User-Producer Driven Innovation

A Case Study of a Drilling- and a Supply- Company, Partnering for Innovation, in the Norwegian Petroleum Supplier Industry

Anna Maria Yun Bjørkhaug

Spring, 2017

Master Thesis at:

UiO : Centre for Technology, Innovation and Culture
University of Oslo

Faculty of Social Sciences, University of Oslo
User-Producer driven Innovation

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How has the innovation process evolved within-, and between a user and a supplier company?
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Press: Allkopi, Oslo
Abstract

This thesis explores the complexity of innovation processes that occur in collaboration between companies, and in particularly the dynamic relationship between users and producers in innovation processes. The empirical setting is service- and supply- firms in the Norwegian petroleum industry; more particularly partnering in advanced technology development for drilling. Previous literature on innovation processes claim that in most cases, there is a need for collaboration between firms in the process of innovation, as innovation requires the match between diverse sources of knowledge and other resources. Moreover, prior literature has found that successful partnerships take a long time to establish, and therefore a process perspective that looks into partnership development in innovation is necessary.

This qualitative case study aims at contributing to the literature by explaining how user and producer partnerships in innovation unfolds, in order to explain why they collaborate in the intricate process of innovation, and advanced technology development. To shed light on this, the thesis has investigated several joint ventures between a drilling company and a technological supplier. By exploring these, the thesis argues that the complexity of the industry, and intricate process of innovation, creates a need for partnering in advanced technology development cases. The thesis presents some key factors for successful joint ventures when partnering for innovation. Furthermore, it suggests that an implemented technology should not be seen as the closure of the innovation process, but the next step in the continuous cycle of innovation.
Preface

The thesis ends a two-years Innovation study of Technology, Innovation and Knowledge, at the Centre of Technology, Innovation and Culture, University of Oslo. It has been two exciting, and enriching years. I am grateful for the opportunity given, to study in such a great research-and learning environment.

First I want to thank my supervisor, Taran Mari Thune. Her knowledge, and insight around the theories of innovation studies, amazes me. Her insight in the field of study has been helpful during the process of writing the thesis, additional to supporting the drift of the thesis. Second, I want to thank my co-supervisor, Jakoba Sraml Gonzalez. She has always taken the time to give me feedback, and discussed the thesis with me during the process. I am grateful to both supervisors for having an open door policy to their offices, that has been really helpful during this process. I want to thank my very busy informants, who has been positive and interested in my study. I thankfully respect the time given to do interviews, or conversations, this is what forms the basis for the empirical evidence and analysis in the thesis. I want to thank my family, friends and colleagues, who kept up with me during this period of study, and my firm who has organized for me to be able to complete the study. I also want to thank my fellow students. You have inspired me, motivated me, and most of all, become really good friends of mine.

The world is moving fast-forward towards more technology, digitalization and less human involvement. I think it is very interesting to study the world of innovation, even though the exciting times of rapidly change, sometimes seems, and is scary. The Norwegian petroleum industry is in a time of change. While writing the thesis, several former colleagues lost their jobs, due to the oil-crisis that struck in 2014. I have seen and experienced the ripple effects, and that has also been an extra motivation for me writing the thesis. The industry needs to focus on innovations in order to keep up with the world of tomorrow.

Anna Maria Yun Bjørkhaug / May 2017
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List of abbreviations

R&D: Research and Development
HSE: Health Safety and Environment
JIP: Joint Industry Project
IP: Intellectual Property
UPI: User Producer Interactions
IOR: Interorganizational Relationship
SIVAC: Supplier Industry and Value Creation
NSD: Norsk Samfunnsvitenskapelig Datatjeneste
MIRP: Minnesota Innovation Research Program
PART I - INTRODUCING THE RESEARCH

This part of the thesis contains an introduction, presenting the research question, and structure of the thesis. Second, I will present the empirical setting, with previous research in the petroleum industry, particular in Norway.
1 Introduction

The aim of the thesis is to explore the complexity and dynamism of the partnership between user and producer in the innovation processes. The empirical setting is service- and supply-firms in the Norwegian petroleum industry that are involved in developing and deploying advanced drilling technologies. By studying how they plan and execute the innovation process, with the aim of reducing risks and increasing the potential for value creation, the thesis will contribute to existing literature on innovation processes in collaborative technology development projects. The empirical evidence has been collected through a qualitative case study of a longstanding partnership between two companies.

The oil and gas industry is the largest and most profitable industry in Norway. In addition to a handful of petroleum companies, it consists of a large service and supply industry that includes more than 5000 companies (Blomgren et al., 2015; Norsk Petroleum, 2017, 28.02.). The upstream petroleum industry has its origins in the 1860s and is a definitive process-based industry, comprising processes of exploration and production of hydrocarbons. The industry also provides a good example of increasing specialization and interdependence across companies, and other organizations in mature industries in executing operations, as well as in technological innovations (Acha & Cusmano, 2005, p. 6). In the Norwegian petroleum industry, the cost related to exploration and development of hydrocarbons are especially high, as deposits are located off-shore and in harsh environmental and climate conditions (Acha, 2002, p. 97). To some extent, this explains the complexity of the industry, and why companies decide to partnering for the process of innovation.

