products or innovations, and as such contributing to developing solutions to societal challenges as discussed above. Hence, promoting innovation within the research programme becomes an important task for the research manager. Even though innovation processes within research programmes generally are much studied in the literature (Perkmann & Walsh, 2007; Lind et al., 2013), studies focusing on the role of the research manager for promoting innovation within the research programme are scarce. No consensus on best managerial practices are observed, and findings in literature can tend to be inconsistent (Tidd, 2001). Motivated by this, therefore, this study aims at contributing to the understanding of how the research manager in university-industry research programmes can facilitate and promote innovation within these research programmes. As a basis for exploring this topic, the overall research question for this thesis has been:

How can research managers promote innovation in large university-industry research programmes?

To address this research question, a case study consisting of six different Norwegian research programmes has been conducted. The research programmes were all large university-industry collaborative efforts for pursuing long-time research on different topics within energy and climate technologies. Hence, the overruling goal for all of the research programmes was contributing to developing new technologies for addressing the societal challenges of climate change and manmade emissions to the environment. Through this, increased value creation and competitiveness of the Norwegian energy sector was an expected outcome.

For exploring the main research question as given above, three more specific sub-research questions were developed and thereby defined three separate axes for analysis, which were used throughout the study. These three sub-research questions were:

1. *How can research managers build and support frameworks that promote a culture for innovation in the research programmes?*

2. *How do relationships between research programme partners influence the innovation processes, and how can managers affect these relationships?*

3. *How can research managers facilitate innovation through their leadership roles in the research programmes?*

These research questions have been thoroughly investigated for shedding light on how the research manager can influence and promote innovation in the research programme, and the results will be presented and discussed through this thesis. The next section will present a thorough literature review for establishing a basis for further analysis. Following this, the methodology and the case study used for this study are presented. The fourth section presents the results from the study, and these results are discussed and analysed in section five. Finally, the conclusions and implications of the findings are presented.

2 Theory

2.1 Introduction

This master thesis investigates the role of the research manager in promoting and facilitating innovation and innovation processes in large university-industry research programmes (RPs). This will be investigated following the three thematic axes frameworks and organisational structures, relationships and leadership roles, as given by the three research questions presented in the previous section. In this section, relevant theory for the study will be presented.

The first part addresses the framework for innovation which the research programmes operates within. Theory for open innovation, environmental innovations, the research programme as arena for innovation, and organisational structures promoting innovation will be presented. In the second part, the focus is on the relationships between partners in the research programmes, and theory for university-industry cooperation, opposing logics, and coopetition will be discussed. Lastly, the focus is on the research manager. Here, theory addressing the research manager role, managing change, and knowledge and innovation management will be presented. The theory review follows the same structure as is used in the Results (Section 4) and Discussion (Section 5) sections later in the thesis.

2.2 The innovation framework

The first part of the theory discussion relates to the first research question of this thesis, namely frameworks and organisational structures that promote innovation. Specifically, theory for open innovation, environmental innovations, the research programme as arena for innovation, and organisational structures will be discussed.

2.2.1 Open innovation

Historically, successful innovation was something that happened within the borders of each company. An idea was born, followed up through the R&D department, developed through the product department, and introduced to the market and commercialized through the market and sales department. It was considered a competitive advantage to be able to carry out the whole innovation chain within the company, and even a barrier for competitors to entering the industry (Porter, 2008). However, studies have showed that firms often struggle with innovation that extends beyond their own knowledge pool or existing technology (Stuart & Podolny, 1996). As a consequence, over the last decades firms have been opening up their innovation processes (Chiaroni et al., 2011), and today most industries have moved into the era of open innovation, first described by Chesbrough in the early

2000s (Chesbrough, 2003; Chesbrough, 2004; Chesbrough, 2006). In this mode of innovation, companies rely and build on external sources for knowledge, research or products to innovate, as an important supplement to their internal R&D and innovation processes.

Open innovation can take many forms, from alliances between two firms only, to the perhaps ultimate form of open innovation: open source innovation (Lakhani & von Hippel, 2003; von Krogh et al., 2003). Open source software development, often directly done online, is perhaps the most well-known example on open source innovation. Here, the software is developed by everything from a single to a community of developers for free, and the software is available online free of charge (Von Hippel, 2001). Generally, for open source innovation, all interested parties are free to contribute, and the result is shared royalty free. In this increasingly popular mode of cooperation, both the processes and outcome are fully open.

Most companies which aim to innovate through external sources will, as in contrast to open source innovation, try to secure the rights to the results or outcome through patents, transfer of intellectual property rights (IPR) or other mechanisms. This has been called private open innovation (Huizingh, 2011), as it is the main mode of open innovation for private companies. To secure the rights of the results, companies usually have to commit through investments, partnerships, alliances or other geometries for collaboration. The transfer and ownership of results and IPR are governed through contracts specific for the collaborations (Jelinek & Markham, 2007).

2.2.2 Environmental innovations

Open innovation is often particularly effective when the innovation process involves large investments, market uncertainties, uncertain economic benefits etc., as is the case for environmental innovations (EIs) (De Marchi, 2012). EIs concern innovations which contribute to reduction of environmental risk, pollution, negative impact on resource use and energy etc. for the firm, as defined e.g. by Kemp & Pearson (2007). As in contrast to "normal" innovation, economic incentives alone are usually not a strong enough driver for companies to engage in environmental innovation (Demirel & Kesidou, 2011). Hence, policy and regulations are very important factors for motivating firms towards engaging in environmental innovation (Johnstone et al., 2010; Del Rio et al., 2011).

The simultaneous lack of market incentives and dependence on policy and regulations for environmental innovations has been called "the double externality problem" (Rennings, 2000). This describes the innovation process which both create knowledge through the innovation process and positive spillovers for the society (hence "double externality"), e.g. in reduced emission footprint from the industry sector. The challenge with this mechanism is that the company has to bear the cost of the

innovation and development process, whereas society as a whole, not the company specifically, reaps the benefit from the investment (Beise & Rennings, 2005). Hence, economic motivation for such actions are scarce. As a consequence, it has been found that many firms cooperate or rely on external sources of knowledge through open innovation structures for sharing the involved risks when developing environmental innovations, and that these firms are more successful in developing EIs (De Marchi, 2012). One such open innovation structure which is largely used is research, development and innovation (RD&I) cooperation through research programmes or alliances (Ghisetti et al., 2015), often co-funded by external funding agencies.

2.2.3 The research programme

Over the last decades, there has been a clear trend towards increased cooperation between universities and industries through research programmes for enhanced innovation, value creation, and meeting the societal challenges of our time (Adler et al., 2009). One example is the European Union's Framework Programmes[1] and currently Horizon 2020[2], which over the last 30 years increasingly have funded research programmes for joint collaboration between academia and industry within topics as e.g. biotechnology, transportation, telecommunication, nanotechnology, energy and environmental technology or EIs (Caloghirou et al., 2001). Also research programmes funded by national governments for supporting RD&I cooperation between industry and academia in specific countries are commonly and increasingly used.

These research programmes (also called research centres, centres of excellence or simply research projects) are characterised by having partners from both academia and industry, constituting the programme consortium, co-financed both by the public (as the European Commission, or national governments) and by the private industry partners. Furthermore, output, results, and innovations are shared across borders, and the RPs have common goals of long-term focus (e.g. from a couple of years to a decade) on research and innovation with the potential of future value creation within specific fields or topics. The research programmes are usually governed by a board and a general assembly where all partners are represented. Examples of research programmes following this description are the European Commission (EC) Framework Programmes[1,2] as mentioned above and the Norwegian

[1]See the European Commission's official webpages for the Framework Programmes.

[2]See the European Commission's official webpages for Horizon 2020.

Centres for Research-based Innovation (SFI)[3] or Centres for Environment-friendly Energy Research (CEER, in Norwegian: FME)[4].

As discussed, research show that universities and public research organisations (PROs) can play crucial roles as external sources of knowledge and innovation in improving the innovation performance of companies through different types of alliances, as research programmes (Nieto & Santamaría, 2007; Fabrizio, 2009), across a wide range of industries (Cohen et al., 2002). However, even though cooperation with external sources of knowledge as academia has proven to be beneficial, absorbing this external knowledge often proves to be challenging (Cohen & Levinthal, 1990). This is underlined by a range of unsuccessful attempts of technology transfer between two such partners (Santoro & Bierly, 2006). Further, Feller (2005) points towards other agendas for firms when joining research programmes, as the importance of network building and access to competent researchers and personnel, in addition to general state-of-the-art knowledge.

Through a thorough literature review, vom Brocke & Lippe (2015) outline several factors making collaboration through research programmes challenging. Firstly, a diversity of individuals, both in terms of cultural and national background, roles in the project, skills, expertise etc., provides an inherent management challenge. Secondly, different stakeholders will have different expectations and motives for joining the collaboration, and these are often under-communicated, if communicated at all. Lastly, partners joining the research programmes are often located at widespread areas, sometimes spanning whole continents (as for the EC's Framework Programmes), resulting in geographically dispersed teams working together in the programmes. The latter has been referred to as having low *geographical proximity* (Broekel & Boschma, 2012). High geographical proximity for a research programme (meaning most or all partners being located in the same area) has been showed to promote innovation and knowledge transfer because of enhanced face-to-face interaction between individuals (Knoben & Oerlemans, 2006). As a consequence, industry tend to cooperate within their geographical proximity (Broström, 2010).

Barnes et al. (2002) describe the opposite perspective, and identify three universal success factors for the research programme collaboration. These are commitment, trust, and continuity of personnel. The two first factors are related to lowering the barriers of the collaboration, whereas the third relates to building long time relations, thereby contributing to the first two. When planning the RP organisation it is important to consider the inherent obstacles and opportunities for the RPs as discussed here. As

[3]See the SFI official webpage.

[4]See the CEER official webpage.

a research programme can be organised in many different ways, it is possible to develop and support organisational structures that addresses these challenges. This is the topic for the next section.

2.2.4 Structuring for innovation

The research programmes, as discussed above, are big, temporary project organisations (Lundin & Söderholm, 1995), consisting of many different partners, often as many as 20 to 30, involving perhaps hundreds of individuals, and many parallel research activities. Consequently, it is necessary to adapt a certain organisational structure within the research programme for being able to manage and organise the different actors and work processes best possible. These organisational structures define work flows, reporting mechanisms, levels of authority (e.g. flat versus hierarchical organisation) etc. The structures are often planned already in the design phase of the research programmes, and are adopted when the RPs are initiated.

Several studies address how such organizational structures can both contribute to or inhibit innovation (Arad et al., 1997; Judge et al., 1997; Martins & Terblanche, 2003). Arad et al. (1997) emphasise how organisational structures which support flexibility, freedom, autonomy and responsibility promote innovation. Hierarchical structures serving rigidity and control, on the other hand, do not. Judge et al. (1997) argue that structures where people are free to work towards their goals in a creative way and with autonomy, however always within guidelines from management or others, will promote innovation. Specifically this is described as "*chaos within guidelines*". Furthermore, creating and supporting well established and cross-functional teams within the organisation has been found to promote innovation, through connecting a diversity of individuals with complement skills and talents (Arad et al., 1997; Mumford et al., 1997).

The optimal organisational structures for facilitating innovation will vary and can be drastically different taking into account factors as types of innovations to promote, type of technology investigated or type and ambition of the research programme (Teece, 1996; Tidd, 2001). In addition, external factors as market characteristics can also influence the research programme significantly (Cohen & Levin, 1989), and hence how the RP should be organised to reflect this. Common for most of these organisational structures, however, as pointed to in this and in the previous section, is that they rely and are dependent on constructive and engaged collaboration and relationships between people and partners, as will be discussed in the next section.

2.3 University-industry relationship

As cooperation between industry and academia has become more extensive, the management literature concerning different aspects of university-industry[5] collaboration and relationships has grown rapidly. The second research question of this master thesis concerns how relationships between partners in the research programme influence innovation processes, and how the research manager can affect these relationships. Until now, the importance of collaboration through open innovation mechanisms as research programmes have been discussed, and general opportunities and challenges have been highlighted. In the following sections, the discussion will be extended to include the role of relationships between partners in research programmes.

2.3.1 University-industry cooperation through research programmes

Literature have investigated different characteristics of university-industry cooperation. Examples can be effects of different collaboration forms between partners or how engagement or relational involvement from industry partners towards the research programme influence difference processes. Generally, literature argue that relationships between partners in a research programme can influence innovation and knowledge transfer processes significantly (Cohen & Levinthal, 1990; Perkmann & Walsh, 2007; Lind et al., 2013). Perkmann & Walsh (2007) investigate the effects of the relationship between university and industry partners, by dividing the observed relational involvement into three categories: low, medium and high (see Figure 1). High relational involvement is characterized by individuals or teams from the different partners working together for common goals and often creating common output. These interactions are seen as true relationships. In contrast, low relational involvement relies on publications and intellectual property (IP) or licensing for transfer of knowledge between the parties. Perkmann & Walsh conclude that "*specifically, it appears that the contribution of relationships to innovative activities in the commercial sector considerably exceeds the contribution of IP transfer (e.g. licensing)*".

[5] The word university in this context can be somewhat misleading, as the body of research uses this term collectively also for public research organisations (PROs) or even private research institutes. Some authors therefor choose to use the expression "science-industry" instead (Kaufmann & Tödtling, 2001; Carayol, 2003; Protogerou et al., 2013), to avoid confusion. In this study, however, it was chosen to stay with "university-industry" to be in line with the vast majority of authors.

Extent of relational involvement		
High: relationships	Medium: mobility	Low: transfer
Research partnerships Research services	Academic entrepreneurship Human resource transfer	Commercialisation of IP (e.g. licensing)
Use of scientific publications, conferences and networking (can accompany all forms)		

Figure 1. The extent of relational involvement of industry partners towards university-industry collaboration, and effects on the relationships and collaboration types (Perkmann & Walsh, 2007).

In a newer study, Lind et al. (2013) categorises the university-industry links based on their dominant form of collaboration. Four categories are identified, namely specified, distanced, translational and developed collaboration, as presented in Figure 2 below.

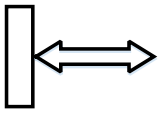
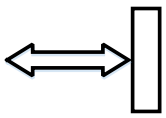
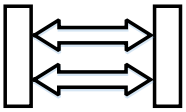
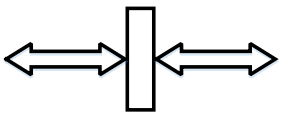
Collaboration form	**Dominant actor**	**Process**	**Illustration** **Industry University**
Specified form of collaboration	Industry	Research process towards product	
Distanced form of collaboration	University	Research process towards research result	
Translational form of collaboration	Industry and University	Two research processes in parallel towards product and research results	
Developed form of collaboration	Industry and University	Research process towards product and research result	

Figure 2. Dominant collaboration forms, dominant actors and characteristics of the research process for different university-industry links (Lind et al., 2013).

The specified form of collaboration usually takes the form of contract research, with a goal of contributing to a specific product or process. This collaboration is dominated by the industry, and the frames within the collaboration are specified by the industry partners. The distanced form of

collaboration is in contrast dominated by the university, and the process focuses on basic research that potentially will have a general benefit for the industry, often in a longer-term perspective. In the translational form of collaboration, research processes dominated both by the university and by the industry are present. In addition, there is communication and interdependence between the two processes, making them different from the processes described above. In the developed form of collaboration, domination from both partners co-exist such that it is only one research agenda, simultaneously contributing towards industrial products and basic research results. Lind et al. argue that young or immature research centres will be more prone to take on specified and distanced collaboration. If these collaborations are successful, the research programmes will be likely to mature into facilitating developed collaboration.

2.3.2 Institutional and opposing logic

The discussion above, concerning the dominant actor in a research process, sheds light on the fact that universities and industry acts and operates quite differently. When one of the parties are dominating the research process, the result is usually quite different than if the other part had designed and dominated the process. Within the management literature, this difference has been referred to as opposing institutional logics (Thornton & Ocasio, 1999; Thornton & Ocasio, 2008). Institutional logic can be explained as the way a company thinks, operates, communicates, decides and relates to its surroundings. In short, the logic in which the company sees the world and lives by; its belief systems and practices (Thornton, 2004). For universities, traditionally the institutional logic has concerned the role as a knowledge accumulator, pursuing the development of science for generally enhancing human knowledge and the progress of the discipline specifically, rather than addressing a societal need (Pirnay et al., 2003). This has been described as Mode 1 knowledge production, or the traditional academic system (Gibbons et al., 1994). Mode 2 knowledge production, on the other hand, is characterised by research aiming at developing new solutions for identified challenges for society, as climate change or cancer treatment (Gibbons et al., 1994). This mode of knowledge production is usually the logic adapted by PROs. Public research funding agencies, whose mission is to contribute to development of society in a certain direction through scientific progress, usually encourage and adapt the logic of Mode 2 knowledge production as well (Lind et al., 2013).

Commercial industry firms' logic are dominated by factors as growth, gaining competitive advantages, positive revenues, commercial research and business development (Lind et al., 2013). Different lenses are found in the literature, and examples can be the competitive forces exerted on the firm from the market that it operates within (an external focus) (Porter, 1985), or the resource-based perspective, focusing on the internal resources in the firm giving the firm a lasting competitive advantage over its

competitors (an internal focus) (Barney, 1991). Generally, the focus and logic of the industrial firms is more short-term and faster pace than the logic of the universities and research institutes.

Opposing institutional logics refers to the situation where two or more organizations with radically different logics are set up to cooperate, which can cause substantial difficulties for efficient cooperation. This will often be the case in large, interdisciplinary research programmes with a consortium of parties from academia, industries and potentially other stakeholders, as public administration or non-governmental organisations (NGOs) (Adler et al., 2009; König et al., 2013; Lind et al., 2013). Opposing logics can also exist between seemingly similar industrial firms (Kandathil et al., 2011). For collaborative research programmes, this adds complexity and potentially poorer cooperation between the industry partners. In addition, challenges and opportunities arise when differing companies aim to cooperate in research programmes, especially if these usually regard each other as competitors. Such factors could also affect relations in and dynamics of the whole research programme.

2.3.3 Industry cooperation, competition and coopetition

Traditionally, strategy management theory has focused on competition between different players in the market (Porter, 1980; Porter, 1985). More recently, literature has also focused on the simultaneous processes of both cooperation and competition between actors. Firms that are competitors in the traditional strategy mind-set will sometimes cooperate to e.g. extend the market (making the pie bigger), and compete when selling their products within that market (slicing the pie into pieces). Brandenburger & Nalebuff (1996) call this process of having simultaneous cooperation and competition strategies for "coopetition". Adding to this, Bengtsson & Kock (2000) argue that while two firms simultaneously can cooperate and compete, they cannot do this successfully within the same area of operation, or with the same persons. Hence, coopetition relates to cooperating e.g. on technology development, while competing in the market, and this has to be executed by different personnel to successfully implement the coopetition strategy.

For being able to effectively execute a coopetition strategy, alliances and relationships between competitors are necessary (Dagnino & Padula, 2009). In such constellations, trust between the partners is key for avoiding opportunistic behaviour (Carayannis et al., 2000). Such opportunistic behaviour can be curbed through strict and complex governance structures or the lack of opportunities for acting opportunistically. Stronger trust is gained, however, if partners avoid behaving opportunistically because of shared values and goals.

Alliances for knowledge sharing and innovation, as research programmes, are common platforms for coopetition. As knowledge is something which is shared, rather than transferred (as would be the case with e.g. money or IP), sharing of knowledge leads to a positive-sum game, where all parties have the same opportunities after the transaction. Based on the new knowledge, each party can process this knowledge into something which creates value and enables competition (Carayannis et al., 2000). In their paper, "*Co-opetition between giants*", Gnyawali & Park (2011) exemplify this through a study of coopetition between Samsung Electronics and Sony Corporation. Here, the two firms joined forces for developing flat screen TV technologies, to reduce their vulnerability, complement each other, reduce the risk involved with large investments, and at the same time compete in the market with separate products. The results were advanced technological development, enhanced common benefits, and most importantly proportionately larger share of the benefits.