The focus on cost-efficiency in drilling and producing oil and gas, is an important part of the competitiveness in the industry today. The market conditions have changed a lot during the last 3 years, with a substantial drop in oil-prices from 2014. Due to this, downsizing and programs to increase efficiency has been necessary the resent years. However, implementing programs to reduce costs and increase productivity has, according to the industry, increased the companies’ competitiveness (Norsk Petroleum, 2017, 28.02.). The thesis aims to explore why and how firms in this industry organize when partnering for developing and deploying advanced technological equipment, with the goal of increasing productivity and efficiency in drilling.
A process innovation often involves developing and modifying a range of products. When the innovation is dedicated to better the performance of a process, it often requires product innovations as well (Rubach, 2011, p. 29; Acha, 2002, p. 96). A shift from oil-operators being in control of everything, to outsource certain processes and technology developments to different parts of the value chain, is an important reason for increased activity and innovation work in service and supply companies (Acha, 2002, p. 68 - 72). Collaboration between firms and organizations in the North Sea province took off in the mid-1980s. Health, safety and environment (HSE) have had a big impact on technology development and innovation in the Norwegian petroleum industry, as these regulations led to searches for safer ways of exploring and developing fields offshore (Acha, 2002).

Even though the context of the innovation process of study is important, collaboration between companies for innovation is not new. Innovations rarely occur within the boundaries of individual firms, because of its complexity (Dodgson, 1994, p. 285). There are different types of collaboration, such as; partnership, network, franchising, licensing, joint-ventures, joint industry project, and strategic alliances. The exact type of relationship between the companies of study is not the most important aspect, but how the innovation processes are managed within the firm, and in partnership. Furthermore, how they utilize and capture value from these innovation processes. By exploring the evolvement within- and between a user and a producer when partnering for technology development, the thesis contributes to existing literature explaining, to some extent, the complexity of the process of innovation in collaboration between firms.

1.1 Research question

To explore why, and how the actual innovation process in a partnership between a user and producer unfolds, the thesis asks following research question:

How has the innovation process evolved within-, and between a user and a supplier company?

There are different areas of focus in this research question. First, it highlights how the innovation process in collaboration has evolved, from the phase of inventing to the implementation phase. Meaning, how the companies have managed and organized the
innovation process within- and between the companies. Secondly, it highlights the dynamic links between the user and producer during the technology development process. And finally, how the companies organize for implementing a new technology, and utilize and capture value from an innovation. To answer my research question, I have formulated three sub-questions related to the overall topic of research.

Sub-question 1: How does the development of the partnership contribute to the innovation process? When companies do not have all the resources for developing technology within the firm, they seek opportunities and knowledge from others, to develop their invention. When the companies have established the need for collaboration, they need to set agreements within the technology development collaboration. This question contributes to the existing literature regarding invention and motives for collaboration, and interorganizational relationship (IOR) literature (Tidd & Bessant, 2014; Kline & Rosenberg 1986; Garud, Tuertscher & Van de Ven, 2013; Ring & Van de Ven, 1994).

Sub-question 2: How does the relationship between Offshore Drill and Techcomp matter for generation of a successful new innovation? In collaboration the companies of study act as user and producer. This question contributes to answering the main research question. It highlights the dynamic links between the two companies, and how these links can stimulate for innovation (Nahuis, Moors and Smits, 2012).

Sub-question 3: How does Offshore Drill and Techcomp capture value from the innovation process? When implementing an innovation, the companies expect to capture some kind of value, and utilize the innovation. With utilizing I mean benefits. This question draws attention to previous literature on capturing value from innovation, such as spillovers and new exploitations. This question contributes to the existing innovation process literature, capturing value from an innovation (Kline & Rosenberg, 1986; Garud, Tuertscher & Van de Ven, 2013, p. 782; Tidd & Bessant, 2014).

1.2 Thesis outline
This introductory chapter (1) has presented the topic, and research question. Next I will present the thesis outline. The next chapter (2) presents the empirical setting. Part II: Literature review and Methodology. In this part I will present a literature review structured by the three sub-
question of the thesis. (3) I will start presenting different types of innovation process models. Second, different types of collaboration between companies for innovation. Third, user producer interactions for innovation. Finally, I will present an analytical framework, based on the concepts reviewed in the chapter. (4) I will present and discuss the methodological choices made in the thesis.

Part III: Empirical Evidence and Analysis. (5) I will shortly present the case, and the two main companies of study. Empirical analysis, and the main findings are presented in the extended analytical framework. Part IV: Discussion and Conclusion. (6) First, I will present the main empirical evidence. Second, discussion of the empirical evidences implications for the literature. Third, I will be answering the research question, concluding remarks, and limitations of the study. Finally, suggestions for further research are offered.
2 Empirical setting

This part of the chapter will review some of the existing literature on innovation processes in the context of the Norwegian petroleum industry. The case of study is the innovation process and technology development process between oil service companies. The oil service companies my study is about, is a drilling company and a supplier. The context of the thesis is important to understand how the innovation process evolved between the firms in collaboration.