University-industry research programmes often have a goal of producing pre-competitive knowledge and results (Nueno & Oosterveld, 1988; Lee, 1996). This implies that the knowledge produced is of common interest for the industry partners, and cannot be commercialised directly, but need further development and refining. As such, the goal of the research programme is to advance the field of study generally, and not a certain partner specifically. In the long run, however, each partner will have as a goal to strengthen their position and increase their share and revenues from participating in the research programme. Hence, participating in such alliances can be seen as a coopetition strategy (Carayannis & Alexander, 2004). It should be noted, however, that not all such research programmes will fall within this category. Coopetition is the case where firms are able to reap benefit and value creation from collaborating with their competitors. Collaboration through research programmes between non-competitors (e.g. a supplier and an end-user), is not to be regarded as coopetition (Ritala & Hurmelinna-Laukkanen, 2009). The distinctions between the modes can sometimes be diffuse.

There is always also a chance of a coopetition strategy failing because of partners acting competitively, despite the common goal of cooperation. Park et al. (2014) discuss how a moderate level of competition is more beneficial for generation of mutual beneficial results within a coopetition strategy, than too low or too high levels of competition. Introduction of too high competitive forces moves the cooperation away from the ideal circumstances under which the partners demonstrate convergent interests in practice (Padula & Dagnino, 2007).

2.4 The research manager

Thus far, the innovation framework for collaborative research programs have been discussed, and further how relationships can affect the innovation processes. However, the main subject under study

through this master thesis is the research manager, and how she or he can influence innovation processes through the mechanisms already described and through adapting different leadership roles. The third and last research question of the study relates to this latter topic, and relevant literature is discussed in the following.

2.4.1 The research programme manager

The research manager is the overall and operational leader of the research programme. As has been discussed, there are several challenges as well as success factors inherent to the research programmes, and hence to leading them. As the overall leader of the research programme, the research manager also has the overall responsibility to address these challenges, lower barriers and supporting success factors for the research programme. However, the research manager has an inherent weak position within such collaborations, which contributes to making the position challenging (Barnes et al., 2002; Adler et al., 2009; König et al., 2013; vom Brocke & Lippe, 2015). There are several factors contributing to this. Firstly, the research programme constitutes a temporary organisation built up to address specific research challenges within a defined budget and time-period. This contributes to giving the research manager a low level of authority, as the organization is temporary and employs none of its contributors. Secondly, within the academic organisations, scientific results and publications are usually regarded as the main deliverables that give rewards. In many cases, this leads to lower status of the manager position than for the scientific positions (Mulec, 2006; Adler et al., 2009). There has also been shown a tendency towards recruiting leaders based on excellent academic records, rather than management skills. This again leads to research managers being both leaders and scientists, often resulting in too little time prioritised for the managerial tasks (Adler et al., 2009). Summarised, through a case study of 16 Swedish boundary-spanning research programmes, Adler et al. (2009) concluded on six essential factors making the research manager position challenging: 1) unsatisfying prerequisites for and focus on research management, 2) low status and weak identity of the manager, 3) few incentives for becoming a research manager, 4) lack of opportunities of leadership development, 5) multiple and contradictory expectations from stakeholders, and 6) uncertainties on how to secure sustainable funding.

Studies have also investigated how research managers best can meet the challenges inherent of the position. Ruuska & Teigland (2009) point towards the importance of the manager having knowledge broker and dialogue skills: high level of trust with the different stakeholders and the capability of understanding different governing logics and communicating effectively between them. Further,

Barnes et al. (2002) describe qualities as diplomatic attitude, participative and delegating leadership style, and technical awareness as important for creating commitment and obligation.

König et al. (2013) further outline a framework for understanding the different roles, functions and duties held by the research manager in interdisciplinary research programmes. By extending the competing values framework presented by Quinn (1988), König et al. identify four widely different areas of management which all falls within the responsibilities of the research manager in a research programme: management of internal collaboration and communication; managing research, scientific and technological results; management of external stakeholders; and administrative management and internal organisation of the research programme. In sum, this highlights the multidisciplinary challenges a research manager most tackle, to be able to lead the research programme successfully.

2.4.2 Managing change

Large research programmes are dynamic environments, usually operating for a limited period of time. Change is inherent to the processes, both through building up the structure, organisation and staffing of the project, as well as through the dynamics given by the university-industry collaboration interface, e.g. because of contradictory expectations and institutional logics. Hence, leading change processes is an inherent task of leading research programmes.

One notable contribution to the field of change management is the paper "*Leading change: why transformation efforts fail*" (Kotter, 1995). Here, Kotter outlines a framework for leading organisational change programs, often nicknamed "Kotter's eight steps". This framework includes eight steps to follow for enhancing the chances of managing the change process successfully. These steps include establishing a sense of urgency, creating a clear vision, communicating the vision and "walk the talk", creating short turn wins, and institutionalizing the new approaches. Further research has moved this field significantly since the Kotter's paper, and currently many authors regard leading change processes as an important factor for both knowledge and innovation management (Utterback, 1994; Leonard-Barton, 1995; Hotho & Champion, 2011; Rusly et al., 2012).

2.4.3 Knowledge and innovation management

Knowledge management (KM) can be defined as the management of creation, transfer and application of knowledge in organisations by actively leveraging know-how, judgement, expertise and experience with the purpose of added value and value creation (Ruggles, 1998; Alavi & Leidner, 2001). Knowledge workers are people working with and of knowledge (Davenport, 2013), i.e. "*someone who is employed*

because of his or her knowledge of a subject matter, rather than ability to perform manual labour" (Serrat, 2008). Consequently, highly educated people as academics or engineers in high-tech industries are knowledge workers. According to some, whereas the increase of manual worker productivity was the most important contribution of management in the 20th century, increasing knowledge worker productivity will the most important contribution of management of our time (Drucker, 1999).

Knowledge management is inherent to research, hence also to leading research programmes (Kasvi et al., 2003). People contributing to the RPs are either researchers themselves or technical experts from contributing partners, i.e. knowledge workers. The knowledge held by the knowledge workers is the fundament they use to do their job. As such, this *intellectual capital* can be regarded as a strategic asset for the employer of the knowledge workers (Stewart & Ruckdeschel, 1998). However, as opposed to tangible assets, knowledge as an asset is owned by the knowledge worker, and is lost if she or he leaves the job. Additionally, if the knowledge worker does not want to cooperate with the employer and the colleagues, the knowledge cannot be utilised for the greater good. As a consequence, knowledge management deeply concerns getting the knowledge workers engaged, feeling like part of the team, wanting to contribute, and shifting from a "what's in it for me" to a "what's in it for us" perspective. This has by several authors been referred to as the psychological contract between the knowledge worker and the employer (Flood et al., 2001; O'Neill & Adya, 2007).

Specifically, researchers and scientists are used to working with a high degree of individuality and freedom. Therefore, leading them towards an overruling goal of a research programme, and aligning them towards the needs and expectations of the industry can be very challenging (Adler et al., 2009). This is especially true for senior personnel. The researchers strive for doing good work which will promote their field of research and provide publications, as supported by the traditional academic mind-set.

Motivating knowledge workers, as researchers, to share their knowledge through legislation or mandates has been found to be largely unsuccessful (Stevens, 2000); simply telling them what to do will not work. Thus knowledge workers cannot be managed in the traditional way as for the manual workers of the 20th century (Ehin, 2008), as first described by Taylor (Taylor, 1896; Taylor, 1914). Several studies show, however, how knowledge sharing can be motived. Tampoe (1993) argue that the opportunity for personal growth, operational autonomy and task achievement are the three top motivating factors. Money, including bonus schemes, does not, however, motivate the knowledge worker to the same extent. Drucker (1999) discusses factors that promote knowledge-worker productivity and, in addition to the three factors mentioned above, adds focus on quality over quantity, continuing innovation as part of the task and responsibility, and seeing and treating the knowledge

worker as an asset in contrast to a cost. Traditionally, workers have economically been regarded as costs. Knowledge workers on the other hand, need to be regarded as assets; they need to be nourished to grow. The goal is the opposite for costs; they should be controlled and reduced as much as possible.

Combined, the literature shows that the knowledge workers need to be in an environment where social capital, promoting a culture for knowledge sharing between workers and employer, is given significant attention and is of high importance (Drucker, 1999; Tymon & Stumpf, 2003; Ehin, 2008). Furthermore, knowledge workers stands as a prerequisite for technology innovation processes, and as such knowledge management becomes an integral part of innovation management as well (Carneiro, 2000; Gupta et al., 2000).

2.5 Knowledge gaps and theoretical framework

2.5.1 Knowledge gaps to be addressed

The various facets of managing university-industry research programmes have been highlighted through this theoretical review. It is clear that this type of cooperation is increasingly utilised, both as a response to firms' approach of open innovation, the funding agencies' interest in directing research towards societal challenges, and the universities' transition from solemnly Mode 1 knowledge production to increasingly Mode 2. Theory also shows the many difficulties with this type of collaboration, and the challenges the research managers face when leading such programmes.

Often, industrial innovation and eventually value creation is a main goal for the industry to participate in research programmes. As has been shown, literature focuses on the barriers for collaboration, effectiveness of knowledge transfer, best practices for research and knowledge management etc. Studies have also investigated how to foster innovation through research programmes, e.g. Perkmann & Walsh (2007). Literature fails, however, in describing best practises for such processes, partly because they are so dependent on a range of factors which will always vary from case to case (Tidd, 2001). Additionally, literature focusing specifically on how knowledge transfer and innovation can be improved by actions taken and factors influenced by the research manager has been found to be scarce. This has been the focus through this study, hence the aim is to contribute towards the knowledge pool of innovation management by shedding light on this topic.

2.5.2 Theoretical framework

The overall research question of this thesis has been "*How can research managers promote innovation in large university-industry research programmes?*". The theoretical foundation for this has been discussed throughout this section. Based on this discussion, a theoretical framework for this thesis is presented in Figure 3 below:

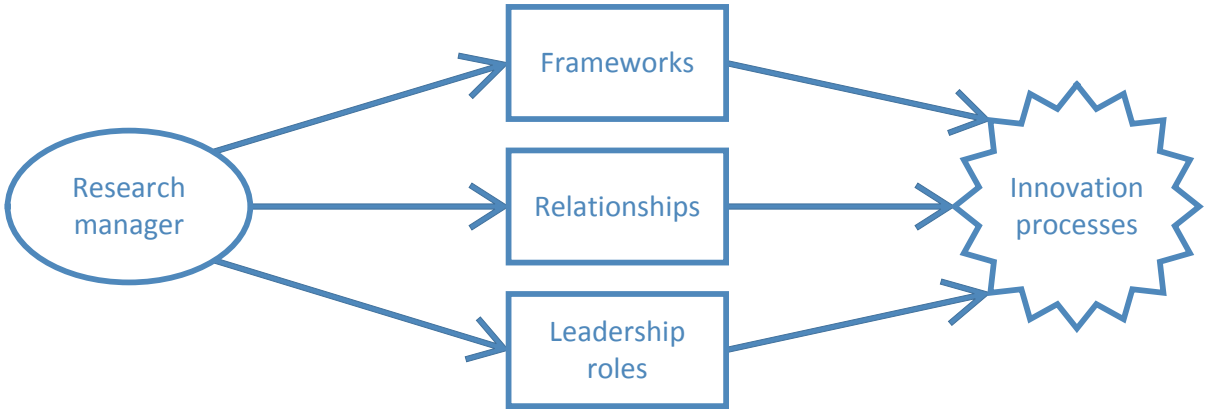


Figure 3. The theoretical framework of this study.

As has been discussed throughout this section, the theoretical framework illustrates three factors that the literature argue will influence and potentially promote innovation and innovation processes in a research programme. These are frameworks and organisational structures, relationships between the partners in the research programmes, and leadership roles the research manager can adapt for knowledge and innovation management. These three approaches or axes were also the foundation for the three sub-research question of the study, as described in the introduction (see Section 1). As illustrated in the figure, by influencing these factors, the research manager can also influence and promote innovation and innovation processes in the research programme. Hence, the main aim of this thesis has been to investigate the research manager's role in these processes. The theoretical framework as presented here formed the basis for this study, and will be further discussed and analysed through the empirical part of this thesis, in Section 4 and Section 5. Any interdependencies seen between the three axes will also be investigated and discussed.

3 Method

3.1 Introduction

Through this section, the method used for this study will be presented. Firstly, the rationale for choice of methodology, or the research design, will be given, supported by relevant literature. This is followed by a thorough description of the case studies, the data collection, and the data analysis processes. Finally, the method will be evaluated and discussed by rising several critical question to the validity and appropriateness of the method. The comparability of the selected cases will also discussed.

3.2 Research design

3.2.1 Deductive versus inductive approach

This thesis addresses how managers can promote innovation in university-industry cooperation, with the goal of gaining new knowledge and building theory. Two general approaches are usually employed for such research: the deductive or the inductive approach. Deductive processes or research aims at acquiring knowledge and building theory through constructing hypothesis and testing these in real life situations (building generalizations and testing through observations of specific instances) (Hyde, 2000). The inductive approach is the reverse process, where one makes observations in real life, and tries to build hypotheses by analysing the acquired data (observation of specific instances, used to establish generalisations). In this study, the inductive approach was chosen, as the goal has been to build emerging theory on the described innovation processes, without being biased by the researcher's presumptions and expectations arising from the work of building hypothesis, a potential weakness of the deductive approach. The deductive and inductive approach can also be seen as mirrors of each other, where the inductive approach is used to establish new theory, whereas the deductive approach can be used to test the new theory. As the current body of research on the research manager's role in promoting innovation processes within the research programme is scarce, the deductive approach would also be less appropriate for this study, as there are few applicable hypothesis in the literature which could be tested. Hence, the inductive approach was the obvious choice. However, testing the findings and emerging theory from this thesis using the deductive approach would be a good candidate for future research.

3.2.2 Case studies as research method

According to Eisenhardt & Graebner (2007), research based on case studies is a well-tested method for precise, generic and surprisingly objective theory building. The method is well suited for exploring

new areas of research (Eisenhardt, 1989), and is well-tested within organisational research (Eisenhardt & Graebner, 2007). This method was chosen for this study, as the aim has been to explore and develop the understanding of how managers can promote innovation in temporary university-industry organisations: the boundary spanning research programmes. Studying such programmes in practise would give a fundament of rich, empirical data for theory-building.

Eisenhardt (1989) outlines a framework and process for building theory through case studies which relies on eight steps. These are 1) defining the research question(s), i.e. what one wants to study, 2) case selection, 3) deciding on data collection methods (interviews, surveys etc.), 4) acquiring data (entering the field), 5) analysing data, 6) shaping hypothesis, 7) comparing with literature, both supporting and conflicting, and 8) establishing new theory (reaching closure). This framework is also in accordance with Yin (2013), another much cited scholar within the field. The work with this study roughly followed the process as outlined above.

3.2.3 The research questions

The research questions in a qualitative study using inductive approach define what one wants to study, and by which lenses or approaches one intends to shed light upon the selected topic. Through the work whit this study, the main research question was articulated early in the process. After initial studies of relevant theory, the three sub-research questions were formulated to shape the lenses used for further work with the study. After starting the work and gaining more insight on the selected topics through analysis of acquired data and more in depth studies of relevant literature, the research questions were revised several times, until the final version as presented Section 1 here was settled. Using such and iterative approach for shaping the research questions throughout the research process is in line with the methodology presented by Eisenhardt (1989) for case study research. The aim of the comprehensive and iterative process was to ensure that the research questions really addressed the topics which the data acquired through the study could shed light on. Thus, the focus of a study could change throughout the research process, as e.g. described by Bettenhausen & Murnighan (1985). In this study, however, the overall topic of all the research questions remained the same throughout the process.

3.3 Case selection

Through this section, the considerations made when selecting the cases for the study will be discussed. This is followed by a thorough description of the case study and each of the cases.

3.3.1 Theoretical considerations

The cases were selected by theoretical sampling (Coyne, 1997; Eisenhardt & Graebner, 2007). Hence, the cases were not selected as part of a population, but because they represented particularly interesting cases for investigating the phenomena under study. As described by Eisenhardt & Graebner (2007), just as certain laboratory experiments are chosen because they have special characteristics rendering them particularly relevant for giving theoretical insight, in theoretical sampling cases are selected because of their characteristics and potential for theory-building.

It is usually less challenging to draw general conclusions from single case studies compared to studies with multiple cases, because the data sample is smaller and less diverse. However, the opposite is typically the case for theory building, which is less challenging when studying multiple cases due to the broader empirical data base. This also results in more robust theory, because the emerging hypothesis and theory are based on more evidence through analysis of rich empirical data, which also makes the emerging theory more generalizable (Eisenhardt & Graebner, 2007) . In this study, three cases were selected for in-depth studies, whereas three more cases were added as secondary cases. These were added to broaden the basis for data collection and thereby the potential for solid theory-building through cross-case generalisation. However, these were studied less in-depth, as detailed in the following section. To narrow the scope of the study, it was also decided to select all cases from within the same governmental funding scheme, which contributed towards the Norwegian energy sector.

3.3.2 Case description

The cases selected for investigation through this thesis were large, Norwegian university-industry research programmes (RPs). The programmes were all part of the Norwegian Centres for Environment-friendly Energy Research[6] (CEER; FME in Norwegian) large-scale initiative for research, development and innovation (RD&I) within the fields of renewable energy and climate technologies. The centres (or rather research programmes, as they will be called here) were established as a consequence of the Norwegian Agreement on Climate Policy in 2008[7].

This funding scheme supported large university-industry research programmes pursuing research, competence, innovation and technology transfer from academia to industry with the ambition of increased competitiveness of and value creation from the Norwegian energy sector. Both universities, research institutes and industry partners participated in the programmes. The first research

[6] See the CEER official webpage.

[7] See the Norwegian Government's official webpage.

programmes started in 2009, and operated for eight years, until early 2017. The funding was partly from the Research Council of Norway (50%), the industry partners, contributing with both cash and actual work (in-kind) (25%), and in-kind contributions from the research partners (25%). The characteristics of the CEER funding scheme common for all cases selected are summarised in Table 1 below.

Table 1. Characteristics for the Centres for Environment-friendly Energy Research funding scheme supported by the Research Council of Norway (RCN), common for all research programmes investigated in the study.

Objectives	Funding	Project period
The RPs shall develop competence and innovation through long-term commitment to research within topics of environmentally friendly energy, transport and CO_2 management and emission abatement technology. The RPs shall strengthen technology transfer to the industry, internationalization and education within the selected topics.	50% research grants from the RCN, 25% from the industry partners (cash and/or in-kind), and 25% from the research partners (in-kind). Total annual budget was in the range of 40 to 60 million NOK per RP per year.	The RPs were granted from the RCN early 2009, and started during fall 2009. They operated for 8 years, until early 2017. All RPs were through a mid-term evaluation during spring 2013, where all RPs were recommended to continue operation until 2017.

From within the described funding scheme, six cases out of eleven possible research programmes were selected for the study. Three of the RPs did not have technological research as scope, and were therefore disregarded, as innovation processes for technological research was the main topic of the study. Further, for the last eight RPs, two pairs of research programmes investigated the same technology, however from different perspectives. Only one of the research programmes from each pair was included for further study.