2.1 Supplier innovation in the Norwegian petroleum industry

In figure 1, I present the value chain of the petroleum industry in Norway, presented by the Ministry of Petroleum and Energy (2014). The figure gives an overview of the different actors in the Norwegian petroleum industry. The area of focus is highlighted within the red circle. The case study will focus on drilling, drilling equipment, and technology. There are two main categories of actors: (1) The oil operators, their main focus is on the exploration knowledge. (2) The oil-suppliers, which is a wider category containing drilling companies, and other service- and supply- companies, specializing in delivering services and technology to both drilling companies, and oil-operators (Acha, 2002, p. 68 - 72). The division of labor is defined as oil entrepreneurs, prospectors, skilled helpers, and semi-skilled helpers (Acha, 2002, p. 68).
Increased complexity due to the harsh environment and HSE concerns has emerged. Risk and cost due to more advanced knowledge in the field has led to new business models for profitably exploiting what is left in the mature provinces (Fletcher, 2001; Acha, 2002, p. 88). Cost and effectiveness of drilling represents a fundamental part of the economic viability of the field. Most of the technological innovations in drilling are developed and elaborated by the oil-service companies. High development costs and risks in application, a joint industry project (JIP) can be relevant for research involving both oil-companies and service-companies (Acha, 2002, p. 83).

2.1.1 Outsourcing and specialization

The cost related to the drilling process is especially cost-demanding in the Norwegian petroleum industry because of the harsh environment it operates in (Acha, 2002, p. 97). The oil companies have redefined which operations that should be controlled internally and which one is best off outsourced to suppliers and collaborators. The shift from oil-companies being in control of everything, to outsourcing some processes and technology developments to service companies, is partly the reason for gained activity in innovation work in drilling-, service- and supply- companies (Acha, 2002, p. 68-72). The oil-operators are more interested in outsourcing activities linked to technology development and techniques, and are demanding more integrated packages of service solutions from the oil service companies. Oil-operators can direct and give the contractors a direction, but the contractors stand more freely do develop new technologies and techniques related to their core competences (Acha & Cusmano, 2005, p. 19 – 20). This has led to a change in motives for pursuing innovation and development of new technology in service and supply firms; from just reducing operating costs, to emphasis technologies that creates value in the option it provides (Acha, 2002, p. 95). The study of Perrons (2014) implicates that because of the increasing technology driven industry, there has been a dramatic change in market power between the oil-operators and supply companies.

2.1.2 Collaboration between firms

Contradictory trends, increased competence specialization and increased systemic complexity, the latter being described as increasing dependence on complementary sources of knowledge, and technological advancements has been a driver for technological partnerships (Acha & Cusmano, 2005, p. 3). There are two main reason for collaboration between oil and gas firms; they want to, or they have to (Garcia, Lessard & Singh, 2014, p. 27). All companies in the
petroleum industry are somehow in a collaboration. Even though a company has the assets to develop a technology within the firm, in order to utilize and optimize the technology they are dependent on other companies. The other reason for collaboration is because they want to. This refers to e.g. reducing risk, and the company’s capability (Garcia et al., 2014).

2.1.3 Technological capabilities

Pavitt (1998; Brusoni, Prencipe & Pavitt, 2001, p. 597) describes a technology as the body of knowledge, or the understanding and practice, included design and manufacturing. He also emphasizes the increased range of fields of specialized technological understanding. It is not the technology itself that offers a strategic advantage, but the knowledge when implementing it (Acha & Cusmano, 2005, p. 7). Acha (2002) studies implies that true core technological capabilities in the upstream sector has been defines as: “The capability to integrate new technologies and techniques and to elaborate new methodologies of exploration and production” (p. 81). Technological capabilities, does not solely come from within the firm, but is also connected to the firm’s integrative dynamic capability to solve key challenges (Garcia et al., 2014, p. 27 – 28). This refers to a firm’s ability to combine a unique set of resources and sustain a unique a competitive advantage (Garcia et al., 2015, p. 22).

2.2 Summary

In order to understand how the oil service companies, organize innovation, we need to understand the industry and the oil operator’s important role. There are some important studies done within the upstream petroleum industry. In this chapter, I have presented some interesting findings, mainly presented by Acha. The industry setting favors complexity and is one of the main factors that has led to outsourcing of technology development, and specialization of equipment. This has led to an arising opportunity to address these complexities with their technological capabilities within a company, or in collaboration, and offers new technology and innovations to the industry. Due to this change, there is a shift in market power between the actors in the industry.
PART II - LITERATURE REVIEW AND STATEMENT OF METHODOLOGY

This part is divided into two main sections. In the first chapter (3), I will start giving a literature review, where I will examine the analytical framework that forms the basis for empirical data presented and discussed in the thesis. I will start this part defining the concept of innovation. Several researchers have addressed the process of innovation. In order to understand how innovation, occur. I will give a review of different types of models and concepts that explains different phases of the innovation process, and the relationship between the different actors involved in it. In short, the phases of the innovation process involve; why, and how firms try to come up with new ideas, invent, or do innovation work. Why, and how firms collaborate to develop new technology and innovations in forms like user producer interactions, and how organizations are able to implement and utilize new technology and innovation. In the last section of this chapter, I will present an analytical framework, inspired by the models and concept of the innovation processes, collaboration between firms, and User Producer Interactions (UPI).

In section two (chapter 4), I will account, and reflect upon, the choice of a qualitative case study. I will discuss the research design, gathering and analyzing data, and I will reflect upon the validity and reliability of the case study, ethical concerns, and my role as a researcher.
3 Literature review

3.1 Introducing Innovation

“Innovation is not a new phenomenon. Arguably, it is as old as mankind itself” (Fagerberg, 2005, p. 1). There is also made a clear distinction between invention and innovation. We call it innovation, when the invention attempts to carry out in practice, or is implemented. (Fagerberg, 2005, p. 4). Our understanding of innovation, is built on Schumpeter’s ideas where innovation is a specific social activity with a commercial purpose, within the economic sphere. Invention on the other hand, do not have the intent of commercialization, and can be carried out everywhere (Fagerberg, 2003, p. 131).