Of the six remaining research programmes, three were selected as primary case studies. Even though the research programmes had many similarities, the cases were selected based on the "polar types principal": cases as different as possible (polar types) should be included in the study to strengthen the generalizability of the emerging theory (Eisenhardt, 1989; Pettigrew, 1990). The rationale behind this is that if theory can be generalized based on findings from polar types or quite different cases, it is reasonable to believe the theory is generally broader applicable, than if the theory is only based on empirical data from very similar cases.

When finally deciding on the three primary cases, differences in factors as type of technology investigated, market considerations for the technology, type and role of the host institution and number and type of industrial partners were used to select cases as different as possible for the study. The remaining three cases were used as secondary cases, studied less in-depth (see details in the next section). Characteristics of each of the six research programmes are given in Table 2 below.

Table 2. Partner composition of the research programmes. Approximate partner numbers are given to preserve anonymity.

Primary RPs (1-3)	Participants
Research programme 1	A research institute hosted the RP. The RP included universities (2-3) and research institutes (5-6). Industry partners (6-10) represented technology end-users. [8]
Research programme 2	A research institute hosted the RP. The RP included a university (1) and research institutes (4-5). Industry partners (8-12) represented most of the value chain.[8]
Research programme 3	A university hosted the RP. The RP included a university (1) and research institutes (1-2). Industry partners (20-25) represented most of the value chain.[8]
Secondary RPs (4-6)	
Research programme 4	A research institute hosted the RP. The RP included universities (1-2) and research institutes (4-5). Industry partners (16-20) represented mostly end-users.[8]
Research programme 5	A research institute hosted the RP. The RP included universities (2-3) and research institutes (2-3). Industry partners (6-10) represented mostly technology providers.[8]
Research programme 6	A research institute hosted the RP. The RP included universities (2-3) and research institutes (3-4). Industry partners (10-14) represented mostly technology providers.[8]

As described in Table 1, the industry partners contributed with 25% of the funding of each RP. This could be both cash contributions, and documented costs as working hours, equipment, software licences etc. The type of contribution varied significantly from partner to partner, with a tendency towards the bigger companies mainly contributing with cash, and the smaller companies contributing to a larger extent also with work. The total size of the contribution (as measured in NOKs) also varied between the partners in each RP and between each of the RPs.

Further, the three primary research programmes investigated three different areas of technology, delivering contributions and solutions into quite different markets. Table 3 below summarises the main market characteristics for each of the research programmes.

[8] Approximate partner numbers are given to preserve anonymity.

Table 3. Market characteristics for the research programmes.

Research programme	Market characteristics	Comment
1	Slowly emerging market	For research programme 1, the market was slowly emerging, and there were uncertainties regarding future developments of the market. There only existed a handful of pilot projects for the technology worldwide. This was one of the reasons for all industry partners being end-users, as given in Table 2, as no technology providers had had the commitment to join under the unsecure future perspectives for the market.
2	Slowly emerging market	Research programme 2 contributed with technology into a slowly emerging market. During the RP2 project period, the market for the technology went through a recession, which affected the RP and the research and innovation processes significantly. E.g. one of the most influential industry partners in the RP stopped pursuing the technology and removed it from its strategy. However, some commercial pilot projects did exist. Also, some of the systems and technologies investigated had relevance for similar, but mature and existing markets. There were several technology providers in the RP.
3	Emerging and rapidly growing market	Research programme 3 contributed to a new market segment in a conventional industry. This segment was emerging and rapidly growing. This led to interest from the actors within the whole value chain towards the research programme. The industry partners communicated that they wanted results rapidly, which could be used in the emerging market.

The differences in market characteristics for the research programmes could influence how the different cases could be compared. This will be further discussed in Section 3.6.2.

3.4 Data collection

The main research question in this study has been "*How can managers promote innovation in large university-industry research programmes?*". One implication of this is that the research manager is the main subject under study. Since the scope of a master thesis is limited, only three research programmes were included as cases for full in-depth study and analysis. However, as the research manager him or herself is a significant source or information for understanding the implications of the research question, three additional or secondary case studies were added where only the research manager was studied directly (through interviews, see next section). Using this approach, valuable empirical data on the research manager perspective could be gathered from a broader pool of cases without increasing the workload significantly. Hence, the primary cases would be used as primary sources of information, whereas data from the secondary cases would be used to strengthen and confirm findings, forming a broader empirical base for theory generalisation.

3.4.1 The semi-structured interview

Inductive data collection using semi-structured interviews was chosen as the main data collection method for this study. Through interviews, the researcher or interviewer is enabled to interact with the interviewee or source of information directly and can influence the conversation by highlighting certain aspects, or going deeper into detail on topics found especially interesting or relevant (Longhurst, 2003).

One important aspect of the interview, certainly if comparing to surveys, is the flexibility the method imposes. In inductive research, one aims at investigating certain research questions for building theory within a specified field of research. Here, the topic has been the research manager as promotor for innovation. When preparing for the interview, the researcher prepares a set of questions based on assumptions on what would be the most relevant questions for shedding light on the topic under study. However, some of these questions might turn out not be relevant, and other topics can emerge through the interview which the interviewer did not prepare for. Through a survey, the researchers will only get answers to the specific questions asked. If it turns out that these questions did not have particular relevance for the topic under study, the data collected is useless for the purpose. During a semi-structured interview, however, the researcher is free to follow up on topics found relevant or interesting, without having thought of this topic during preparation. Hence, the method enables the researcher to focus on what the interviewee finds most interesting or relevant to shed light on the topic under study (Krueger & Casey, 2014). In addition, the use of active *probing* enables the researcher to follow up and go further in-depth on particularly interesting topics or comments, or where the answers are unsatisfying (Louise Barriball & While, 1994). Examples of probes which were used are "*Can you explain more about that?*", "*Why do did you do that?*", "*Why do you say that?*", or "*Which effect do you think that have?*". These approaches were used actively when collecting data for this study. The term "semi-structured" is used to underline that that the interviewer comes prepared with a plan and a set of questions one wants to ask. However, the interviewer stands free to deviate from the structure if that seems appropriate during the interview.

As the interviews were conducted during the last year in which the research programmes were in operation (of a total of eight years), for parts of the interviews a retrospective interview approach was used (Miller et al., 1997). Using this approach, the interviewer tries to shed light on or reconstruct past experiences which could have contributed to the present situation of the interviewee (Fraenkel et al., 1993). Obviously, this approach does not provide the researcher with exact data from the past (longitudinal data), but can help to give information regarding important events that have happened throughout the research programme period. This approach has one drawback, namely that the interviewee will describe the past through the lenses of the present (Silverman, 2013). However,

people tend not to forget about significant events (Denzin & Lincoln, 2011), and by backing up the acquired data with actual longitudinal data from secondary sources of information, as past reports or other written documentation, it can to a certain extent be possible to double check statements. Generally, throughout this study, all interviewees were encouraged to describe their involvement and experiences from the research programmes from start to end. As an example of the retrospective appraoch, all the research managers and management team members were asked the question "*Did you have innovation in mind when you planned the research programme?*".

When performing interviews, one should always reflect on that the interview takes place as a social interaction between the interviewer and the interviewee. When being asked a question, the interviewee will under normal circumstances try to answer as best as she or he can to satisfy the interviewer. In addition, if the interviewer is looking for certain patterns or results, it is a risk that he or she keeps asking questions which only highlight certain aspects and neglect the full story. Such pitfalls has led to discussions on the objectivity of interviews as research method. Kvale (1994) argues that the interview can be an objective research method in light of being *unbiased.* This is manageable through good preparations, asking objective questions, avoiding leading questions or follow up questions, and through systematically checking and verifying all results (e.g. through *triangulation*, see Section 3.5). This approach was adapted as far as possible through this work, e.g. by avoiding the temptation of asking obviously leading follow-up questions if an interviewee touched upon a findings from earlier interviewees. Instead it was deliberately chosen to let the interviewees choose their own words.

3.4.2 Sampling

The research manager[9] (or research programme director, as the overall research manager for the entire RP has been called under the CEER scheme) was the main unit of analysis (as defined by Yin (2013)) in this study, and thus the first person to be interviewed in each of the cases. This was also convenient as a good first-hand introduction to each research programme, complementing the written material studied during the case selection and as preparation for the interviews. For the secondary cases, only the RP directors were interviewed. For the primary cases, however, to fully understand the implications and perspectives observed through interviews with the research managers, also representatives from the other stakeholder groups in the research programmes were interviewed. To

[9] In the following, it is tried to use the term "research manager" when addressing manager roles in the research programmes in general. The term "research programme director" is used to address the overall manager position in each RP.

further reflect the leader perspective, one additional member of the RP management team was interviewed for each case.

The researchers working and performing research in the programmes were the ones who were most directly influenced by the research manager, hence their perspective and experiences were important. To minimize the potential of selective biases, three to four researchers were interviewed from each of the three primary cases. These interviews were done as respondent groups with all researchers participating in the same interview, to enable discussions and common reflections among the researchers. The aim of this was to see whether a certain consensus could be observed among the researchers, and also to let the researchers comment and react on each other's statements or attitudes if they did not reflect the common conception in the group. Consequently, these interviews typically lasted longer than the other interviews conducted (see Table 5 below for details).

The last stakeholder group was the industry partners. Two different industry partners were interviewed from each case. The industry partners were interviewed separately, to enable them to be as open as possible. In addition, dependent on type and role of the industry partner, the experiences from being an RP partner could vary significantly. It was therefore important to interview them separately to ensure that these differences were captured in the data collected. In RPs 2 and 3, one representative from each industry partner (four in total) was interviewed. For RP1, two representatives were present during each of the interviews. Table 4 below summarizes type and size of each of the industry partners interviewed.

Table 4. Description (size and type) of the industry partners interviewed for each of the research programmes 1 to 3.

Industry partner	**Research programme 1**		**Research programme 2**		**Research programme 3**	
	Size[10]	*Type*	*Size*[10]	*Type*	*Size*[10]	*Type*
Industry partner 1	Large	End-user	Large	Technology provider	Large	End-user
Industry partner 2	Large	End-user	Small	Technology provider	Medium	Technology provider

It was discussed whether representatives from the Research Council of Norway also should be included in the study. It was concluded, however, that the RCN more had the role of a third party to the different cases, than as an active contributor. Because of this, the RCN was not included as a primary source of information to the study. Table 5 below summarises all interviews, number of informants and secondary sources of information used in the study.

[10] Sizes of companies are classified in accordance with the European Union definition: Small < 50 employees, medium from 50 to 249 employees, and large > 249 employees. See EU's official webpages.

Table 5. Persons interviewed from each research programme and secondary sources of information.

Primary RPs	**RP1**	**RP2**	**RP3**	**Approximate interview time**	**Sum**
RP Director	1	1	1*	70 min.	3
Management team member	1*	1	1	50 min.	3
Researchers[11]	4	3	4	80-90 min.	11
Firm representatives[11]	4	2	2*	50-60 min.	8
# of informants in RP	*10*	*7*	*8*		*25*
# of interviews in RP	*5*	*5*	*5*		*15*
Secondary sources	Annual reports Reports Mid-term review documents Web page News articles	Annual reports Project highlights Mid-term review documents Web page	Annual reports News articles Mid-term review documents Web page		-
Secondary RPs	**RP4**	**RP5**	**RP6****	**Approximate interview time**	**Sum**
RP Director	1	1*	1	60 min.	3
Researchers	-	-	1		1
# of informants in RP	*1*	*1*	*2*		*4*
# of interviews in RP	*1*	*1*	*1*		*3*
Secondary sources	Annual reports Innovation reports Mid-term review documents Web page	Annual reports Mid-term review documents Web page	Annual reports Mid-term review documents Presentation News articles Web page		-
Total # of informants					*29*
Total # of interviews					*18*

* Interviews conducted as telephone interviews.
** In RP6, the research director was accompanied by one researcher in the interview.

In total, five interviews were conducted for each of the primary cases, varying from seven to ten informants in total. In addition, three interviews were conducted for the secondary cases, one for each case. Summarised, this resulted in 18 interviews and 29 informants in total for the study. Were possible, the interviews were conducted as physical meetings. For convenience, five of the interviews were performed as telephone or Skype meetings.

In addition to the interviews, a range of written documents were used as secondary sources for data. These were annual reports, web pages, mid-term review documents etc. from each of the research programmes.

[11] When in the following quoting interviewees from interviews where several persons attended, a number will be designated to each person (e.g. 1 to 4), such that the reader can identify quotes from the separate interviewees.

3.4.3 The interview guide

An interview guide was developed before the first interviews were held. This work was done by looking to relevant example interview guides and using supporting literature. The interview guide was first made for the interviews with the RP directors. Consequently, the same interview guide was further developed for interviews with management team members, researchers and industry partners. The structure and topics for the interview guides were kept the same for all variations. However, the questions were altered somewhat for each of the interviewee groups. The aim was to get all informants to respond to the same underlying questions, but formulating the questions in light of the interviewees' role in the research programme.

The interview guide was divided into four main parts: 1) introduction to and goals for the interview, 2) questions on background for the persons interviewed and the RP generally, 3) the main interview questions, and 4) debrief and feedback. The main part of the interview was again divided into three sections: 1) the interviewee and innovation, 2) the research programme and innovation, and 3) the research manager and innovation. In addition to this, a printout of a varied set of probes (questions for digging deeper) was brought to the interview as support.

When developing the interview guide, much attention was given to translating the research questions into questions which were more concrete, and which the interviewee more easily could relate to. Instead of e.g. asking "*How can you as a research manager promote innovation*", it was asked questions as "*Do you find the research programme innovative?"* followed up by "*Do you have any experience with innovation?*". Also, the first questions focused on getting to know the interviewees, getting them comfortable and "warmed up", by asking questions as "*What is your background*" and "*For how long have you been working with the research programme*". It was also underlined before the interview started that the interview did not aim at testing the interviewee's skills or knowledge about innovation, but rather had as an aim to understand his or her perspectives and reflections on the topics discussed.

The interview guide was improved several times during the study as more experience was gained on how to conduct the interviews. The interview guide used for interviewing the research programme directors is attached in Appendix 1 – Interview guide for research managers (in Norwegian).

3.4.4 Approaching interviewees and notes on anonymity

All interviewees were initially contacted by email. In the email, it was clearly stated what the purpose of the interview would be, and the goals of the study. First, research programme directors were contacted and interviews were scheduled. After the first interview and as a relation was established, each of the RP directors were asked whether they were willing to let their research programme be part

of the study as one of the selected cases. After approval, the RP director was asked for further advice on who to interview within the research programme. Finally, contact was established with the other interviewees, through email, and with reference to the dialogue with the RP director. The interviews took place over the course of about ten weeks. All persons contacted accepted the invitation for the interview, and all interviews were conducted as planned.

Before starting each interview, it was explained thoroughly how anonymity would be ensured: no names of persons, firms, partners or research programmes would be given. Further, when direct quotations have been used, the interviewee has been presented with the quotation and the setting it is presented in, for his or her approval. This was also communicated to the interviewees before starting each interview.

3.5 Data analysis

The interviews were recorded and transcribed in detail, however selectively (Yin, 2013). Selective transcription was chosen over verbatim transcription because of the number of interviews to be conducted during the quite limited duration of this study (6 months). While transcribing the interviews, sections or quotes found particularly interesting or relevant were highlighted in the text right away. Immediately after each interview (when possible), first thoughts were noted down as a reaction on the interview. These notes were both on the interview, the respondent and the setting itself, in addition to notes on what had been discussed in the interview and immediate thoughts regarding findings and results. In total, the notes and transcriptions of the 18 interviews constituted a document of 116 pages of empirical data[12]. This document was used as basis for further analysis.

The data analysis started by reading the interviews carefully. The most relevant data was categorized and labelled using theoretical categories (e.g. university-industry relationship, leading change, innovation structure) and lifted into separate tables. The interviews were read and re-read, following three different strategies for analysing data, seeing similarities and differences, and recognising patterns, as in accordance with Eisenhardt (1989).

The first strategy that was used was within case analysis. Here, each case was studied individually, both as a mean of getting to know the case thoroughly as a stand-alone entity, and in search for patterns or contradictions in the data. Within case analysis also served as a basis for the second strategy adopted, which was cross-case analysis. Using this strategy on the data material was the first step towards recognising patterns across the cases, which served as a fundament for further generalisation of the

[12] Font type: Calibri, font size: 11, line spacing: 1.

findings. The third strategy adapted was analysing the data, i.e. re-reading the interviews, according to stakeholder groups: RP directors, management team members, researchers and industry partners. Analysing the data according to these categories enabled recognition of patterns not only case by case, but also group by group. As an example, by using this strategy it could easier be recognized if a certain attitude, action or approach by the research managers resulted in mutual attitude or reaction among the industry partners.

Throughout the whole analysis, as data was categorised and labelled with theoretical categories using tables, these were also structured in accordance with the three different strategies for analysis as described above. Where possible, secondary sources for information were used for triangulation as a means of validating the findings from the empirical data basis (Golafshani, 2003). Iterating between analysing the data and consulting with literature, conflicting or supporting, was done actively for deeper understanding of the implications of the findings, and for shaping propositions from the study which related to current theory.

The last step of analysing the data was developing propositions for new, emerging theory, based on the grounded theory building done through this study (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 2013). This was done through several iterations of comparing available theory with the new data from this study. The propositions will be presented in Section 5.

3.6 Evaluation of method

3.6.1 Critical reflections on methodology

The aim of this master thesis has been to study how the research manager can influence and promote innovation processes in large university-industry research programmes. The method used and described in the previous sections was chosen because it was believed to be serve the purpose of the study. According to Silverman (2013), there is no right or wrong method, only methods that are more appropriate than others when used for a specific type of research or setting. It is therefore in place to discuss whether the chosen method was appropriate for the purpose.

One other obvious methodology for performing or adding data to this study could be a quantitative approach, e.g. by using surveys (Creswell, 2013). This was however not prioritised for several reasons. Firstly, as already discussed, if surveys are used, the researcher will only get answers to the specific questions asked. In this study it was not clear from the beginning which aspects that would be more important, which interdependencies to expect etc., and hence there would be a risk of asking the wrong questions through a questionnaire or survey. Secondly, the body of research on the selected

topic of this study has been found to be scarce. Thus, there is little data available to base and develop a survey from. Lastly, and maybe most importantly, the main subject of this study is the research managers, the person behind the title, and how he or she can act, behave, and decide to promote innovation processes in a research programme. Consequently, the social interactions between the leaders and other persons, and implications of these, would be a very important parameter in the study. A qualitative approach using interviews would enable the researcher to gather rich, in-depth data on the research manager as a person and the social interactions in a way that the quantitative approach would not. Hence, it is believed that the method chosen was the best possible considering the prevailing circumstances.

When performing qualitative research, one should always reflect on the objectivity of the study, both when collecting and analysing data. The interview situation will always be a social construct, with the risk of the interviewee being biased, trying to answer questions to please the in interviewer, or answering questions which the interviewee not is in position to answer or simply does not know the answer to. Further, the interviewer can influence objectivity by asking leading questions, or neglecting to focus or follow up on important matters throughout the interview. These pitfalls have always been taken into account when performing the interviews to try to minimize the effects. Also, using several sources of information, as several different interviewees within each case, and secondary sources of information, increases the validity of the data when they confirm each other, and make the conclusions drawn from the data more convincing (Yin, 2013).

When analysing a rich data sample, there will always be a risk of seeing patterns which one are looking for or expects because of a desire to confirm personal biases or preconceived notions (Flyvbjerg, 2006; Yin, 2013). Conclusions based on such data analysis can obviously be false, and one can overlook other important findings that the data contains. Using multiple sources of information is an important contribution towards also reducing this risk (Yin, 2013)

The selection of cases for the study also influences the validity of the results and not to mention the generalisability of the findings and emerging theory. The cases were all selected from within the CEER scheme of the RCN, which make the general structure and appearance of each case similar. However similar, it is important to take into consideration that differences between the cases might exist that make direct comparison difficult, giving misleading results or results with poor generalisability. For the cases under study, one such difference which has been observed is the markets into which the research programmes contributed. How this potentially can influence the study is discussed in the following section.