Several researchers have defined the concept of innovation. Fagerberg (2005, p. 1-8; Fagerberg, 2003, p. 125 – 130) says that innovation is a systematic phenomenon of complex social- and economic change, where different elements interact to make innovation possible. Lundvall & Borrås (2005, p. 599-626) describe innovation as a process of learning. Another one is made by Rubach (2011, p. 27) “Innovation is a complex, interactive, collective, and social process where the outcome can’t be planned. However, the innovation process itself can be planned”. The concept of innovation is broad and contains activities and processes (OECD, 2009, p. 11). Innovation is the process of turning ideas into reality and capture the value from them (Tidd & Bessant, 2014, p. 18). And finally, Dodgson (1994, p. 285) says that the individual firm does seldom confine the process of innovation themselves. In other words; innovation is a phenomenon that can be understood as a complex-, interactive-, social-, and collective- process or system of collaboration. The outcome of the innovation process cannot be planned, but managing the process can be done.

The knowledge about the process of innovation, and systems of innovation is something that has caught our attention the last decades (Fagerberg, 2005, p. 1-8). Innovation studies has made a distinction between product innovation and process innovation, but since both are related, and somehow connected to each other, it is hard to tell which one comes first (Rubach, 2011, p. 29; Acha, 2002, p. 96). Evolutionary perspective of innovation processes is consistent and has attracted the contributions of many scholars. In short, evolutionary perspective builds on; “variation (the emergence of novelty), selection (the weeding out of those that are unfit), and retention (the elaboration of those that remain), and is sensitive to path dependence dynamics”
(Arthur, 1989; David, 1985; Garud et al., 2013, p. 778). “Rather than path dependence, scholars from Science and Technology studies, view agency as part of an emergent ecology of interactions between social and material elements, all prescribed within a process of path creation” (Garud & Karnoe, 2001; Garud et al., 2013, p. 778). Despite the differences, both perspectives emphasize the difficulties associated to development and implementation of novel ideas (Garud et al., 2013, p. 778).

The next sections of this chapter will take a look at how a firm can manage the actual innovation process within a company and in collaboration, and how the firms implement and utilize innovations. I will take a look at different types of models or concepts of innovation processes. Reviewing the different phases of the innovation process, I will present strengths and weaknesses of the models, in order to contribute in the explaining of the intricate process of innovation. (1) The first model is Tidd and Bessant’s (2014, p. 47) “Simplified model of the innovation process”. (2) The second model is Kline and Rosenberg’s (1986, p. 289 – 290) “Chain-linked model”, (3) this model is the “innovation process” model from Garud et al. (2013, p. 775).

3.2 The simplified model of the innovation process

(1) The simplified model Tidd and Bessant (2014, p. 47) presents is a linear model of innovation processes, within a firm. The model presented underneath is a simplified redesign of this model.

![Figure 2 Simplified model of the Innovation Process](https://example.com/figure2)

It starts with a search; this phase involves how a firm is able to search for new opportunities and ideas to thrive; better their market position, gain profit, or in some cases to survive (Tidd & Bessant, 2014, p. 22). Then they select an idea, or ideas, based on strategic choice, such as competitive differentiation, or based on previous capabilities that will gain profit, strengthen their market position, or in some way are beneficial for the company (Tidd & Bessant, 2014, p. 22). After selection, they can turn the ideas into an innovation concept, that will be further handled by the development department (Tidd & Bessant, 2014, p. 89-90).
The **implementing** phase of the innovation process, is a huge time-, energy-, resource-demanding, and cost-demanding part of the innovation process. It contains putting together all the pieces into an innovation (Tidd & Bessant, 2014, p. 22). The phase can be divided into three core elements: (1) “Acquiring knowledge” involves offering a solution to the problem (combining new and existing knowledge), detailed development, or maybe back to the concept stage to review, modify or approve (Tidd & Bessant, 2014, p. 91). Effective R&D can also mean that a firm outsource the technology development phase to another firm, if the firm have the access to external sources with technological capabilities, and internal resources to implement the technology acquired into effective use (Tidd & Bessant, 2014, p. 92). This is not an easy and simple transaction, and it involves the firm’s ability to find, select, negotiate, and maybe most importantly, utilize the technology transfer (Tidd & Bessant, 2014, p. 92). (2) “Executing the project” is getting the idea ready for the final launch. There are several problem-solving loops, expected and unexpected difficulties that must be taken care of by the management, and this part of the innovation phase is the most time- and cost-demanding. The process may fail because of the user needs and capability was not taken into consideration in the innovation process. Hence, paying attention to the market is crucial (Tidd & Bessant, 2014, p. 91-93. (c) “Launching and sustaining innovation” is about understanding the dynamics of adoption and diffusion. Implementation of internal process innovations stresses communication, involvement, and training to succeed. These elements can make the resistance for change easier, and can facilitate for the involved to be better prepared for the transition. The importance with active and early user involvement, increases with the degree of uncertainty (Tidd & Bessant, 2014, p. 94).

The final step in their model is **capturing value**. Innovation is rarely created to a company’s own sake, but to capture some kind of value like; market share, cost reduction or it could be a social innovation. Capturing value can be done by methods like patenting or the use of tacit knowledge. The release or launch of an innovation can also be beneficial in the creation of a new innovation process cycle. If the invention is a failure, the process itself creates important information about what exactly went wrong, additional to internal, and/or external learning, and adjustment that should be done by the firm(s), before initiating for a new innovation process. It is also important to note that the firm should emphasis both the success stories, and the failures. They should comprehend the experience, instead of spending their energy focusing on mistakes, and responsibilities (Tidd & Bessant, 2014, p. 95).
3.2.1 Strengths and weaknesses with the simplified model of innovation

The model gives an overview of what the different phases in the innovation process involves, but the model itself, can be misunderstood and can imply that the innovation process is less messy than it actually is. Even though Tidd and Bessant (2014) emphasizes that the process of innovation most likely do not occur in this linear form, the model fails to explain the messy process, when organizing for innovation. The different phases in the model notes that e.g. development process in an innovation process can be outsourced to other firms. But the model does not explain how this difficult transaction between the firms unfolds.

3.3 The chain-linked model

(2) Kline & Rosenberg (1986) criticize attempts often made by scientists, that the representation of the innovation process models is made to smooth, linear and to “well-behaved” (p. 285). They argue that the linear model does not involve feedback between the different phases of the innovation process. The figure presented below is an alternative to the linear models of innovations processes (Kline and Rosenberg, 1986, p. 290).

![Chain-Linked model](image)

Figure 3 Chain-Linked model [based on, Kline and Rosenberg (1986, p. 290), chain-linked model]

The phases marked with a “c” represents the central-chain-of-innovation, and can remind us of a linear model of innovation process. What is important to notice is that they have added feedback between and backwards from the different phases (Kline & Rosenberg, 1986, p. 289). The markets force and innovation are closely linked. The marked force will in time lead to new designs, market pull, and new designs will in time lead to new market conditions, technology push. It is the cycle of the innovation process (Kline and Rosenberg, 1986, p. 289 – 290). In the invention phase you seek to invent something new, or something that is a routine in specific companies or communities, but not commercialized to the public at large (Kline and Rosenberg, 1986, p. 292). This is not invention in the usual sense, “it consists analysis of various
arrangements of existing components or of modifications of designs already within the state of the art to accomplish new tasks or to accomplish old tasks more effectively or at lower cost” (Kline and Rosenberg, 1986, p. 292). The latter rather than the first one, seems to be the initiator of the central-chain-of-innovation (Kline and Rosenberg, 1986, p. 292).

Research and knowledge work is not solely connected to the start-up phase in the innovation process. But it extends through all the different phases of the innovation process, and can be divided into two stages; (1) You will search for existing knowledge through your knowledge base and contacting experts, or (2) you initiate for R&D work to solve the problem if you cannot find the answer somewhere else (Kline & Rosenberg, 1986, p. 290 - 291). Type of science needed in the different phases varies. The development phase frequently contains the systems nature, concern analysis of the interaction of components in a system, and a holistic overview of the final product or process. In many cases this type of research can be science, even though it is not ordinarily thought of as such (Kline & Rosenberg, 1986, p. 292). Especially in the context of commercial success. This type of research is not only necessary, “but could often play a more important role than science in cost reduction and improved system performance” (Kline & Rosenberg, 1986, p. 292).

3.3.1 Strengths and weaknesses with the chain-linked model
The chain-linked model succeeds, to some extent, to explain the intricate process of innovation. At least it gives a better explanation of the messy process than a linear model of innovation does. It contains many of the details and the rich variety inherent in the totality of the innovation process (Kline and Rosenberg, 1986, p. 294). The model itself though, looks quite messy, and to understand the model, the phases, layers, and arrows, the model needs an explanation in order to be understood. A weakness of the model is that it does not say anything about how the relationship between different knowledge sources and firms work together in the development process, if external knowledge sources are needed, and/or they have to implement a R&D initiative. Although Kline and Rosenberg (1986) mention that they might have to search outside for knowledge acquisition, their model do not say anything about the actual relationship.

3.4 Innovation Processes
(3) The next model, Innovation Processes, presented by Garud et al. (2013, p. 776 - 777) from the Minnesota Innovation Research Program (MIRP), cover the innovation literature at the
differing phases; invention, development, and implementation, initiated within a firm, multi-party networks, or within a community (Garud et al., 2013 p. 779 – 793). The model presented below looks quite linear, but they emphasize that it is important to note; most innovation processes do seldom unfold in orderly linear steps, but more of a repeated cycle of divergent and convergent phases (Garud & Karnoe, 2001; Garud et al., 2013).

<table>
<thead>
<tr>
<th>Levels</th>
<th>Key mechanisms</th>
<th>Firms</th>
<th>Multi-party networks</th>
<th>Communities</th>
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<tr>
<td>Invention</td>
<td>Recombination</td>
<td>Creativity</td>
<td>Knowledge networks</td>
<td>Inverse commons</td>
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<tr>
<td>Development</td>
<td>Transformation</td>
<td>Internal venturing</td>
<td>Platform leadership</td>
<td>Industry infrastructure</td>
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<tr>
<td>Implementation</td>
<td>Institutionalization</td>
<td>Adoption</td>
<td>Diffusion</td>
<td>Stabilization</td>
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*Figure 4 Innovation Processes [based on, Garud et al. (2013, p. 780), Innovation processes]*