3.6.2 Comparison of cases – effects of market externalities

The three research programmes contribute with research, innovation and ultimately technology into three quite different markets, as described in Table 3 (see Section 3.3.2). RP1 was contributing to a technology in a slowly emerging market with uncertainties of future developments. On the other hand, RP3 developed technology towards a rapidly expanding market. Including the three secondary cases (RPs 4 to 6), some of the markets for which the research programmes contributed to had gone through recessions throughout the lifespan of the RP (RP2 and RP5). Others had no significant change to the market characteristics during the RP lifespans.

Through this study, it will be argued and discussed that the market situation affected the research programmes in several ways. One example was how different market characteristics could influence how innovation was defined in the RPs. Another example was how the state of the market could affect the involvement of and cooperation with the industry partners.

The research managers and research programmes could, however, only indirectly influence their markets, through developing new or improving existing technologies for the market. Beyond this, the market was mainly experienced as an externality, over which the research programmes and managers had very limited influence or control. The research managers leading the research programmes in this study seemed to be well aware of this, and promoted the research programmes best possible under the prevailing circumstances from the given market regime.

The aim of this study has been to examine how the research manager can promote innovation through university-industry collaboration. How this can be done best possible will to some extent depend on the prevailing market conditions for the technology to be developed. Therefore, direct comparison of the different cases in this study could at times be somewhat difficult, or unfair. Throughout this study, the research manager will be the main unit of analysis and discussion. However, when prevailing market conditions or characteristics were found to influence the findings, this will be remarked and explained to promote objectivity of the study and generalisability of the emerging theory.

4 Results

4.1 Introduction

In this section the main results and findings from the study are presented. The results will be further discussed and analysed in the following section (Section 5). Here, the results will be presented following the same outline as used in the theoretical section, following the three research questions under investigation (frameworks, relationships and leadership roles; see Section 1).

4.2 The innovation framework

In this section, results addressing the first research question will be presented: "*How can research managers build and support frameworks that promote a culture for innovation in the research programmes?".* The word framework is here used in the broader sense, meaning both formal organisational structures, the research programme itself, being the framework the research collaboration operates within, and frameworks for innovation, as the open innovation framework. In the following, results regarding the open and environmental innovation framework, the research programmes and organisational structures to promote innovation are presented.

4.2.1 Open and environmental innovation

The aim of the CEER funding scheme is clearly stated to be promotion of innovation and knowledge transfer through collaboration between academia and a consortium of industry partners over time. The research programmes were all structured as a response to this. There were also governance structures in place for regulating processes as decision making and ownership and transfer of IPR. Generally, the IPR regulations granted the industry partners user rights to specific or all relevant results. As such, private open innovation structures were observed in the RPs.

All the RPs pursued development of environmental technologies, hence addressed environmental innovation. RP1, and to a certain extent also RP2 seemed to be affected by "the double externality problem", as underlined by the RP1 director:

> *It's somewhat special for [the technology], as the market is emerging slowly. There are big uncertainties. (Research programme director, RP1)*

The participating industry partners also shared this perspective:

> *[The technology] has been through a though period. [The research programme] has had difficulties with the industry not being there for absorbing results. (Industry partner 1, participant 1, RP1)*

RP3, on the other hand, seemed to be in a quite different position. As the market had emerged and grown rapidly during the project period, industry partners had already been able to commercialise products and make substantial profits as a result of being partner in the research programme:

> *Now we have a market share of about 30% within [the given market segment], compared to 3-4% within [the ordinary industry]. (Industry partner 1, RP3)*

Hence, it is clear that "double externality" of the environmental innovation was not the case for the technology and market for RP3.

4.2.2 The research programmes

The research programmes were all structured and organised by the same model. Certain projects were defined within the RPs, each having a dedicated project leader. In these projects, different research tasks were defined, led by task leaders. The project leaders represented their respective projects in the research programme management team. The RP director, and often an administrative manager, led the management teams. In addition, varying roles were found in the different management teams, as industry contacts or scientific coordinators. The RPs were big organizations with many levels of authority.

When asked to explain how the research program directors, together with the management teams, worked with innovation, many immediately referred to the formal structures in place as innovation committees or innovation reporting mechanisms (see Section 4.2.3), and how these were followed up. There were also divergent opinions present on whether the RPs were innovation programmes or not, and hence which role they should play:

> *[The research programme] is more of a competence centre than an innovation centre. (Industry partner 1, participant 1, RP1)*

> *We regard [the research programme] as an innovation centre, absolutely. (Industry partner 2, RP3)*

The large majority of parties interviewed, both researchers, managers and industry, underlined, however, the importance of innovation and potential value creation resulting from the research in the research programmes. It is clear that a felt innovation pressure was present, especially from the Research Council of Norway and partly from the industry partners. However, this was regarded as a

positive stress, helping the RPs to stay focused on the bigger picture and keeping the research relevant for the industry:

> *There is an innovation pressure to a certain extent, which is very good! [...] The CEER scheme was initiated to promote industry in Norway. (Research programme director, RP5).*

The RCN required that the RPs reported on innovations from the programmes through the annual reporting, and as such made the innovation pressure more explicit. There were also conflicting perspectives throughout the RPs concerning how innovation was defined. There was a tendency, however, towards the researchers and industry partners defining innovation as a new and implemented process or product, whereas the research managers also included early innovations (yet not implemented results) and innovative research into their definitions.

4.2.3 Structuring for innovation

Several of the research programmes had formal organisational structures in place for handling innovation in the RPs. Specifically, these were committees for innovation, and innovation reporting mechanisms. Many of the RP directors highlighted these constructs as the main vehicles for promoting innovation in the RPs.

4.2.3.1 Innovation committees

Both research programme 1 and 2 reported that they had innovation committees when they first started the programmes, as a part of their innovation strategy. Research programme 3 never had such a committee. However, in both RP1 and RP2 the innovation committees were stopped after some years, because the management teams of the research programmes did not see the added value from having and operating them over time:

> *We started the [research programme] with [...] an innovation committee responsible for innovation in the research programme. Only a few partners wanted to join the committee, and they thought it was hard to find their role there. (Research programme director, RP1).*

> *We had a committee for innovation when we started, led by the industry and with all industry partners represented. But it did not work well, the industry partners came [to the meetings] with different people every time, so we shut down the committee. (Research programme director, RP2).*

Research programme 4 reported that they had an innovation committee the first few years to establish an innovation strategy and innovation reporting mechanisms. As this was fulfilled, the committee became obsolete, and the responsibilities were transferred to the management team.

When asking the industry partners about innovation committees, however, several found these arenas as good places to interact with and influence the direction of the research programmes:

> *We had an innovation committee the first three years. They had as their goal to enhance innovation [in the RP]. Roughly speaking, this part was successful. (Industry partner 1, participant 1, RP1).*

> *[...] the innovation committee disappeared, and I don't know why. [...] It was a good idea. [...] It was part of the coordination as well, influencing the [research] teams and their focus. (Industry partner 2, participant 2, RP1)*

Overall, five of the six RPs investigated started the programmes with an innovation committee (RPs 1, 2, 4 and 5) or a dedicated task for promoting innovation (RP6). Of the four innovation committees, two were shut down (RPs 1 and 2), and two were actively merged into the board or the management team (RPs 4 and 5). Only RP 6 continued the innovation task as planned from the beginning.

4.2.3.2 Innovation reporting mechanisms

The RCN used the number of innovations reported as one of the key performance indicators (KPIs) for evaluating each research programme. This contributed to keep focus on innovations as important output from the programmes. However, what an innovation was, was not defined explicitly in this regard. This led to the research programmes reporting innovation quite differently. RP1 and RP2 in this study adapted a Technology Readiness Level (TRL) methodology[13] for the purpose of reporting innovations and the relevant maturity level. This resulted in a system where research that was regarded as having significant newsworthiness was reported as innovations:

> *We have had an active innovation strategy. First we implemented the TRL methodology, which was a big process including all the researchers were we had them specify their research in the TRL context. [...] I think it works well; it gives us focus. (Research programme director, RP2).*

[13] Technology Readiness Level (TRL) is a method first developed by NASA to describe technological maturity on a scale from 1 (idea or basic principles) to 9 (commercialised product or process). The method is widely used within a range of industries today, see e.g. Mankins (1995) or the description of TRL on Wikipedia.

One industry partner commented that this system resulted in reporting of very many innovations, more than what the partner experienced was the real innovation outcome:

> *Spontaneously I would say five innovations [have emerged from the research programme]. To me [tenfold of that] feels like too many. (Industry partner 2, RP2)*

Other research programmes only reported innovations which had been implemented by a user (RP4). In between these two, one research programme (RP6) chose to report identified innovations which were considered as finalized from the research perspective, meaning that further development was outside the scope of the research programme. RP3 invited all the industry partners to document their innovations based on results from the research programme. This was then reported together with identified innovations from the programme that had not been implemented yet, but had the potential to become so:

> *We started out asking all partners how they defined innovation. Then, we asked all partners to report innovations they meant came as a result of their participation in the research programme. We then reported all innovations, i.e. innovations from the industry partners alone or innovations found together with other industry partners, innovations from industry partners and researchers, and innovations from research partners. (Research programme director, RP3).*

Table 6 on the following page summarises the innovation reporting mechanisms employed for each RP.

Table 6. Reported innovations and innovation reporting scheme used in each of the research programmes.

Research programme	***Reported innovations***	***Innovation reporting scheme***	***Comment***
1	Newsworthy and industry relevant results	TRL methodology	The RP adapted the TRL methodology for identifying and reporting innovations. Research results considered having significant newsworthiness were reported as innovations together with a TRL number to indicate the maturity and distance to market for the result.
2	Newsworthy and industry relevant results	TRL methodology	The RP adapted the TRL methodology for identifying and reporting innovations. Research results considered having significant newsworthiness were reported as innovations together with a TRL number to indicate the maturity and distance to market for the result.
3	Implemented results / innovations	No specific	In RP3, no specific reporting mechanism was adapted. Innovations were reported based on implemented innovations reported by the industry partners, and innovations in the RP with the potential of becoming implemented by the industry in the future.
4	Implemented results / innovations	Dialogue with partners and researchers	RP4 used the innovation committee to develop a system for registering and describing innovations and new solutions. The innovation committee was also used to validate that registered results were regarded as innovations by the committee as well. Only implemented innovations were reported.
5	Implemented results / innovations	No specific	In RP5, no specific reporting mechanism was adapted. The RP director stated that they generally were conservative by only reporting innovations which had been implemented and which were directly derived from the RP.
6	Finalised results	Identifying early / potential innovations	The RP had adopted a methodology were they identified early innovations having the potential of becoming innovations. Throughout the development, these innovations were tracked, and when the RP considered them as finished from the research perspective (i.e. further development will happen by the industry), they were reported as innovations.

4.3 University-industry relationship

In this section, results addressing the second research question are presented: "*How do relationships between research programme partners influence the innovation processes, and how can managers affect these relationships?*". Specifically, results regarding industry partner engagement, facilitating cooperation in the RPs, and coopetition and competition are presented.

4.3.1 Industry partner engagement and involvement

It was generally accepted among both research and industry partners across all three main research programmes that more involvement and engagement towards the research programme from an industry partner gave increased benefits and return on investment for the partner. Furthermore, it was underlined that increased involvement from the industry partners gave the research programme increased momentum and enhanced transfer of knowledge and results. Table 7 on the next page summarises the observed level of involvement from the industry partners towards the three main research programmes in the study.

In all three RPs, there was a general tendency towards the research partners trying to engage the industry partners into closer and more concrete cooperation. The industry partners on their part seemed to acknowledge this. The lack of engagement often related to lack of internal resources for following up. This was pointed to as a main reason for getting less out of the research programmes from the industry partners themselves:

> *[We] could have gotten more benefit [from the research programme] if we followed [it] closer throughout the whole period. (Industry partner 2, RP2)*

It was further observed that engagement from the industry partners towards the research programme was connected with the modes of cooperation present within the RP. This is the topic of the following section.

Table 7. Observed level of involvement from the industry partners towards the three main research programmes in the study.

Research programme	***Industry partner involvement***	***Comment***
1	Low	The industry partners attended bi-annual technical meetings and some workshops, but little concrete collaboration or involvement from partners beyond this was observed. Reports and journal articles were the main way of transferring knowledge from the RP to the partners, in addition to participation in technical meetings and seminars/ webinars: *The partners in [the research programme] have until recently been very reserved. (Researcher 1, RP1)* *It is a big challenge to get real intervention [with the industry partners]. [...] For many of the topics, the industry partners are far away, I would say too far away. (Management team member, RP1)* Nevertheless, industry partners reported that they were pleased with the involvement and what they get out of the collaboration: *[...] This is [...] one of the most efficient projects in terms of cooperation between universities and industry [we have been in]. (Industry partner 2, participant 2, RP1)*
2	Low to intermediate	Parts of the research programme was characterised by low industry partner involvement, as for RP1: *Often the industry partners attends meetings once every semester, but are little involved in between. They become a bit peripheral. (Researcher 2, RP2)* However, in RP2 there were also examples of more concrete cooperation where industry partners contributed with measurement campaigns, equipment or software: *We have contributed with measurements and testing of equipment [...] as basis for further research. (Industry partner 1, RP2)*
3	Low to high	Both researchers and industry partners in the RP argued that the links between the partners should have been closer in parts of the project. However, the research program had several concrete, large-scale pilot projects. In this part of the RP, the engagement from the partners was high. Several of the researchers had also taken up permanent positions with the industry partners' firms. *The pilot projects have enforced a cooperation on a very concrete level. [...] They are like innovation arenas. (Researcher 1, RP3)* *It was through [the pilot projects] it really took off. [...] It was a good cooperation from there and onwards. (Industry partner 1, RP3)* In other parts of the RP, however, engagement and involvement from the industry partners were very low. This tended to be the parts of the RP which was more dominated by fundamental or long term research.

4.3.2 Facilitating cooperation

Within the three main RPs, close cooperation was mostly observed in RP3 where the research was structured around concrete pilot projects. RP4 also reported how working with concrete research case studies relevant for the individual industry partners led to higher engagement and commitment:

> *We have case studies in the research programme [were] we get the partners engaged, which is very good. Through the mid-term review, we found that the industry partners who had engaged in case studies gave us very good scores, whereas it was poorer from those that had not. (Research programme director, RP4)*

Several industry partners also shared this perspective:

> *[The cooperation] works better when there are clear topics which we also can engage in. [...] We're good when the tasks are concrete. (Industry partner 2, RP3)*

> *[The cooperation through the pilot projects] has developed into a relationship with mutual dependencies where we use each other's brands and capacities. (Industry partner 1, RP3)*

In RP1 and RP2, where such concrete collaborations not were achieved to a large extent, much focus was given to linking the right people between research and industry:

> *We must ensure communication on the researcher level with the industry. The technical experts in the firms have to meet our researchers, such that the researchers can understand the challenges and plan their research accordingly. (Research programme director, RP1)*

In addition, industry partners highlighted the importance of matching the right people at the right level within the organisation to increase understanding between the parties and as such foster innovation:

> *We were quite clear on that we wanted [technical] workshops too, such that we could be present with the right technical experts. [...] Make it a bit more social: We're in this together, how can we solve this problem? (Industry partner 1, participant 1, RP1)*

It is evident, however, that linking the right people was not always straightforward. Several barriers were observed, as low commitment from the industry partners, reluctance from the researchers to prioritise time with the industry, or personal chemistry between individuals:

> *[Linking the right people is] challenging. We are successful within some areas, but not within others. We have worked a lot with this; direct contact not hindered by the leaders. (Research programme director, RP1)*

> *[Collaborating with the industry] has influenced the way we work. It takes much resources to travel to [the industry partner]. [...] It takes time to prepare, and the travel spends budget and then we have much less time to do the research we had planned. (Researcher 3, RP1)*

> *We see that coupling PhD students and researchers directly to the industry partners [...] is important. We have made this happen, partly. It is very person dependent. Some persons have the engagement and time, the chemistry matches and so on, but for others it gets very formal. Then it doesn't work well. (Research programme manager, RP2)*

For some industry partners, networking amongst the other partners was recognized as one of the main drivers for joining to the research programme. Researchers within the research programmes reported that they observed the same.

> *[Network was important] for us, since we were new in the market. [...] We did not really think too much about that side [results and products]. We were in a starting phase and were searching. (Industry partner 1, RP2)*

> *[...] many come to the meetings to network and keep a bit updated on what was going on. (Researcher 2, RP2)*

These observations point towards low relational involvement and limited interest in close collaboration. However, it was observed that partners exhibiting such attitude engaged in spin-off projects from the research programmes to pursue further research on selected topics. To be able to achieve this, facilitating good networking arenas, for both industry and researchers, was important. One researcher also argued that expecting or requiring too much from the industry partners whose main interest was networking could be counterproductive for the cooperation:

> *"We don't want to scare the partners away by having too high expectations either, we've lost partners before [because of that]" (Researcher 1, RP2)*

Table 8 on the next page summarises the observed level of collaboration and collaboration forms for the three main research programmes under study.

Table 8. Observed level of collaboration for the three main research programmes.

Research programme	Observed level of cooperation	Comment
1	Low	Little concrete cooperation was observed within the research tasks. The industry partners participated on meetings, workshops, webinars etc., but did not contribute to the specific research. Feedback loops for comments and input for future directions were in place to a large extent.
2	Low to intermediate	Direct industry involvement with measurement campaigns and tests and contribution to industry partner's software occurred. Beyond this, cooperation was observed to be on similar level as for RP1, as feedback loops and widespread interaction between partners took place, but little concrete cooperation was observed.
3	Low to high	Three distinct types of collaboration were observed: For the more fundamental research, there was little interaction with the industry. More specific research, where researchers contributed to development of specific products for different firms was also present. This was a collaboration directly between one industry and one research partner. Lastly, the research programme had carried out several pilot projects with contributions from all stakeholders from both university and industry.

4.3.3 Opposing logics: cooperation with PhD students

Education of PhD students was a prerequisite for the research programmes. Each programme educated between 20 and 30 candidates throughout the programme period, and a significant share of the budget was allocated towards these educational programmes. Several of the industry partners commented that they regarded this as challenging. Whereas most saw the importance of educating PhD students in long term research programmes, they struggled to see the relevance or added value for them as industry partners of the RPs:

> *PhDs were started in the beginning [of the research programme], and they typically last for 3-4 years. But by then the industry has already moved two steps ahead. You must almost be lucky for the industry to be able to use these results, especially in such a broad field of research. (Industry partner 1, participant 2, RP1)*

> *PhDs are very important, but there is a risk of goal conflicts [between the industry and the research partners]. (Industry partner 1, RP3)*

The gap between industry interests and PhD research also seemed to be widened by PhD students not being sufficiently connected to the research programmes, but rather with the university or the research group the student worked in:

> *[The research programme] was never a topic when I started my PhD. We talked more about the group and the thesis. (Former PhD student, RP2)*

Several of the industry partners interviewed pointed to increased interaction between the PhD students and the industry as a way to address this issue:

> *The PhDs were not inside the companies, which they could have been. [...] We would have been open for that. (Industry partner 2, participant 1, RP1)*

> *When [the research programme] started, it should have been a requirement for all industry partners to have one PhD linked to them. [...] We should have been responsible for a PhD student who would know us in and out throughout the period. That would have given us a much better start. (Industry partner 2, RP3)*

Differences in attitude and logic was observed between the different industry partners in the RPs as well. This could influence the RPs' ability to support coopetition strategies, as presented through the next section.