### 3.4.1 Invention

Early debates around mechanisms underlying invention were centered around demand-pull and technology-push (Freeman, 1975; Mowery & Rosenberg, 1979). It is crucial to understand demand and supply factors to understand the process of innovation (Mowery and Rosenberg, 1979). In order to do so this literature has evolved over time and it “draw attention to recombination of ideas and artifacts across different domains of knowledge and practice” as a mechanism to invention (Hargadon, 2003; Van de Ven, Polley, Garud & Venkataraman, 1999; Garud et al., 2013). Firms are often divided into units, hence, it can be difficult for new ideas to emerge. If the managers in the units are not able to appreciate the value of a new opportunity, the novelty can then be dampened. A firm can be motivators for innovations to occur with allowing exploitation during work, which can be chosen over exploration in a firm. Novel ideas should be protected in a firm to get the potential from it (Garud et al., 2013, p. 779 – 784). If the managers of the units are aware of this potential, and protect the novelties, faster firm entry into emerging fields is being associated with this (Eggers & Kaplan, 2009; Garud et al., 2013). One of the main reasons for joining a network is to increase a company’s own innovation capacity, and is typically a temporary system to perform a contractual-based relationship like supplier relations or joint ventures (Rubach, 2011, p. 36 – 38). No firm has all the assets to develop an innovation alone, it is easier to develop an idea with others, than doing it alone (Miles, Miles & Snow, 2005, p. 19; Garud et al., 2013, p. 786). Organization can in some cases refer to the network of firms that cooperate to design the whole product, manufacture its components, assemble and market it (Orton & Weick, 1990; Brusoni et. al., 2001, p. 597 – 598).
Complex problems can require inputs from several firms, and refers to invention in communities (Garud et al., 2013, p. 783). This type of invention often emerges in undeveloped or undiscovered markets, niche markets that are not commercially viable (Baldwin, Hinerth, & von Hippel, 2006; Garud et al., 2013, p. 783). This multiplexed interaction, with contact and connections between the scientists involved, “generate solutions to complex problems that any scientific group operating on its own would have found difficult to address” (Garud et al., 2013, p. 784).

3.4.2 Development

The development phase is messy and contains a proliferation of paths and many setbacks. It also contains shifting assessments of progress, and fluid participation of different stakeholders (Garud et al., 2013, p. 777). “…there are false-starts and dead-ends, partial triumphs and victories, as an idea proceeds from conception to commercial development” (Van de Ven et al., 1999; Garud et al., 2013, p. 785). Firms are rich with resources such as experience, knowledge, and patient capital to nurture ideas from conception to commercialization, but also offer a fertile ground for development (Porac, 1997; Garud et al., 2013, p. 786). Organizational arrangements such as development projects within the firm can be one way to overcome the traps from cognitive, behavioral, and structural constraints (Martin, 2009; Garud et al., 2013, p. 786). Formal collaboration like a network can also make it possible for companies to achieve innovations they could not, or would not pursue alone (Garud et al., 2013; Chesbrough, 2003; Van de Ven, 2004). Garud et al. (2013, p. 788) argue the need for a macro infrastructure for innovation, which contains; proprietary R&D, manufacturing, marketing, and distribution functions. Furthermore, it includes collective resources, institutional standards, and legitimacy, and educated consumers. It is beyond the reach of any individual firm, and it involves private- and public- organizations, and financial institutions.

3.4.3 Implementation

Even though the potential viability of an idea has been explored and elaborated, does not mean that the idea can exploit its benefits (Brown, 1997; Garud et al., 2013, p. 789). The implementation phase of the sites studied, “did not occur as a simple diffusion process, but instead occurred by integration of the innovation with what already existed” (Garud et al., 2013, p. 777). It is important to understand the cultural aspect, when implementing a new technology or invention (Garud et al., 2013, p. 790). “Implementation of innovations proceeds more
smoothly in those cases where the new overlaps with, and becomes integrated into existing organizational arrangements” (Garud et al., 2013, p. 789 – 790; Hargadon & Douglas, 2001). An invention is implemented, and becomes an innovation when the process becomes widely accepted, adapted, a routine, the technology is streamlined so it can be mass-produced, the knowledge is codified, and the invention is black-boxed (Green, 2004; Garud et al., 2013, p. 790; Ulrich & Eppinger, 2008; Kline & Rosenberg, 1986; Lam, 2005). Spillovers, like knowledge, combination and recombination, is facilitated through the implementation of an innovation (Garud et al., 2013, p. 791). Implementation in a multi-party network is still difficult, even though the innovation offers benefits (Garud et al., 2013, p. 791 - 792; Garud & Kumaraswamy, 1995; Jacobides, 2005). Implementation can be studied by standards, or how meanings are stabilized in different communities (Garud et al., 2013, p. 792; Phillips, Lawrence, & Hardy, 2004; Porac, 1997; Rosa, Porac, Runser-Spanjol, & Saxon, 1999).

3.4.4 Strengths and weaknesses with the innovation processes model
The innovation processes model does to some extent manage to explain the complexity of the innovation process. They characterize the innovation process of repeated cycles of divergent, driven by people, time, ideas and money, convergent, by institutional rules, and organizational mandates (Garud, et al., 2013, p.777). They emphasize that one should explore and experiment with arrangements that are harnessing complexities as a generative force (Garud et al., 2013, p. 803). The model presented is a linear model of the innovation process, and the explanation of the model gives us an overview of the innovation process’s complexity in different levels, but the model fails to tell us something about the linkages between those different levels.