4.3.4 Coopetition

In the guidelines for the research programmes given by the RCN, it was stated that the goal of the research programmes was to *"develop expertise and promote innovation through focus on long-term research in selected areas of environment-friendly energy"*[14]. Generally, this points towards that the research will have a pre-competitive nature, enabling competing firms to collectively join the research programmes forming coopetition alliances. In RP1, this was clearly the case, where all industry partners were large firms and end-users which were collaborating through the research programme on maturing a technology necessary for the given industry sector. This was underlined by one of the industry partners:

> *The industry partners are all running for the collective goal, not company goals, which is good. [...] And as all industry are end-users, not vendors, we share the same perspective. (Industry partner 2, participant 1, RP1)*

Generally, the research programmes were designed such that specific results or technology reaching a level of maturity beyond the pre-competitive stage could be further pursued in spin-off projects, with a narrower industry consortium or a single firm alone. In such cases, the principle of "first right to refusal" was prevailing, meaning that all partners in the research programme should be given the offer

[14] See the CEER official webpage.

to join the spin-off activity. If this opportunity was not used, the partners had no rights after this decision gate.

In RP3, when inviting the industry partners to join the programme, the management team was concerned about competition between industry partners in the program. Thus, they only invited one actor from each part of the value chain. In later projects, however, this policy was abandoned, as they experienced that these precautions were not necessary:

> *When we established [the research programme], we were very clear on not including competing firms, only one actor from each part of the value chain was invited. When we now are developing a new research programme, the industry say: Why should we worry? The research programme is more about methods and ways to work. Open innovation is more interesting. (Management team member, RP3)*

Competitive behaviour has, however, been observed in the research programmes designed for promoting coopetition. When competing technology providers (vendors) participated in the same programme, it could be hard for them to operate freely; they avoided giving away their best ideas:

> *I have experienced earlier that it's easier to intervene and cooperate [with the industry] when it's only one vendor participating. Then they don't have to give their knowledge away to everyone. If your competitor participates in the same research programme, it might be easier to be silent and just watch. (Researcher 1, RP2)*

In one other case, it was observed that an industry partner might was interested to join the research programme in order to supervise the development such that no competing technology came out of the programme, in addition to incrementally improve their own products:

> *One industry partner might be more concerned about participating in order to monitor that no competing products are developed, rather than to invest in revolutionary new solutions. We have come up with some new solutions for a technology, which they haven't been interested in. The new technology would in any case take years to develop – the size of the company and their ability to invest is of course a part of the picture. (Management team member, RP3)*

4.4 The research manager

The focus will now be turned towards the research manager; the main unit of analysis in this thesis. In this section, results addressing the third research question will be presented: "*How can research managers facilitate innovation through their leadership roles in the research programmes?*". The focus will be on the different leadership roles and behaviour observed when the research managers address

bridging opposing logics, change processes within RPs, team building and knowledge and innovation management.

4.4.1 Bridging opposing logic

It has been elaborated on the opposing logics observed between the industry and research partners in the research programme (See Section 4.3.3). Generally, the research programme directors were able to adjust their perspectives to a greater extent than the researchers working in the RPs. The RP directors also communicated much more directly with the industry partners than the researchers did, hence they were also more exposed to the industrial logic. The following quote underlines the opposing logic between industry and research partners at start-up of RP1:

> *When we started, we were very self-confident; [...] we thought we had much to contribute with and that we were very good. We were told that "we do not regard your publications as results. [...] we need something else, something we can bring home to our firm". (Research programme director, RP1)*

Several of the industry partners also described the starting phase as challenging:

> *It was difficult for us to take on a central role; we had to be spectators in the beginning, because this was very new for us as well. We probably were spectators too long, and that might be our own fault, but it was hard to find our role. (Industry partner 2, RP3)*

Other industry partners described how their expectations in the beginning were high, but that they did not feel that the research programme met their expectations:

> *Immature partners, as us, waited for the researchers to come up with innovations. But then we realized that we had to take initiatives ourselves, mean something and draw up some boarders. Then it became a bit more [innovation]. (Industry partner 1, RP3)*

From the early stages and onwards, the research programme directors underlined the importance of aligning the programmes towards the industry's needs and the RCN's expectations. This resulted in much effort towards involving and engaging the industry partners, bridging the different partners' perspectives and to explicitly focus more on innovation. After some time, this contributed towards more aligned expectations from the different partners. The RP1 director elaborated on how both the industry partners and the RP management increased the understanding of each other's perspective and logics over the project period:

> *[I] believe the partners have moved from thinking about [the research programme] as a research programme which delivers publications to delivering solutions which the industry need, mostly because of how we talk with the partners about innovation. We are willing to listen and hear what they need and what they think. (Research programme director, RP1)*

An RP1 management team member further elaborated on how they had adapted the way they communicated and talked with the industry to make the message clearer to them:

> *We have to get better at communicating clearer and simpler [with the industry]. It has been a development, if you study the way we talk. (Management team member, RP1)*

Following this, several of the RP directors also thought that industry partners would have withdrawn from the research programme if they had not had this focus on engaging the industry towards the RP, e.g. by increasing the focus on innovation throughout the research programme:

> *[I think] we might have had fewer partners [if we had not followed up explicitly on innovation]. (Research programme director, RP1)*

Also industry partners underlined the importance of management focus for bridging the gap between industry and research:

> *[The research programme director] understood that she/he had to increase focus [on dialogue]. We were invited to give input [to the projects], [...] then we got very involved. [The communication with] the research programme director and the project leader became a very good match for us, we became an advisor [to the project]. (Industry partner 2, RP3)*

4.4.2 Change processes

As presented during the theory review, change processes are intrinsic to both temporary organisations as research programmes and to innovation processes. This was also observed through this study. During the design and early phases of the research programmes, several of the programme directors pointed towards that research was the main driver, and innovation and value creation was a more secondary objective, or something they did not give too much focus. In addition, the experience with operating and leading such broad and long term research programmes was scarce, giving a steep learning curve. The RP2 director described how the innovation focus grew stronger from when they started the RP:

> *When we designed the research programme it was mainly described as a research agenda, which should give value creation and innovation, but the innovation focus came much stronger after we had started [the research programme]. [...] [The reason for this was] a combination of several things: partly because several of the partners had it on their agenda, but also because the RCN put it on the agenda. (Research programme director, RP2)*

Several of the RP directors discussed how they tried to motivate the researchers for innovation and for aligning their research towards the industrial needs. However, the researchers in the different RPs replied very differently when asked how this had impacted their work and research:

> *[Management] follow up [on innovation] very much, they sell it to us as something positive. If they had a different focus and signalled that this just was something they needed to report, we would have followed up quite differently. (Researcher 3, RP2)*

> *It hasn't been much interaction with the research programme management, [...] and not too much coordination either. It's much about completing deliverables and working plans. (Researcher 4, RP1)*

As such, it is evident that the RP directors to a varying extent were successful in motivating the researchers for innovation and innovative research in the RPs.

All the research programmes were through a comprehensive mid-term review about half way through the project period. This was initiated by the RCN, and resulted in a decision gate on whether the programmes would receive funding for the remaining project period. The review was done by external experts. As part of the process, surveys and questionnaires were distributed to all partners. The evaluation process and conclusions gave the research programmes invaluable information for further directions of the programmes. Indeed, most of the partners reported that the programmes were improved through this process, both in terms of management, dialogue and output.

During an eight-year period, preconditions, surroundings and markets change. When asked whether the research programmes were able to take such changes into account to form a dynamic research environment, the majority of respondents said yes to some degree, but far from enough. Generally, annual working plans for each research topic or activity were flexible, whereas the research topics and budget for each research partner were fixed and challenging to change:

> *The budgets between the research partners are negotiated with much ado from the start of the research program, so they are locked, no one wants to change that afterwards, it's not very dynamic. (Researcher 4, RP1)*

There was one example of a significant restructuring of the research activities internally for one research partner as a result of the mid-term review. Here no budget was moved between partners. Still, the process was difficult:

> *After the mid-term review, we stopped many tasks and added new ones. It was a real reallocation. It led to quite much dissatisfaction, since we stopped some tasks that were well under way and did good work. (Researcher 3, RP1)*

Some of the research programmes reported to have had unallocated budgets for pursuing interesting research or opportunities along the course of the programme, so called blue-sky research. This was pointed at as a very positive initiative in the mid-term review documents from the RCN. However, none of the researchers interviewed seem to have experienced this as an opportunity.

4.4.3 Team building

Creating and sustaining cross-functional and engaged teams have been showed to promote innovation by literature. This seemed like a challenging task for many of the RPs studied. However, some good examples were observed:

> *In [the research programme] it is really a management team which leads [the research programme]. We do not sit there as project leaders representing ourselves; we represent the research programme. [...] It makes it more fun to be there, than if you're only there as a representative for your own work. [In other projects] people protect their own budgets and don't care about what's happening in other people's tasks. (Researcher 1, RP2)*

> *We have had a very open process for budget and work allocation. It was not bound to each research partner up front. [...] We need the best people to solve the tasks, and then we need to find out who they are! (Research programme director, RP4)*

In RP3, engaged teams were built when working with realising concrete pilot projects where close collaboration between research and industry partners was observed:

> *When I compare with other [research programmes], there were no concrete [pilot] projects. Then the temptation is much higher for taking resources to your own activity. I think it is important that we make something together, we have a physical product which everyone can see! (Researcher 3, RP3)*

One of the research programme directors highlighted how it was important to be a champion for the whole programme, not only for the host institution. This built trust and encouraged cooperation between the partners:

> *We have built a complementary activity with mutual generosity. I work at [research institution], but I am very happy when [other research institution] achieve something. It is more important to me that the other research partners are successful, because [my research institution] gets so much for free because I am allowed to talk so much. The others also need some success stories for the research programme to shine! (Research programme director, RP5)*

The industry also commented on building committed teams as a success factor for promoting the overall goals of the research programme, and keeping focus on external drivers and change. However, that the research programmes were temporary organisations built up of persons from a variety of partners was a clear barrier to overall dynamic of the RPs. One industry partner pointed at the benefits of thinking of the research programme as a firm, and make the necessary priorities based on this:

> *I would like to rig it [the research programme] more as a firm than a research programme. Keep focus on the value creation and get rid of the focus on you and us. Lead the researchers in a different way. Don't take their freedom and individuality away, but maybe redefine the tasks and the goals. [...] Always have the goal in front of us: what is our social responsibility here? (Industry partner 1, RP3)*

The idea of managing the research programme as if it was a firm for increasing the commitment to the management team was also shared by one of the RP directors:

> *It was very useful for me to see that it is quite similar to being a leader in an organisation. I started to think of the management team as the leader group in a department. It has defined very much how I have been working with the leader group. (Research programme director, RP1)*

By increasing commitment to the management team, the research directors could generally increase management capacity within the research programmes.

4.4.4 Knowledge and innovation management

Knowledge management, concerning managing knowledge workers and the explicit and tacit knowledge of organisations, is a vital part of managing large research programmes. In the RPs in this study, leading and motivating the researchers seemed to be a prominent part of the knowledge management task. The research programmes were large organisations with quite many organisational levels, ranging from the researchers to the task leaders, the project leaders, and the programme director. Researchers reported this as challenging, as they mostly saw the management on bi-annual meetings and seldom had the chance to communicate directly with top management regarding topics as strategy or research priorities.

One example that underlines this challenge was the process of implementing the innovation reporting mechanisms in RP1 and RP2 (see Section 4.2.3). Both programmes chose to use the TRL methodology, and reported innovations from the programmes by highlighting them and assigning a certain TRL number. In RP2, this process started quite early in the programme (during the first half), and the implementation followed a methodology developed by an industry partner, who also led the work. After this, one person in the management team had as his specific responsibility to follow up on this effort. The researchers and task leaders in the research programme first thought of the innovation reporting as strange, but soon adapted the mind-set:

> *It was a struggle in the beginning, but now it works good to identify and have a list with industry relevant results. Some results are a bit immature, but it gives insight into what can become innovations. (Researcher 2, RP2)*

Although the researchers underlined that the methodology had drawbacks, as when working with software or methods not being concrete technologies, they acknowledged that the innovation focus and the TRL method had helped them to increase the focus on innovation in their research:

> *I believe I think more about innovation, what it is, and what the usefulness can be for the industry. With TRL and innovation you need to take something really concrete, think about what it really is; method, model, thing, and see which use it can have. And the TRL methodology helps with that. (Researcher 1, RP2)*

In RP2, there was a focus on innovation from the management over time. The person responsible for this visited each of the task leaders, sat with and worked with them to get them to use the methodology. By the end of the research programme, the TRL methodology seemed to be widely used and accepted, based on how the researchers talked about innovation and the TRL method:

> *Many say that we have a leader who cares about innovation. It has been a topic regularly, much work has been put into this. It's not just one time and done with that, but continuously. (Researcher 1, RP2)*

In RP1, there seemed to be much more reluctance towards the same methodology. The RP started with this reporting mechanism at a later stage, after the mid-term review, and several of the researchers said that they felt they were asked to identify innovations without understanding how or why:

> *We were instructed on the task leader meeting [on how to use the TRL methodology], and we got quit good instructions. But it felt very strange when we tried to do it. It felt like you were sitting there with some research results, and were trying to make them applicable [as innovations]. (Researcher 3, RP1)*

> *I don't think the TRL methodology works for innovations. It's a good thing for describing technologies, but not for innovations. (Researcher 2, RP1)*

Even though RP1 and RP2 were comparable regarding results and technologies investigated, the group of researchers responded quit differently to the implementation. It was evident that in RP2, more efforts had been spent on engaging the researchers, teaching them how to do the work, and let them see the value of the effort. As one member of the RP2 management team put it:

> *[...] you have to walk the talk. People have to be treated differently. You have to talk with them, it's not enough just sending an email. People find it scary: "I don't know this, I don't understand this". And people don't want to admit that, when they are smart. And people in these research programmes are smart. Then they will rather call it a waste of time. (Management team member, RP2)*

This concludes the presentation of results from this study. In the following section, the results will be analysed and discussed, and theoretical propositions based on the implications of the results will be presented.

5 Discussion

5.1 Introduction

Through this section, the most significant results and findings from the study will be discussed, analysed and compared to the prevailing body of research. The discussion will follow the same structure as used for the theory discussion and presentation of results. The overall research question this thesis addresses is "*How can research managers promote innovation in large university-industry research programmes?*". This has been investigated in detail, by using the three thematic axes as given by the sub-research questions of the study, repeated here for convenience:

1. *How can research managers build and support frameworks that promote a culture for innovation in the research programmes?*
2. *How do relationships between research programme partners influence the innovation processes, and how can managers affect these relationships?*
3. *How can research managers facilitate innovation through their leadership roles in the research programmes?*

The three main sections of the discussion address each of the questions above specifically. Throughout the discussion, several theoretical propositions will be given to highlight the main findings. These propositions serve as main conclusions and the contributions to emerging theory from this study.

5.2 The innovation framework

The innovation framework which the research manager and the research programme operates within, is the first topic for this discussion. This includes both the research programme itself, including formal and organisational structures for promoting innovation, as well as the framework the research programmes operates within, which here specifically relates to the open innovation framework for university-industry collaborations within environmental innovations. The discussion begins with discussing the role of the CEER research programmes, as research or innovation programmes. After this, the focus is shifted towards analysing the first research question of the study: "*How can research managers build and support frameworks that promote a culture for innovation in the research programmes?*". Specifically, it will be discussed whether the more formal organisational structures adapted by the research programmes are successful in harnessing innovative research and generally a culture for innovation within the RPs. The discussion ends with a proposition for new theory as a conclusion and contribution to the field of research.

5.2.1 Research or innovation programmes?

The Research Council of Norway generally states an ambition for the CEER research programmes to develop competence and innovation through long-term commitment to research. Hence, it can be argued that the RPs were supposed to be both research and innovation programmes. It is reasonable, therefore, to start this discussion and analysis by asking the question whether the research programmes under study truly lived up to being both research *and* innovation programmes. If so, it would be fair to analyse the cases and results further in light of the established literature on open innovation through university-industry research programmes, as presented in Section 2.

Throughout the research programmes, there were conflicting perspectives on what innovation is. The researchers and industry representatives tended to describe innovation as being something new that has been used or implemented by an industrial actor in a commercial setting. Following this, many of the activities within the RPs could not contribute directly to innovations almost by definition, as they were supposed to be both research-driven and of pre-competitive nature. There are many formal definitions of innovation which would support this view, e.g. Edison et al. (2013) who define innovation as a new product or process which gives and added value in an economic or social context *when being used*.

Even though there were conflicting views on whether the RPs could or should contribute to innovations, the large majority of interviewees underlined that they regarded the research programme they participated in as innovative. This points towards an important aspect of innovation in the research programmes under study: the focus was more on being *innovative* and contributing with *innovative research*, than on delivering *innovations*. In this context, an innovation is something new which is implemented or brought to market. Innovative research, on the other hand, is research that can be described as something else than the obvious next step; new and industry relevant research, new combination of methods, new fields of research etc. As innovation can be described as a process from idea to adapted product or process, innovative research will be an important contribution towards the initial steps of innovation, where new ideas are born, conceptualised and initially developed. Consequently, this is the part of the innovation process where the research programmes under study aimed to contribute. When discussing this with the research managers in the RPs, their thoughts on what innovation was revealed that they had reflected on this, taken it into account and thus tried to work with and promote innovation thereafter. This is underlined by the RP1 research director, stating that "*the partners have moved from thinking about [the research programme] as a research programme which delivers publications to delivering solutions which the industry need, mostly because of how we talk with the partners about innovation*" (Research programme director, RP1). As

such, both the industry and research partners had matured regarding what innovation means in the RPs, and what the expected contributions should be.

In addition to that most of the partners underlined the ambition of pursuing innovative research, the actual innovativeness of the RPs has also been supported by findings through secondary sources of information as reported innovations to the RCN, annual reports etc. It was also clear that some of the industry partners had been able to innovate, commercialise and profit based on results and activities from the RPs: "*Now we have a market share of 30% within [the given market segment], compared to 3-4% within [the ordinary industry]*" (Industry partner 1, RP3).

As presented in Section 4, the research programmes started out as more pure research programmes. The research managers had ambitions of promoting innovation and innovative research in the RPs, but had little experience or concrete tools for making this change. However, as both the RCN and industry partners made their expectations regarding innovation as outcome from the programmes more explicit, changes were initiated. By the end of the programmes, it seemed fair to argue that all the research programmes in this study were both research and innovation programmes, hence operated within the framework of open innovation, as described by (Chesbrough, 2006). This was underlined by the RP2 research director: "*When we designed the research programme it was mainly described as a research agenda, […] the innovation focus came much stronger after we had started [the research programme]*" (Research programme director, RP2). More specifically, since the RPs were broad collaborations where ownership rights of results and intellectual property were governed by contracts, as opposed to the open source innovation regime, the RPs were best described as private open innovation arenas, as defined by Huizingh (2011).

This discussion highlights the role of the research programmes under study, and places them within the literature for open innovation collaboration between university and industry actors. Hence, this body of research will be the basis for the further discussion. This is an important fundament for the understanding of the cases and for the further analysis. The attention will now be turned towards the first research question of this thesis, namely "*How can research managers build and support frameworks that promote a culture for innovation in the research programmes?".*

5.2.2 Building culture through structure

When the research directors were asked how they and their management teams promoted and worked with innovation, most started with elaborating on the formal structures in place in the RPs for dealing with innovation related issues. One example is the RP2 director who stated "*We have had an active innovation strategy. First we implemented the TRL methodology, which was a big process*

including all the researchers were we had them specify their research in the TRL context" (Research programme director, RP2). Specifically, innovation committees and mechanisms for reporting innovations were highlighted by many. These two mechanisms were formal structures embedded in the RP organisation. Literature, as Arad et al. (1997), argue that structures promoting flexibility, autonomy and responsibility promote innovation, whereas hierarchical structures do not. It is perhaps somewhat surprising, therefore, that the research programme directors supported their innovation management to such an extent on these formal and potentially hierarchical structures. Hence, the central question emerging from this is whether these mechanisms functioned as promoters for innovation, through contributing to a shift in the culture of the research partners towards an environment supporting more innovative research. This will be discussed next.

5.2.2.1 Innovation committees

Four of the six RPs in this study had an innovation committee planned already from the design phase of the programmes. However, all of the four programmes ended these efforts within a few years. From this, it is quite clear that the committees did not fulfil their intended purpose of promoting innovation in the RPs from the research manager's perspective. Several commented that the industry partners did not commit to the committees sufficiently. They were often represented by different persons at every meeting, and therefore it was very hard to maintain any continuity of the work, as underlined by the RP2 research director: "*The industry partners came [to the meetings] with different people every time, so we shut down the committee*" (Research programme director, RP2). It seemed like it was hard for the RPs to define a concrete role or give a certain mandate to the committees, which again can have contributed to lowering commitment from industry, as the scope of the work was unclear. Only RP4 reported that they were able to use the innovation committee as they had hoped: for defining innovation in the RP and developing reporting mechanisms and an innovation strategy. This was a concrete mandate, which enabled the innovation committee to work against defined goals and within a given scope. This again enabled the participants to see the importance of their contributions. This, rather than a more vaguely described ambition of promoting innovation in the RP in general, can have contributed to increase the commitment to the work done by the committee.

The two industry partners in RP1 both commented that they thought the innovation committee was a good initiative: "*Roughly speaking, [the innovation committee] was successful*" (Industry partner 1, participant 1, RP1). Nevertheless, the committee was shut down. Here, the committee served as an arena for engaging the industry generally, whereas it was not experienced that the committee was able to promote innovation specifically in the RP. Further, when the industry partners commented on

the innovation committee as something they valued, as explicitly stated for RP1, this suggests that maintaining such a committee could contribute to enhancing industry engagement generally towards the RP; by creating more informal arenas for meeting the industry, discussing their needs and priorities, and generally expose the university and industry logics to the opposing partner. Perkmann & Walsh (2007) find that higher relational involvement and engagement between industry and research partners give higher contributions towards innovation activities. As such, innovation committees can promote innovation in the RPs indirectly, through promoting engagement and building relationships between the partners. This, however, would also require engaged management in the RP, taking the role as bridge builders between the industry and the researchers for translating the discussions in the committee into useful input towards the actual work. This is in line with Ruuska and Teigland's (2009) findings, underlining the importance of the research manager as a bridge builder between research and industry.

It is difficult to conclude on whether innovation committees can promote a culture for innovation based on the observations and data discussed here, especially since several of the committees only lasted for a short period of time. It is clear, however, that RP4 was able to utilise expertise from the industry partners within the field of innovation management by giving the committee a clear mandate and following up on this. As such, the RP4 management team was able to learn from the experience of the members of the committee when first starting to develop their own framework and processes for innovation management. Hence, as competent innovation and knowledge management is a solid fundament for successful innovation processes (Carneiro, 2000; Gupta et al., 2000), the findings from this study do suggest that an innovation committee can promote innovation processes in a research programme, as was experienced in RP4.

5.2.2.2 Innovation reporting mechanisms

Where the innovation committees discussed above were adapted mainly as vehicles for promoting innovation top-down through interaction with the industry and learning from their experience, the innovation reporting mechanisms adapted by the majority of the six RPs were structures for organizing, communicating and reporting innovations inside-out from within the programmes. The RPs which used a dedicated reporting mechanism for innovation, also used this as a tool for communicating the most important results from the RP to the industry partners and other stakeholders. As several of the reporting mechanisms adapted also took preliminary innovations into account (i.e. yet not implemented), as the TRL methodology used by RP1 and RP2, the procedure enabled the research programmes and managers to highlight the innovativeness of their research and results, even though

these were not yet implemented innovations. In addition, several of the research partners were familiar with e.g. the TRL methodology from their own companies. Hence, using this approach could contribute to making the research more palpable for the industry partners, hence bridging opposing logics between industry and university partners and as such promote increased knowledge transfer and possibly industrial innovation (Perkmann & Walsh, 2007; Lind et al., 2013). However, even though the effect of using the reporting structure for communicating with the industry was beneficial, this was not necessarily the main motivation for adapting these structures.

It was the ambition of the RP directors to use the innovation reporting structure also for promoting innovation amongst the researchers through continuous focus towards the topic over time, as argued by the RP2 director: "*[The TRL methodology] works well; it gives us focus*" (Research programme director, RP2). However, as discussed, literature generally disregard bureaucratic structures as promotors for innovation (Arad et al., 1997; Judge et al., 1997). Using the RP1 and RP2 cases, which both adapted a quite similar TRL methodology for innovation tracking and reporting, as basis for this discussion, it was observed that this type of reporting was somewhat controversial among the researchers. Several regarded this as yet another administrative task without any added value, as in line with what the literature argue would be the result when adapting bureaucratic structures with the ambition of promoting innovation (Arad et al., 1997; Judge et al., 1997). As stated by one of the researchers: "*I don't think the TRL methodology works for innovations. It's a good thing for describing technologies, but not for innovations*" (Researcher 2, RP1). As such, implementing the TRL methodology induced much frustration amongst the researchers, and rather counteracted innovation than motivating for it.

It was, however, observed a significant difference in attitude between researchers in RP1 and RP2. Where the researchers in RP1 mainly reflected the attitude described above, the researchers in RP2 seemed to have adapted the attitude shared by the research director, as underlined by one of the researchers: "*[Because of the TRL methodology adapted] I believe I think more about innovation, what it is, and what the usefulness for the industry can be*" (Researcher 1, RP2). There can be different explanations to this. Firstly, in RP2 they implemented the innovation reporting quite early, and they had been doing this for many years. The researchers commented that in the beginning they too felt opposition towards the method, however, over years they adapted and experienced the benefits as well. Secondly, in RP2 there was a dedicated person in the management team responsible for following up directly with the researchers on this reporting. Hence, they were helped, educated and guided on how and why to do this. They felt that the management really wanted this, and were engaged towards the effort. This is in accordance with the literature on leading change processes, as e.g. "Kotter's eight steps" (Kotter, 1995). By management "walking the talk", the researchers experienced that the

innovation reporting was not only yet another administrative task, but something which was important for the research programme. As such, it can be argued that the researchers kept their freedom and autonomy, as deemed necessary for successful knowledge management and innovation (Arad et al., 1997; Drucker, 1999), whereas the innovation reporting scheme worked as a guideline for how and why to keep the focus on innovation and the industrial needs. This is similar to what Judge et al. (1997) describe as a good environment for stimulating creativity and innovation, where researchers are free to achieve their goals through autonomy, empowerment and creativity within guidelines (or "*chaos within guidelines*").

It is clear from this discussion that employing a formal innovation reporting mechanism can promote a culture for innovation. However, the effect is indirect, as the structure itself will not inherently promote innovation. The innovation culture is developed over time, by the research manager giving continuous and enhanced focus to the topic and by using the reporting mechanism as an active means for achieving this. Without this whole-hearted follow up by the research management, the risk of the innovation reporting scheme being experienced as yet another bureaucratic obstacle increases significantly, thus rather counteracting innovation, as observed to some extent in RP1. When successful, however, the benefit is twofold. Firstly, it can contribute to bridging the gap between partners in the university-industry collaboration by presenting innovative results in an "industry-friendly wrapping", thereby increasing engagement and potentially boost knowledge transfer and collaboration. Secondly, it can promote innovative research amongst the researchers by contributing to developing a culture for innovation within the RP. Based on this and the discussion above, the following is proposed:

> ***Proposition 1: Formal structures as innovation committees and reporting mechanisms for innovation will indirectly promote a culture for innovation and innovative research, given continuous attention and focus from management to the topic over time.***

Where current literature argue that organisational structures can contribute to either promoting or counteracting innovation (Arad et al., 1997; Martins & Terblanche, 2003), these findings suggest that it is not the formal structures that inherently will promote (or counteract) innovation, but rather the actions and focus of the research manager through employing these more formal organisational structures. This adds to the current body of research.

5.3 University-industry relationships

In this section, the discussion relates to the relationships observed between university and industry partners within the research programmes, including both engagement, involvement and forms of

collaboration, how these relationships influence innovation, and whether research managers stand in a position to promote innovation through effecting such relationships. Specifically, the following discussion will address the research question "*How do relationships between research programme partners influence the innovation processes, and how can managers affect these relationships?*". Four topics will be discussed, namely the role of relationships for promoting innovation in the RPs, how the research managers can influence such relationships, opposing logics between partners and the role of coopetition within the research programmes. Throughout the discussion, main findings will be highlighted through several propositions, which also act as suggestions for new theory within the field.

5.3.1 The role of relationships for innovation processes

The discussion here begins with analysing the role of relationships between research and industry partners for promoting innovation processes in the research programmes under study. Through the theoretical review in Section 2.3, two models on relational involvement (Perkmann & Walsh, 2007) and dominant collaboration forms (Lind et al., 2013) between industry and university partners were presented. Generally, these studies argue that higher relational involvement as well as developed collaboration forms (where both university and industry logic co-exist, and both parties pursue and contribute to the same superior research agenda) will contribute to enhancing innovation processes in university-industry collaborations. In Table 9 (see next page) the relational involvement and dominant collaboration forms found in the three main RPs under study are summarised, as according to the models in the two studies.

Table 9. Relational involvement according to the Perkmann & Walsh (2007) model, and dominant collaboration form and logic according to the Lind et al. (2013) model.

RP#	***Relational involvement***	***Dominant collaboration form***	***Dominant actor / logic***	***Comment***
1	Low: Transfer	Distanced	University	Knowledge was mainly transferred through publications, reports and presentations, hence relational involvement was low. The research was mainly driven by processes towards research results, mostly through distanced collaboration forms and university logic was dominant within the RP.
2	Low to Medium: Transfer to Mobility	Distanced / (Specified)	University / (Industry)	Knowledge was mainly transferred through publications, reports and presentations, hence relational involvement was low. However, direct industry involvement with measurement campaigns, tests and contribution to industry partner's software did occur. These processes were characterised by somewhat higher relational involvement. The research was mainly driven towards research results through distanced collaboration forms, dominated by university logic. Where industry was more directly involved, the dominant collaboration form moved towards the specified form.
3	Medium to High: Mobility to Relationship	Distanced / Specified / Developed	University / Industry / University and industry	Both distanced, specified and developed cooperation forms were observed within different parts of the RP. The developed cooperation took place through pilot projects, where both university and industry logic co-existed and contributed to the same research agenda. For these projects, relational involvement was high, relationships were formed, and there was a feeling of "we're in this together". Knowledge was transferred just as much through concrete experience from the collaboration, as through reports or publications. For more fundamental research within the RP, distanced collaboration and low relational involvement were observed, as for RP1 and RP2. Finally, specified research for developing or improving products for specific industry partners occurred.

As can be seen from Table 9, there is a correlation between relational involvement and dominant collaboration form and logic across the research programmes investigated. Where the collaboration form was distanced, mainly driven by the research partners and towards research results, the relational involvement from industry partners was low, and knowledge was transferred mainly through formal channels of communication. This was underlined by a RP1 management team member stating that "*It is a big challenge to get real intervention [with the industry partners]*" (Management team member, RP1). On the other hand, where more developed or concrete collaboration took place, as for the pilot projects in RP3, the relational involvement between the partners was also higher, and characterised more as true relationships. Here the knowledge was developed together, or transferred through collective experiences and learning: "*[The cooperation through the pilot projects] has*

developed into a relationship with mutual dependencies where we use each other's brands and capacities" (Industry partner 1, RP3). As a supplement to this observation, the RP4 research director described how the partners that had committed to working with the research programme through specific case studies were more satisfied with the research efforts generally and reported higher added value of the collaboration: "*We found that the industry partners who had engaged in case studies gave us very good scores, whereas it was poorer from those that had not*" (Research programme director, RP4). Based on this, it is proposed that the Lind et al. (2013) and Perkmann & Walsh (2007) models are closely correlated: the developed collaboration form is a strong promotor for high relational involvement, and both factors contribute towards building true relationships between partners.

True relationships between university and industry, as described above, has been found to promote innovation in research programme collaborations (Perkmann & Walsh, 2007; Lind et al., 2013). Findings in this study also support this; the more concrete the cooperation had been, the more the industry got out of the cooperation in terms of useful results or true innovations. It seemed like the industry partners acknowledged this, also those who did not commit or engage to a high extent to the research programmes: "*[We] could have gotten more benefit [from the research programme] if we followed [it] closer throughout the whole period*" (Industry partner 2, RP2). Further, the results suggest that in those cases were the industry were distanced from the collaboration, the researchers also tended to distance themselves more from the industry. In RP1, where low relational involvement from the industry was observed, the researchers were also more reluctant to engage towards industry, partly because they doubted that the industry would commit and meet their engagement, and hence partly because they were unsure of what they would get out of it, as underlined by one of the RP1 researchers: "*[Meeting with industry] takes time to prepare, and the travel spends budget and then we have much less time to do the research we had planned.*" (Researcher 3, RP1). The researchers, however, clearly stated that they wanted a closer collaboration with the industry, where both sides were relationally involved to a higher extent. As such, the findings here not only support the literature, but also suggest that the absence of relational involvement from industry can counteract innovation in research collaborations. Hence, the reasoning so far leads to the second proposition of this study:

> ***Proposition 2: Engaged relationships between university and industry through high relational involvement and developed cooperation will contribute towards increasing understanding and promoting innovation and innovative research, whereas absence of relational involvement from industry can counteract innovation and innovation processes in research collaborations.***

All industry partners interviewed for this study generally seemed quite engaged towards the research programmes. They acknowledged the importance of the RPs, and the efforts put in by the research partners. However, high engagement does not necessarily lead to high relational involvement. It was observed that many research partners engaged actively when present, e.g. at bi-annual RP seminars, but were distanced and little involved in between these meetings. As such, it is importance to underline that even though general engagement is a positive factor, it does not promote innovation to the same extent as high relational involvement, especially if the engagement only is experienced sporadically. Based on this reasoning, and by building on Proposition 2, the following is proposed:

> ***Proposition 3: Industry engagement towards a research programme will not alone promote innovation to the same extent as high relational involvement and concrete collaborations will.***

The observed tendency towards general engagement, but lack of relational involvement or developed cooperation can to a certain extent be explained by the "double externality problem", as described by Rennings (2000). This has been defined as the situation within environmental innovation where the company has to bear the costs of the innovation, whereas the society reaps the benefit when the innovation is implemented. This is often the case for climate technologies, e.g. mitigation technologies for different emissions from industrial processes. All RPs in the study were involved with environmental innovations, whereas the double externality problem seemed especially relevant for RP1 and somewhat for RP2, as underlined by one of the RP1 industry partners: "*[The technology] has been through a though period. [The research programme] has had difficulties with the industry not being there for absorbing results*" (Industry partner 1, participant 1, RP1). The industry partners saw the necessity of technology in the future, but did not yet have any clear economic incentives. Hence, if e.g. the research was distanced from the immediate industrial needs, or if other tasks within the company became urgent, resources for following up on the research programme would soon be prioritised for other needs. This can explain the general engagement from industry (they acknowledged the importance of the development), but lack of involvement and concrete collaborations, as the economic incentive for pursuing the technology from the industry perspective was weak. As such, "double externality" stood as an obstacle for efficient innovation processes, as also argued by literature (Rennings, 2000; Beise & Rennings, 2005).

Through this part of the discussion, focus has been on how relationships influence innovation processes in the research programme. Now, this discussion will be continued through shifting focus towards how the research manager stands in position to promote innovation and innovation processes

through influencing development of committed relationships between industry and research partners in the RPs.

5.3.2 Promoting cooperation and relationships

The research managers constantly tried to engage the industry and create meeting arenas for them to interact with the researchers and project leaders. In RP3 and RP4, this was realised through the pilot projects and case studies, where industry and researchers worked collectively together to create a common output. This created a feeling of "we're in this together" and an interdependency between the partners. This highly contributed to lowering the barriers for effective cooperation. By creating concrete projects with strong interdependencies between partners for reaching a common and clearly articulated goal, the research manager can contribute towards promoting relationships and thereby innovation in the research programme, as underlined by one of the RP3 researchers: "*The pilot projects have enforced a cooperation on a very concrete level. [...] They are like innovation arenas*" (Researcher 1, RP3). This is in line with Barnes et al. (2002), who argue that commitment and trust are two universal success factors for university-industry collaborations; commitment and trust would be prerequisites for successfully implementing such collaborations as described here.

Not all industry partners, however, had the ability or desire to engage actively in the research processes. They regarded their role as being contributors of knowledge and experience, in addition to using the research programmes as platforms to network with customers and discuss and interact with competent personnel, as identified by Feller (2005) as a main driver for industry to join such collaborations. In this case, expecting and requiring active involvement through collaborative efforts can be counterproductive. As one researcher argued: "*We don't want to scare the partners away by having too high expectations either, we've lost partners before [because of that]*" (Researcher 1, RP2). The already discussed issues relating to "the double externality problem" can also lead to the same attitude among partners (Rennings, 2000). In this situation, the research manager can be in a position where one has to choose between having less engaged partners, or no partners at all. Here, the managers seemed to be best served by listening to and discuss with the partners and aligning expectations and modes of collaborations between all partners thereafter. To manage this, the research manager needs to have excellent dialogue and knowledge broker skills, as underlined by Ruuska & Teigland (2009), to be able to lead and align such processes. In fact, both the RP1 and RP3 research directors commented that they thought that more of the partners would have dropped out had they not continuously worked with involving the industry partners into processes of the research

programmes: "*[I think] we might have had fewer partners [if we had not followed up explicitly on innovation]*" (Research programme director, RP1).

In conclusion, the research manager is in a key position for understanding the dynamics of the research programme, and thereby aligning expectations from the different stakeholders. The research manager is the one person who communicates most with all involved parties, and as such stands in position to understand the different and opposing perspectives. By promoting concrete and engaged cooperation between partners, this can be used to also boost innovation and innovativeness of research within the research programme. However, failing to act as a knowledge broker between different stakeholders, could contribute to opposing innovation and knowledge transfer, as partners could lose interest or not see the added value of the cooperation, and thereby not want to contribute to the processes or ultimately withdraw from the research programme, consequently discouraging cooperation and thus innovation. Therefore, to conclude this section of the analysis, the following is proposed:

> ***Proposition 4: The research manager can be a key enabler for engaged relationships by acting as a knowledge broker and bridge builder within the research programme, whereas failing at this can counteract innovation processes.***

5.3.3 Opposing logics in university-industry relationships

In the previous section, it was described how engaged relationships through real and concrete cooperation contributed to lowering the barriers for effective collaboration through the research programmes. Opposing institutional logic have been found in literature as a significant obstacle for achieving this, as e.g. described by Adler et al. (2009) and Lind et al. (2013). This is supported also by findings in this study; opposing institutional logic was evident and a source of frustration within all three main cases under study. The opposing logic was perhaps least evident for the pilot projects as described in RP3. However, even the industry partners contributing to these projects argued that the researchers focused too much on the research itself, its value as a stand-alone product or results, and the researchers' tendency to neglect the short-term needs of the industry: "*[The researchers] think that research has an intrinsic value making the part on innovation the responsibility of the industry partner. To them a negative result still has a value. To us this is worthless*" (Industry partner 1, RP3).