3.4.5 Summary
Defining the concept of innovation, I referred to Dodgson (1994, p. 285) who said that innovation rarely occur within the boundaries of individual firms. I have now presented three different innovation process models. Even though some of the models and theories regarding the process of innovation, includes collaboration between firms in different modes and emphasize the context the innovation process unfolds in, the models or concept fails to explain why and how this relation occur, how it unfolds, and the linkages between the different stages.
3.5 Collaboration between firms

In this section, I will present the theory around collaboration between firms in an innovation system. Second I will review Ring and van de Ven’s (1994, p. 97) “Process Framework of the Development of Cooperative IORs” model, exploring the relationship between firms, how they emerge, grow and dissolve over time, in Inter Organizational Relationships (IORs). Third I want to explore the interaction and collaboration between the user and producer in the process of innovation, within the Schematic presentation of User Producer Interactions (UPIs) presented by Nahuis et al. (2012).

Because of the complexity and uncertainty connected to innovation, the innovation process frequently requires inputs from a multiplicity of sources such as research institutes or organizations, suppliers, customers and competitors. Collaboration is defined as two or more partners working together, and contributing with differential resources to the collective good (Dodgson, 1994, p. 285). Collaboration is: “a process of working together to achieve mutually beneficial outcomes” (Rubach, 2011, p. 41). Collaboration between firms have been described in different terms, such as; cooperation, strategic alliance, supplier relations, franchising, licensing, partnership, joint venture and network (Haugland, c2004). In other words, collaboration is a process with two or more partners contributing in a process to achieve a collective good.

3.6 Cooperative Interorganizational Relationships (IORs)

Ring and Van de Ven (1994) has made a process framework of the Developmental process of cooperative IORs. They focus on how the IORs emerge, grow, and dissolve over time. The “IORs include strategic alliances, partnerships, coalitions, joint venture, franchises, research consortia, and various forms of network organizations” (Ring & Van de Ven, 1994, p. 90). Researchers have studied antecedent conditions, structural properties of IORs in comparison with other governance forms, like transactions cost or agency theory perspectives. This type of research provides useful insight about conditions leading to the formation of IORs, however, the development process of IORs is not addressed in these research (Ring & Van de Ven, 1994, p. 91). The conceptual framework of Ring and Van de Ven (1994, p. 94) is built on the assumption that the companies involved in an IOR are seeking efficiency and equity from the outcome of the collaboration. Fair dealing is based on norms and established precedents, under
the condition of high uncertainty, this is important in order for the companies to exchange transaction-specific investments (Ring & Van de Ven, 1994, p. 94).

![Diagram of Development of Cooperative IORs](Image)

The conceptual framework is presented above, and consist negotiation, commitment, and execution stage. The assessments for engaging in such IOR is efficiency and equity (Ring & Van de Ven, 1994, p. 97). The performance in an innovation network is affected by the source of scientific and technological knowledge (Orsenigo, Pammolli, Riccaboni, Bonaccorsi & Turchetti, 1998). Another important factor for having an effective network, is that the nature of knowledge, conceptualized in terms of tacit- or explicitness for sharing information and skills (Powell & Grodal, 2005, p. 56 – 79). “Learning is often related to two sides of knowledge: explicit (codified), and implicit (tacit)” (Klev & Levin, c2009, in Rubach, 2011, p. 49).

Knowledge is characterized by the degree of specificity, the tacit knowledge, complexity and independence (Winter, 1987; Acha, 2002, p. 84). Explicit, or codified knowledge is the knowledge that is easily transferred, but tacit knowledge is harder to share, because it is not put in an explicit form (Rubach, 2011, p. 47). In engineering-dominant industries, tacit knowledge is a recognized feature which can be identified by a long formal or informal apprenticeship cycles of new staff. Complexity arises combined with several different scientific and engineering disciplines and technologies of a greater variety of capabilities (Acha, 2002, p. 84 – 85). “Absorptive capacity refers to a firm’s ability to absorb domain-specific knowledge based on its prior knowledge. To the extent that firms within a network lack absorptive capacity,
recombination of knowledge is hampered” (Garud et al., 2013, p. 782). The lack of absorptive capacity is a barrier to the flow in a network (Cohen & Levinthal, 1990).

### 3.6.1 The stages

The negotiations stage is where the organizations develop joint expectations for the development process. It is also a focus on formal bargaining processes, which furthermore include the social-psychological processes to enter into negotiations with one another. It is often necessary to repeat the cycle of formal bargaining, and informal sense making before the cooperatives agree to terms. In the commitment stage the legal agreement is formally draft, to avoid misunderstandings and legal impediments. Trust between the actors in a network is essential, because of the strong incentives to cooperate and to counteract with others (Johanson, 1989, p. 76). The companies involved in a network will have to invest time, training, develop, and trust (Miles et al., 2005). To increase efficiency and smarter business, network can be a way to go. “Issues that drive the process include the distribution of resources and assets across members of a network, the nature of interactions required between different parts of the innovation, and the appropriable of the benefits across network members” (Garud et al., 2013, p. 787). “The terms and governance structure of the relationship are established, and they are either codified in a formal relational contract or informally understood in a psychological contract among the parties” (Ring & Van de Ven, 1994, p. 98).