The perspective on the role of the PhD students in the RPs was one topic where the opposing logic was particularly evident. Generally, the industry partners acknowledged PhD education as an important activity within research, but struggled to see the direct relevance for them as contributors to the research programmes, as underlined by one of the research partners: "*PhDs are very important, but*

there is a risk of goal conflicts" (Industry partner 1, RP3). The industry displayed an attitude towards PhD education as an activity which spent large portions of limited funds, whereas the return on the investment for the industry was regarded as limited. The researchers on the other hand, argued that the PhDs contributed significantly to the more fundamental research within the RPs, thereby providing the necessary fundament for performing the more industry relevant or innovative research. This exemplifies the opposing logics within the research programmes on this specific topic, in line with description from literature (Thornton & Ocasio, 2008; Adler et al., 2009; König et al., 2013)

Both the industry and the research partners highlighted several factors which the research managers could have addressed for lowering the barriers of opposing logics for this specific topic. It was evident that many of the PhD students were quite remotely linked to the research programmes. They received the funding for their studies through the RP, but felt commitment towards their university and research group rather than the research programme: "*[The research programme] was never a topic when I started my PhD. We talked more about the group and the thesis*" (Former PhD student, RP2). If the research managers had been able to promote commitment and link the PhD students closer to the RPs and their associated goals and challenges, this could have contributed to increased common understanding and the industry seeing more of the relevance of the PhDs. This could also increase the relational involvement of the PhD students towards the RPs generally and the industry specifically (by seeing and acknowledging their needs), as according to Perkmann & Walsh (2007) will contribute towards building relationships and hence promote innovation.

Building on this, several industry partners also suggested that they themselves could be formally linked to PhD students, through co-supervision or longer stays e.g. at the industry partners' labs: "*We should have been responsible for a PhD student who would know us in and out throughout the period. That would have given us a much better start*" (Industry partner 2, RP3). Through this, the students would get to know the company well, and be better positioned to target their research towards the industrial needs, although still through a longer-term perspective. Through this, actual collaboration between the PhD students, their research teams and the industry partners could emerge over time. If accompanied by high relational involvement, ultimately this could mature into developed collaborations where the university and industry logics co-existed, as described by Lind et al. (2013). Generally, these are opportunities which the research managers can utilise to address the challenges inherent to opposing logics to promote development of relationships and hence potential for innovation and innovative research within the research programmes. However, even when having the intention of making this happen, it is not given that the outcome will be successful, as experienced in RP2: "*We see that coupling PhD students and researchers directly to the industry partners [...] is*

important. […] Some persons have the engagement and time, the chemistry matches and so on, but for others it gets very formal. Then it doesn't work well" (Research programme director, RP2).

Several of the RP directors more generally underlined the importance of linking the right people from the different partners to ensure that interaction occurred throughout the organisations, thus avoiding that upper management and the research directors were the only points of contact between partners in the RPs: "*We must ensure communication on the researcher level with the industry. The technical experts in the firms have to meet our researchers, such that the researchers can understand the challenges and plan their research accordingly*" (Research programme director, RP1). This is in line with the reasoning discussed above on how and why to link and engage the PhD students towards the industry partners, as supported by Perkmann & Walsh (2007) and Lind et al. (2013). Although not an easy task, when adapting this philosophy, the research managers can contribute personally to building bridges on the management level in the RP organisation, whereas linking people working in the organisation contributes to building bridges between those actually engaging in and performing the research in the RPs. For making this happen, however, the research managers need to facilitate and promote this interaction by trying to engage both the industry partners and the researchers. If successful, this can contribute to lowering barriers for cooperation by increased understanding through bridging opposing logics, and thereby promoting innovation and innovative research within the RP. In conclusion and based on the reasoning above the following is proposed:

> ***Proposition 5: By facilitating close links between researchers and their peers amongst the industry partners, the research manager will contribute to increased understanding through bridging opposing logics throughout the research programme, and hence promoting development of relationships.***

This proposition is specifically in line with and further supports the propositions 2 and 4, as previously presented in Sections 5.3.1 and 5.3.2. The discussion in this section has thus far been related to relationships between industry and research partners, by investigating challenges and opportunities for promoting innovation through university-industry interactions. Now, however, through the last part of this section the focus will be on the role of relationships between the industry partners in the RP, and how this can influence cooperation and innovation. Specifically, the role of coopetition is discussed next.

5.3.4 The role of coopetition

The research programmes under study were all designed to promote pre-competitive knowledge, technology and innovation. Hence, firms that usually regarded each other as competitors were enabled to cooperate through the research programmes through joining forces for further development and expanding their common markets. As first described by Brandenburger & Nalebuff (1996), they used the research programme as an arena for coopetition. Further, a coopetition alliance where industry teams up with different research providers for promoting research within a certain technology or market, falls neatly within Chesbrough's framework of open innovation (Chesbrough, 2003). This was the basis for the research programmes investigated through this study.

A prerequisite for fruitful coopetition alliances is mutual trust, and shared values and goals (Carayannis et al., 2000). This was observed as being the case in RP1. The industry partners were all quite similar, being large companies and technology end-users, and they all shared the common goal of developing the technology for the benefit of the industry in general. This was a very good position to be in for the research programme, as the discussions with the partners could be on a more aggregate level, focusing on the general needs of the technology as a whole, and less on the specific needs for each of the partners, as underlined by one of the industry partners: "*The industry partners are all running for the collective goal. [...] And as all industry are end-users, not vendors, we share the same perspective*" (Industry partner 2, participant 1, RP1). Also in RP3, both the industry and the researchers commented that having competitors among the partners did not cause any difficulties, as the knowledge and output for the partners just as much concerned methods and ways of working, as technology or IP (Bengtsson & Kock, 2000).

Without fundamental shared trust and common goals amongst the partners, there will always be chances of opportunistic behaviour (Carayannis et al., 2000). The chances for this will increase as technology and research results are matured, or if contributions from the partners are very specific. In RP2, the researchers commented that they suspected that the partners were reluctant to share their background or to commit to activities in fear of other partners behaving opportunistically: "*I have experienced earlier that it's easier to intervene and cooperate [with the industry] when it's only one vendor participating. [...] If your competitor participates in the same research programme, it might be easier to be silent and just watch*" (Researcher 1, RP2). This is in line with what Carayannis et al. (2000) describe will be the outcome when trust between the partners is weak. Furthermore, Park et al. (2014) underline how moderate levels of competition within coopetition alliances will be more beneficial for the outcome of the alliance than no competition present, giving no tensions at all, or too much competition, potentially giving opportunistic behaviour or partners becoming reluctant to share or engage. This is in line with what has been observed through this study. Large research programmes

can be beneficial for the research partners, but can become a challenge for the industry partners, as many different and potentially competing actors are collaborating on a broad range of topics within the same programme. It can be harder to build trust in a larger than in a smaller collaborative effort (Adler et al., 2009).

For the research managers who led the research programmes under study, coopetition did not seem to be a topic attracting too much attention. One reason for this could be that the interactions within the RPs mainly were observed to be between research partner and industry partner, and to a much lesser extent between several industry partners and a research partner, or between industry partners directly. Hence, the upside of coopetition was somewhat peripheral, as the industry partners themselves did not engage actively to reap the benefits from coopetition. Some partners argued that they engaged towards the RP also because of networking, hence pursuing dialogue with other industry partners. This, however, was mainly networking between costumers or potential future collaborators, and hence did not fall within the category of coopetition, as discussed by Ritala & Hurmelinna-Laukkanen (2009). In conclusion, it seemed like the potential downsides of coopetition, i.e. weak forms of trust and fear of opportunistic behaviour, were the main challenges which had to be addressed by the research manager. However not prominent throughout the RPs, if these factors were present, it could contribute negatively towards building relationships between the partners, and hence impair the innovation processes. This is a potential pitfall research managers should be aware of. Accordingly, the following is proposed:

> ***Proposition 6: Limited direct cooperation between competitors within research programmes disables industry partners to reap the intended benefits from coopetition, while still exposing them to the potential downsides as weak forms of trust and fear of opportunistic behaviour.***

This concludes the discussion related to relationships and innovation processes in the research programmes. The discussion now continues with addressing the last topic of this thesis, namely the role of the research manager.

5.4 The research manager

In this section, finally the attention will fully be turned towards the main subject of this study, the research manager. Thus far, structures for innovation and relationships in the research programme have had the main focus. Through this, it has indeed been argued that the research manager plays a vital role in promoting innovation in the research programmes, and that lack of management focus even can counteract or hamper innovation processes. The third and last research question of this study has been: "*How can research managers facilitate innovation through their leadership roles in the research programmes?*". To a certain extent, this has already been addressed through the previous sections. Hence, the following discussion will at times be a synthesis of what has been discussed, however now keeping the focus explicitly on the different leadership roles taken on by the research manager. Specifically, this section starts with discussing the research manager as a bridge builder between partners and stakeholders, and continues with analysis regarding the research manager as a change maker, and as a team player. The section ends with a discussion of the many facets of the research manager and a final proposition is suggested.

5.4.1 The bridge builder

Several authors have already argued that the research manager in a university-industry collaboration, as in the research programmes under study, needs to be an effective bridge builder between the different stakeholders within the organisation. Ruuska & Teigland (2009) point to the importance of the manager having knowledge broker skills, meaning the capability of promoting trust from different stakeholders and of communicating effectively between them. Barnes et al. (2002) argue that a diplomatic attitude and a participative and delegating leadership style are important factors.

As the name implies, the bridge builder role concerns promoting dialogue and interaction between partners with differing motives, expectations or institutional logics (vom Brocke & Lippe, 2015), which here specifically relates to interaction between industry and research partners within the RPs. This underlines an important point; the bridge builder is a leadership role mostly used externally towards the other partners in the RPs, and not towards the researchers within the research manager's own organisation. Consequently, the bridge builder role concerns interacting with industry partners to actively promote engagement and eventually relationships characterised by high relational involvement and developed collaboration for promoting innovation throughout the research programmes (Perkmann & Walsh, 2007; Lind et al., 2013). This in line with the findings in this study, as has been thoroughly discussed in Section 5.3, and highlighted by propositions 2 to 5.

Literature underline, however, the inherent weak position of the research manager and challenges this entail, especially in meeting with the external partners. One example can be the potentially low status and limited authority the research manager has amongst the partners (limited power to enforce authority) (Adler et al., 2009). Another example is the conflicting expectations and goals which need to be balanced and aligned by the research manager to keep the different stakeholders satisfied and engaged (vom Brocke & Lippe, 2015). This underlines that even though there is a great opportunity for acting as an effective bridge builder in the RP organisations, it is at the same time a very challenging task, as underlined by one management team member: "*We have to get better at communicating clearer and simpler [with the industry]. It has been a development, if you study the way we talk*" (Management team member, RP1). As for this study, all research directors argued that they spent much time interacting with and trying to engage the industry partners, to understand their perspective and align expectations, but also recognised this as a challenging task. However, when successful, the strategy was experienced to be quite effective: "*[The research programme director] understood that she/he had to increase focus [on dialogue]. We were invited to give input [to the projects], [...] then we got very involved*" (Industry partner 2, RP3).

As the bridge builder leadership role can contribute to increase understanding, align expectations and develop relationships between partners, this promotes innovation both according to literature (Perkmann & Walsh, 2007; Lind et al., 2013) and findings from this study. However, the bridge builder role also more generally contributes to enhancing relevance of research by exposing the researchers towards the industry perspectives, expectations and needs. What the bridge builder leadership role does not address, however, is actively leading the researchers towards meeting the needs and expectations of the industry partners. For meeting this challenge, the research manager needs to use different management tools and take on a different leadership role, namely the change maker role.

5.4.2 The change maker

As the literature on knowledge management underline, managing change has been found to play a central role in the process of promoting innovation among knowledge workers (Carneiro, 2000; Gupta et al., 2000), as managing innovation concerns grasping and shaping opportunities and ideas in an ever-changing environment. For the research programmes under study, this related much to motivating the researchers to engage towards the industry partners, the industrial needs and shaping and aligning the research accordingly. However, where the bridge builder role, as discussed above, seemed to attract a lot of attention from the RP directors, engaging within own ranks through the change maker role was not necessarily given the same amount of focus. This is underlined by one of the RP1 researchers: "*It hasn't been much interaction with the research programme management, [...] and not too much*

coordination either" (Researcher 4, RP1). There could be several explanations to this. One issue is that as the consequences of losing a partner in the research programme are very specific and dramatic (e.g. because of lost funds), the main focus will naturally be towards the funding partners, i.e. the industry. This is underlined by the following quote, where the RP1 director explained her/his engagement towards keeping the partners in the RP: "*[The most challenging with being a research director] is when a central industry partner says that they want to withdraw from the research programme. Then anxiety follows, what happens now? Until we move into action and become constructive*" (Research programme director, RP1). One other reason explaining the less time spent towards trying to engage the researchers could be that the managers assumed that the researchers naturally adapted the same perspectives as themselves, and thereby tended to neglect the efforts necessary to communicate perspectives and mobilise change within own ranks, as also underlined by the quote from the RP1 researcher above. As argued by Judge et al. (1997), innovation is best promoted by "*chaos within guidelines*". If the guidelines from the research manager does not appear, only "chaos" is left. In other words, the researchers in the research programmes need a clear leader to be able to align towards the common goals of the RP.

A specific example of the change maker role in action is the implementation of the innovation reporting mechanisms in RP1 and RP2, as thoroughly discussed in Section 5.2.2. Here, it was concluded that the implementation eventually promoted innovation in RP2, whereas the effect was neutral or even negative for RP1. Furthermore, it was argued that the reason for this largely was that the RP2 director managed to adapt change management practices, as e.g. described by Kotter (1995), for implementing the structures, and hence successfully took on the change-maker leadership role. This is supported by the way the RP2 researchers described the management focus on innovation: "*[Management] follow up [on innovation] very much, they sell it to us as something positive. If they had a different focus and signalled that this just was something they needed to report, we would have followed up quite differently*" (Researcher 3, RP2). By this, the reporting mechanism became a positive means for promoting innovative research facilitated by the research manager in RP2. In RP1, where change management practices were not adapted as successfully, the implementation on the other hand induced frustration among the researchers. This reaction is also in line with the knowledge management literature, underlining that one cannot motivate knowledge workers through telling them what to do (Stevens, 2000). Motivation comes through empowering the knowledge workers and motivating them towards wanting to share their knowledge (Flood et al., 2001; O'Neill & Adya, 2007). Consequently, a prerequisite for inducing change amongst knowledge workers is motivating them for the change and working with them for them to understand and embrace the greater good both for the RP and for them as individuals, hence always keeping the psychological contract between the research

manager and the researcher intact (O'Neill & Adya, 2007). As such, taking on the change maker role for motivating for innovation and innovative research will be of key significance for the research manager.

When working with the researchers for implementing the TRL methodology, the RP2 director ensured close follow-up over longer periods of time by amongst others one of the management team members. This person was dedicated towards the task, and aligned with the RP2 director on why and how to do this. This is underlined by how they worked with implementing the change not only as a reporting scheme, but also for developing a change in culture over time: "*[As a manager], you have to walk the talk. People have to be treated differently. You have to talk with them, it's not enough just sending an email*" (Management team member, RP2). As underlined by this, the researchers did not embrace the change until they themselves experienced the usefulness of the method and the added value of adapting it. This underlines the importance of the change-maker leadership role, which enables change by continuous focus and engagement over time (Kotter, 1995).

The discussion above also exemplifies how the research manager was able to team up with an engaged management team member for taking on the role as a change agent, and thereby promoting the collective goals and ambitions of the research manager and the RP. By building committed management teams supported by common understanding and collective goals, the research manager can enhance management capacity throughout the RP organisation. Hence, the research manager as a team player will be discussed next.

5.4.3 The team player

As discussed in Section 2, literature has showed that creating cross-functional teams can support innovation and innovation processes (Arad et al., 1997). The research programmes investigated in this study were quite big organisations, not only supported by a single research manager, but rather by a complete management team. The RP directors led these teams, which had the project leaders as the main participants, each leading separate research activities within the RPs. The project leaders were often employed by and represented different research partners within the RPs as well.

Several of the RP directors discussed the importance of engaging the management teams and working with them for aligning towards common goals and understanding. The aim of this was to motivate the whole management team towards taking on the supereminent perspectives and objectives of the research programmes and taking decisions based on these perspectives, instead of putting personal interests or research activities first. In short, trying to avoid and exclude opportunistic behaviour within

the management team. The effects of doing this successfully were underlined by one of the researchers in RP3: "*In [the research programme] it is really a management team which leads [the research programme]. We do not sit there as project leaders representing ourselves; we represent the research programme. [...] [In other projects] people protect their own budgets and don't care about what's happening in other people's tasks*" (Researcher 1, RP3). In RP3, the unified management team was much promoted by the very concrete pilot projects, which had strong interdependencies between the different actors. Hence, promoting personal interests on the expense of others got less attractive, as it was quite evident how such opportunistic behaviour ultimately would harm the progress of the common pilot projects. In addition, the overruling and common goals both of the pilot projects and the RP as a whole were articulated very clearly, and therefore easier to lead by and align with. Building on this, one of the other research directors underlined how she/he always tried to promote the other members, to create engagement and mutual generosity: "*We have built a complementary activity with mutual generosity. [...] It is more important to me that the other research partners are successful, because [my research institution] gets so much for free because I am allowed to talk so much. The others also need some success stories for the research programme to shine!*" (Research programme director, RP5). By actively promoting the other members of the RP and the management team, the research manager could show clearly that she/he had no ambition of opportunistic behaviour, and thereby promoting trust and commitment within the team by "walking the talk" (Kotter, 1995; Barnes et al., 2002).

The research directors were not the only ones taking on management perspectives within the RPs. The management team members, being project leaders for the different activities within the RPs, also carried out the role as research managers when leading their respective research tasks. Hence, building engagement and commitment amongst these individuals specifically, as described by Barnes et al. (2002), would contribute to increasing the overall management capacity within the RP, as several took on the research manager role throughout the RP organisation and shared the perspectives and responsibilities of the research director. This is also described as a key mechanism within the change management literature (Kotter, 1995). When trying to change an organisation, if a manager at a given level within the organisation does not actively support the process, there is a significant chance for that the part of the organisation below this manager does not pick up the required momentum to create the wanted change. As such, having managers not engaged towards the change process can short-circuit entire parts of the organisation. Consequently, building, engaging and motivating the management team to lead the RP with a common voice will be extremely important for the research director for being able to efficiently lead and change the research programmes as a whole. The research director needs to be an engaged team builder.

In addition, by promoting the management team members to take on the mind-set of the research director, they also come in position to take on the other leadership roles discussed here, as bridge builders or change makers. Hence, this contributes to the management team unified and holistically promoting innovation and innovation processes within the research programme. This is of course given that barriers to collaboration are overcome, and that the management team members are able to commit towards working for the greater good of the research programme, and not primarily themselves or their home institution. There will always be chances of people acting opportunistically (Carayannis et al., 2000), and using the described leadership roles to pursue individual goals. However, if the research director by being an engaged team player can overcome the obstacles and unite the management team, the benefits will potentially be significant.

5.4.4 The manager's many facets: The research *and* innovation manager

Through this part of the study, it has been investigated how the research manager can facilitate innovation in the research programme through taking on different leadership roles, specifically the roles as bridge builder, change maker and team player. It has indeed been found that these leadership roles can contribute efficiently to promoting innovation processes, if carried out actively by the research manager. Table 10 (see next page) summarises the three different leadership roles as discussed here.

Table 10. Identified leadership roles, main targets and main functions.

Leadership role	Main targets	Main function / objective	Comment
The bridge builder	Industry partners	Promoting relational involvement and relationships	The bridge builder role was used when communicating with and between partners in the RP, especially between university and industry partners. Hence, the role was mostly used externally, and therefore tended to attract much attention from the research manager. Important for the role is knowledge-broker skills, and the ability of aligning conflicting perspectives and expectations within the RP. The main target with the leadership role is to tie partners closer to the RP, and eventually develop close collaborations and relationships.
The change maker	Researchers	Promoting change towards innovative research	The change maker role was used for engaging and motivating for change within own ranks; the research manager's own organisation or other researchers within the RP. The change maker role used practices from the knowledge management literature for engaging, motivating and creating commitment from the researchers towards innovation, innovative research, and keeping the research relevant for industrial needs. Failing at taking on the change maker leadership role, will hamper the change and innovation processes, and can induce frustration among the researchers.
The team player	Management team members	Promoting cross-functional teams and holistic leadership of the RPs	The team player role was used to create committed, engaged and cross-functional management teams. Adapting this role successfully contributed to unifying the management team, and hence enabling all members to contribute to lead the RP holistically towards the collective goal and ambition. In addition, the team player role will contribute towards excluding opportunistic behaviour by the management team members, and enable them to take on the other leadership roles as described here, to further promote innovation and innovative research from the RP.

As can be seen from the table above, the three identified leadership roles are used for targeting different stakeholders, and as such for promoting different mechanisms or results. The bridge builder role targets the external industry partners for promoting engaged relationships. The change maker role targets the researchers for mobilising for change internally towards focus on industrial needs and innovative research. The team player role targets the management team members for promoting holistic leadership of and increased management capacity within the RP. As such, these leadership roles are quite different, targets different stakeholders, and thus have quite different objectives. It is important therefore, that the research manager acknowledge the different needs of the different stakeholders, and that they have to be treated differently, through taking on the different leadership roles when interacting with the different stakeholder groups and pursuing different objectives. As has been discussed earlier, when this is done successfully, the research manager stands in a pivotal position for promoting innovation. Failing at taking on these leadership roles or acknowledging their differences, however, can counteract the objective and induce frustration in the research programme.

This is underlined by the findings in this study highlighting how formal structures and relationships amongst partners can contribute to promoting innovation if promoted actively by the research manager through the change maker and bridge builder roles. At the same time, the findings also suggest how formal structures can hamper innovation processes and lack of engaged relationships can create frustration amongst partners if the research manager fails at promoting these mechanisms through not engaging into the described leadership roles. Based on this reasoning and the discussion above, it is finally proposed:

> ***Proposition 7: For promoting innovation from different stakeholders within the research programme, the research manager needs to take on varying leadership roles which addresses the needs of the specific stakeholder group. Mixing or ignoring these leadership roles will induce frustration and counteract innovation within the research programme.***

Turning back to the very beginning, the analysis in this thesis started with discussing whether the research programmes under study were research or innovation programmes. The conclusion was quite clear, they were supposed to be both; research programmes enabling innovation and value creation. The main focus was clearly on research, whereas the innovation and innovative research should be an intrinsic part of the programmes. As such, the research managers in the RPs should be both research and innovation managers, and not either or.

The research managers in this study all worked within research institutions, and as such were trained research managers. Innovation management was more alien to them, and hence was given less attention and gave greater challenges. The different leadership roles, as discussed here, can been seen as important tools for the research managers for developing into also becoming innovation managers. Even though used to address different stakeholder groups and to pursue different direct objectives in the research programmes, the overruling objective for taking on each of these roles is the same: to promote innovation and innovative research. The findings in this study suggest that it is precisely through these key leadership roles that the research manager actively can promote innovation. By taking on these leadership roles, the research manager can use them as means and tools for influencing people and processes towards increased innovativeness of the research programme. Basically, through these key leadership roles the research manager is in a pivotal position to also become an innovation manager for the research programme.

6 Conclusion and implications

Through this section of the thesis the main findings will be summarised and conclusion from the research done will be presented. This is followed by a discussion first regarding the implications of the study for the different stakeholder groups, and lastly limitations of the study and suggested further research.

6.1 Main findings and updated theoretical framework

The aim of this study was to investigate how the research manager can promote innovation in large university-industry research programmes. This was done following three axes of investigation, namely frameworks and formal structures built to promote innovation, how relationships between partners influence innovation processes, and lastly how research managers can promote innovation through taking on different leadership roles.

Firstly, the findings suggest that formal organisational structures built for promoting innovation can serve as means for establishing an innovation culture given continuous attention and focus from management to the topic over time. The effect of the implemented structures for promoting innovation are indirect, as lack of management focus highly increases the chances for failure of the initiative. Secondly, the findings suggest that engaged relationships between research programme partners can be promoted by high relational involvement and developed cooperation, and that this will contribute towards reducing friction caused by opposing logic and promoting innovation and innovative research. The research manager is in a key position to promote such relationships by taking on the role as a bridge builder between partners. Lastly, the findings suggest, as supported by the last statement, that the research manager stands in a pivotal position for promoting innovation in the research programme by taking on different leadership roles as, in addition to the bridge builder, the change maker or the team player. Through these leadership roles, the research manager can actively influence innovation processes and innovative research, i.e. by promoting formal organisational structures for innovation or engaged relationships between partners.

In Section 2 of this study, a theoretical framework for this work was suggested (see Figure 3, Section 2.5.2). This framework was based on three mechanisms on which the research manager could rely to promote innovation (frameworks, relationships and leaderships roles), and which have been the basis for the analysis done in this study. The findings as presented here suggest a need for updating this framework. Initially it was assumed that the leadership roles was one separate means for promoting innovation in the research programme. Now, however, it is rather found that by taking on leadership

roles, the research manager can influence other mechanisms through actively engaging in these roles, and thereby more indirectly promote innovation. Consequently, in the initial framework there was a missing link between the research manager and the frameworks and the relationships. Supported by the findings in this study, it is now suggested that this missing link specifically is the different leadership roles. Figure 4 below presents an updated theoretical framework as supported by this reasoning:

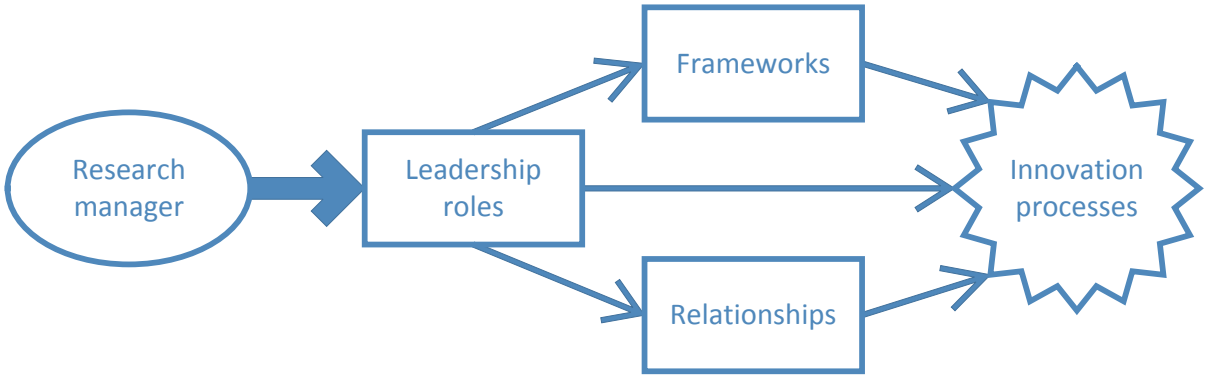


Figure 4. Updated theoretical framework, as supported by findings from this master thesis.

The updated theoretical framework underlines one very important point: it is all about the people. It is about how people interact, how people engage, and how people take on different roles when meeting one another. One who has expressed this both explicitly and beautifully is the immortal playwright William Shakespeare, in his 1599 theatre play "*As you like it*". And what could suit better than letting the master's own words summarise this conclusion:

"All the world's a stage, and all the men and woman merely players;

they have their exits and their entrances, and one man in his life plays many roles".

6.2 Implications

6.2.1 Implications for research managers

Through this study, it has been argued that the research manager stands in a pivotal position for promoting innovation within the research programme, by addressing and engaging with the different stakeholders of the RP. Specifically, this will best be done through taking on different leadership roles explicitly for each of the different stakeholder groups. It is important that the research manager is aware of these different leadership roles, how they can be used, and how they will be effective tools for promoting innovation and innovation processes within the research programme. Even though the researchers and their peers within the industry partner companies are the persons who will actually pursue and develop the innovations, the research manager has an important responsibility for impacting these persons towards increased innovativeness. As has been discussed, the research manager is possibly the one person in the RP who is most exposed to all the different perspectives, expectations and cast of characters within the research programme, and therefore stands in a position to influence a range of processes at a range of levels within the RP. The potential benefit from doing this successfully from an innovation perspective can be significant.

One other important reason for that the research manager should be aware of the power of the position regarding promoting innovation is the potential consequences if this power is not used as expected. The findings here suggest that if the research manager does not actively engage towards the industry partners for promoting relationships or engage towards the researchers for actively implementing change, this can induce frustration within the research programme. As shown from the knowledge management literature, the knowledge worker needs to be motivated to flourish, and frustration would counteract this. Hence, if the research manager is not able to actively promote innovation as expected, the consequence could be to indirectly counteract innovation processes within the research programme. Being aware of this and acting thereafter will be of key significance for the research manager for promoting and managing innovation processes successfully.

Throughout this study, the research manager has been the main subject under investigation. The aim has been to shed light on how the research manager best possible can promote innovation in the research programmes. Consequently, the research manager has received almost all attention throughout the discussions. Nevertheless, this work has implications for other stakeholder groups, specifically the researchers and the industry partners. This will be covered in the two following sections.

6.2.2 Implications for researchers

Even though the focus in this study has been on the research manager and implications of this study are perhaps most evident for the person holding the manager position, it is important to underline that the findings of this study do not imply that the researchers cannot influence or promote innovation within the RPs. As a matter of fact, a senior researcher can be an extremely important change agent for promoting innovation, e.g. if this person adopts the managerial perspective. Any researcher can also adapt the leadership roles as discussed here for promoting innovation amongst colleagues or partners. Consequently, an important implication of the findings from this study is that any person working within the research programme can influence processes and promote innovation by adapting perspectives, tools and methods as described for the research manager throughout this thesis.

Further, it has been discussed how the research manager has an inherent weak position within the research programme. For the researchers, this implies that by opposing the research manager and initiatives started by him/her, the researchers could contribute to further weaken the position, and eventually jeopardize the actions of the research manager, and in the extreme the whole research programme. However, if aligning with the research manager and actively supporting the initiatives for promoting innovation and change, the researchers can instead work as change agents for the research manager within the RP, and thus strengthen the research manager position and work. As the research manager is in a key position for aligning partners and promoting innovation, this implies that the researchers as well can support these processes, by promoting the research manager. As such, the findings from this study also relates to and concerns the researchers in the RPs.

6.2.3 Implications for industry partners

Generally, the implications of the findings from this study supports findings from the literature arguing that increased relational involvement of the industry partners and close and developed collaboration between industry and research partners increase the innovation potential from the RP. Consequently, industry companies joining such research programmes should have as an ambition to actively engage and if possible involve themselves and contribute directly to the work and the research processes to optimise their output and return on investment.

More specifically, the findings from this study have implications for the interaction between the industry partners and the research manager. As has been argued, the research manager is in a key position for communicating with and influencing all the stakeholder groups within the RP. As such, for promoting their expectations to and ambitions for the research programme, the first important step

for the industry partner should be to communicate and align with the research manager. There are several reasons for this. Firstly, there is a higher chance of the research manager understanding and adapting the perspectives of the industry than for a researcher, as the research manager is more regularly exposed to such perspectives. Secondly, as the research manager is in a key position for influencing the researchers within the RP, engaging the research manager towards the industrial perspective would enable her/him to take on a change maker role for implementing and promoting these perspectives throughout the RP organisation. As such, by aligning with the research manager, the industry partners can also promote the industrial perspective and hence innovation throughout the research programme.

6.3 Limitations and directions for future research

This study has several limitations, which should be addressed through future research. One limitation is that all the cases selected were quite similar. Even though it was tried to pick as different cases as possible within the CEER scheme, all of the investigated research programmes were organised similarly, funded the same way, and contributed with technology development into the Norwegian energy sector. However, having similar cases is also a strength when doing cross-case analysis, as too different cases would make it much more difficult to perform solid cross-case comparison. As such, future studies should include research programmes which addresses topics within other industry sectors than energy, to investigate the transferability of results between different industrial sectors.

It was early stated in this study that the market conditions were experienced as externalities for each of the RPs having significant effects on the research and innovation processes. As the maturity of the markets affecting the RPs under study were quite different, it could at times be hard to compare the cases directly. To support the generalisability of the findings here, it should therefore be conducted studies on cases where the overruling market conditions are more similar for all cases, such that these externality effects can be ruled out. This also serves as an example underlining that having too different cases renders comparison difficult. Consequently, as commented above, it would be a good strategy for future research to perform several case studies within different markets or industry sectors, to study the transferability of the results case study by case study, instead of grasping over too much in one single case study.

The number of cases investigated can also be a limitation for the study. Even though six cases were included, only three of these were investigated in-depth, mainly due to the limited time available for a master's thesis (6 months). The last three cases served as additional cases with primary information from the research manager only. As such, it was more difficult to validate findings from the secondary

cases, as information given by the research managers could not be cross-checked with other stakeholders within the RP. Future studies should therefore also include more cases for in-depth analysis.

The research programmes were also quite big organisations having 15 to 30 partners and contributions from 50 to 100 different researchers. For each of the primary cases, two industry partners and three or four researchers were interviewed. This quite narrow selection of respondents was, once again, a consequence of the time restrictions of a master's thesis. Even though a representative selection of researchers and industry partners was done for each RP, there could obviously be perspectives or experiences within the RP which were not reflected through the interviews conducted, which could shed new light on the findings from this study. Consequently, to address this, future research should include interviews with more representatives from both the industry partners and the researchers.

Finally, as the research programmes under study were operative over eight years, some of the findings were of longitudinal nature, even though the data acquired was not longitudinal. One example is how the research managers discussed the development of innovation processes in the RPs over time. To better support these findings, future studies could benefit from performing longitudinal case studies, to be able to directly observe changes over time. Generally, although the findings in this study might be transferable to other research programmes, one cannot argue that they are universally valid. However, future research could test the propositions and findings from this study through performing deductive hypothesis testing for analysing the transferability of the current results to other research programmes.

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Appendix 1 – Interview guide for research managers (in Norwegian)

1. Introduksjon

Innledning:

- Jeg tar opp intervjuet hvis det er greit.
- Jeg vil delvis transkribere opptaket.
- Om jeg ønsker å bruke noe av materialet som sitat vil jeg innhente godkjenning først.
- Alt materiale vil bli anonymisert. Om noe annet er ønskelig vil det bli eksplisitt spurt om godkjenning av dette.
- Om vi snakker oss bort, eller kommer ut av det så er det helt greit. Jeg er interessert i dine tanker og erfaringer – alt kan være av interesse. Det er ok å be meg gjenta spørsmålet om du glemmer det underveis.

Mål:

- Lære om lederens/ledernes rolle i innovasjonsprosesser i store forskningssentra.
    a. Husk, forskning viser at dette er veldig vanskelig – jeg vil prøve å lære mer.
    b. Ufarliggjøre situasjonen vi er i.
    c. Hvorfor er det vanskelig? Gjort lite forskning på dette.

2. Bakgrunn

Personlig bakgrunn:

1. Hva er bakgrunnen din?
    a. Hvilken utdanning har du?
2. Hvilke jobber har du hatt?
    a. Har du jobbet i flere felt?
3. Hvilken erfaring har du med ledelse?
4. Hvor lenge har du jobbet med senteret?
    a. Andre roller tidligere?

Bakgrunn for senteret:

5. Hva handler senteret om?
    a. Utdyp.
6. Hva er hovedmålene for senteret?
    a. Har dere nådd målene?
7. Hvordan er senteret strukturert
    a. Har det vært endringer i struktur siden oppstart?

3. Intervjuet

Del A. Dine tanker om og erfaring med innovasjon

1. Hva er innovasjon? (Forventningsavklaring – sjekke om vi snakker om det samme)
2. Har du selv erfaring med innovasjon og innovasjonsprosesser (fra før du jobbet i dette forskningssenteret)?
    a. Har du jobbet med kommersialisering av forskningsresultater?
3. Tenker du på ditt miljø som innovativt?
    a. Hvorfor/hvorfor ikke?
    b. Hvis ja: Hva gjør det innovativt?
4. Andre ting?

Del B. Hva ble gjort i senteret og hvordan fungerte det?

1. Var du med å utforme/søke om senteret?
2. Hadde dere innovasjon i tankene da dere designet senteret?
    a. Hva ble gjort? Hvilke grep?
    b. Struktur?
3. Fortell litt om partnerne i senteret?
    a. Hvor mange?
    b. Hvilke typer? Hvilke industrier?
4. Hvilke samarbeidsformer og kommunikasjonskanaler ble brukt / var tilgjengelige i senteret/for partnerne?
    a. Hvor ofte møtes dere?
    b. Kontakt utover de formelle møtene?
5. Hvordan fungerer samarbeidet med brukerpartnerne?
    a. Aktivt deltagende / Passive / Kommer på møter...?
    b. Er partnerne rigget for innovasjon/opptak av resultater? Intern organisering?
    c. Tillit?
6. Hvordan er kontrakten designet med tanke på IP-rettigheter?
7. Hvordan jobber dere med innovasjon i senteret?
8. Jobbet du som senterleder aktivt med innovasjon i senteret?
9. Er det vanskelig å jobbe med innovasjon i senteret? Hva er vanskelig?
10. Har dere prøvd på noe som ikke fungerte? Noe dere har sluttet med?
11. Snakker dere om innovasjon i senteret?
    a. Hvilke arenaer?
    b. Hvilke resultater har dette gitt?
12. Hvordan er respons blant forskerne når dere snakker om innovasjon?
    a. Blant brukerpartnerne?
    b. Snakker dere samme språk? Forstår dere hverandre?
13. Har det vært endringer i innovasjonsprosessene/-fokus underveis i senteret?
    a. Midtveisevaluering?
    b. Hvordan skjedde endringene? Pådrivere?
14. Tellekanter:
    a. Spin-offs?
    b. Implementerte innovasjoner?
15. Andre ting?

Del C. Lederens/ledernes rolle i innovasjonsprosessene

1. Hva liker du best ved å lede senteret?
2. Er det noe du liker mindre godt ved å lede senteret? Hva?
3. Hva er du mest stolt over / fornøyd med fra senteret?
    a. Var du som koordinator involvert i dette?
    b. Hvilken rolle spilte andre ledere i dette?
4. Mest fornøyd med av innovasjoner?
    a. Var du som koordinator på noen måte involvert i dette?
    b. Hvilken rolle spilte andre ledere i dette?
    c. Andre nøkkelpersoner
5. Hva tror du partnerne er mest fornøyd med fra senteret?
    a. Hva tror du din rolle er/var i dette?
    b. Hvordan tror du partnerne ser din rolle i dette? Ser de det samme som deg?
    c. Mest fornøyd med av innovasjoner (resultater)?
6. Hvordan jobber du med ledergruppa rundt innovasjon?
7. Er det vanskelig å lede innovasjon i senteret? Hva er vanskelig? Hvorfor?
8. Hva ville vært annerledes i dag om dere ikke hadde jobbet med innovasjon som dere har gjort?
9. Har du hatt dialog med andre sentere/ledere av andre senteret om innovasjonsprosesser?
10. Opplever du et innovasjonspress?

4. Avslutning

Andre ting/temaer?

Avslutning/tilbakemelding

- Hvordan opplevdes intervjuet?
- Tips?
- Andre ting jeg burde spurt om?