In the execution stage of the IORs process, they carry the deal into effect. When IORs try to carry out a business deal, renegotiations of the contract might occur in order to move forward. When a deal is completed, or if a deal fails, they typically discharge the relationship, or they could be substituting a new contract (Ring & Van de Ven, 1994, p. 98 – 99). It is important to note that there is a: “… complicated set of informal social-psychological dynamics that go on and that explain how and why cooperative IORs evolve through repetitive sequences of formal negotiation, commitment, and execution stages or events” (Ring & Van de Ven, 1994, p. 99). These relationships may emerge out of a numerous different reasons, but most IORs emerge through small, informal deals with low risk, which require little reliance on trust. After the relationship develops, it increases the probability for further engagement. If the deal is successful, they can develop a more longstanding relationship, and will reduce the need for a legal document (Friedman, 1993; Ring & Van de Ven, 1994, p. 101).
They also propose the following for a cooperative IOR: (1) Congruent sense making, meaning, values, or expectations. (2) Congruent psychological contracts, meaning trust, and understanding the constraints on the relationship (Ring & van de Ven, 1994, p. 100 – 101). These strategies will affect how the sense making activities among the parties will be executed, and differences among these may lead to opportunistic behavior which decreases the probability of achieving congruency in the psychological contracts (Ring, van de Ven, 1994, p. 102). The IOR model presented maintain the balance between formal and informal processes. But the model does not achieve stability (Ring & Van de Ven, 1994, p. 112 - 113).

Events are crucial in developing relationships in an IOR. This is also something that Garud et al. (2013) puts their emphasis on. Key events can be presented in a matrix or a timeline to organize them. Ring and van de Ven (1994) emphasize that it is important to consider the specific context of the cooperative IORs, like e.g. firm strategy and industry structure. When;

…uncertainty, complexity, and duration of economic transactions within and between firms’ increase, it becomes even more important for scholars and managers to understand developmental processes of how equity, trust, conflict-resolution procedures, and internal governance structures emerge, evolve, and dissolve over time. (Ring & Van de Ven, 1994, p. 112 - 113)

3.7 User producer driven innovation

In the next part of this chapter, I will take a look at the theory of user-producer driven innovation. First I will give a brief overview of the topic. Second, I will explore the interactions between the user and producer in a partnership. The user producer driven innovation theory will give an overview of the users and producers role in the process of innovation.

Von Hippel (1976, 1977, 1982, 1988) defines the innovation process as user-driven where the users need leads to innovation, or the user itself conceives the solution, develop a prototype, or utilize a prototype. The users’ role is in their need, and the manufacturers role is to conceive a responsive solution and then builds, tests, manufactures and markets the innovation (Shaw, 1994, p. 276). A lead user is a user who face needs that will be general in a market place some months or years before the bulk of that market place encounters them, and are positioned to benefitted significantly by obtaining a solution to their needs. The supplier or manufacturer can
have a benefit and be given an advantage in the market if they involve the lead-user in the creation, and development process. The lead-user can give the manufacturer a great input in design and entry strategies (Shaw, 1994, p. 276). It is recommended to involve the lead-users in the innovation strategy, which can give the manufacturer benefits in; technical strengths, establish performance/price combination or design specification, learning process on how to operate the new equipment, and how to use it optimally. This can also provide a demonstration effect for other potential customers, and can accelerate the acceptance process for major new designs (Rothwell, 1976; Rothwell, Gardiner & Schott, 1983; Parkinson, 1982; Shaw, 1994). Finally, this relationship between the producer and user can result in a flow of user-initiated improvements. They suggest that there's three design processes; demonstration, make-ability, and redesign for altered specifications. The direct role of the user is maybe seen in the third stage (Shaw, 1994, p. 277).

Mari Sako (1994, p. 269) explains different reasons for supplier relationships. Suppliers may not be willing to invent or spend money on innovating when they do not have a buyer. But when the contract and the collaboration is settled, the supplier will have the incentives to innovate. Two different links that may be explored between supplier relationship and innovation that is: Vertical collaboration, and horizontal collaboration between user and producer (Sako, 1994, p. 268). It is important to distinguish between vertical collaboration, typically user/supplier collaboration and horizontal collaboration where the firms are at the same level, like a network (Dodgson, 1994, p. 285). Linkages between user and suppliers are important elements to the effective management in the system of innovation. An effective management can create opportunities in development, cost and product differentiation, these elements should be in place to create the competitive advantage needed to fund continuous innovation, profitability and growth (Shaw, 1994, p. 275).

3.7.1 User Producer Interactions
In this section I will show the relevance of different types of UPIs and how this interaction affects the innovation process. Furthermore, I will give an overview of how this UPI facilitates for success-, failure-, and direction of technology development addressed by Nahuis et al. (2012). Figure 6 is based on their schematic representation of an innovation system. The concept has been addressed by Lundvall (1988), who emphasize the interaction process of user-producer links that forms the fundament of the innovation process. Users and producers
develop, optimize information channels, develop a common language for knowledge exchange, trust, and creates stronger links with learning by interacting. When the technological characteristics, or user demands are complex and uncertain, strong links between the organizations can occur (Nahuis et al., 2012, p. 1121; Ring & van de Ven, 1994; Acha, 2002; Garud et al., 2013).

3.7.2 Different types of user producer interactions

“We broadly define UPI as interactive learning processes between users and/or leading to or aiming at the reduction of uncertainty about the relation between product and demand characteristics” (Nahuis et al., 2012, p. 1122). Next I will introduce seven different types of user producer interactions (UPI) presented by Nahuis et al. (2012):

(1) **Constructing linkages**, means linkages among and between users and producers. These types of linkages are typically formed and develop through longstanding relationships between the user and producer. Tacit- and difficult knowledge demands close interaction between the actors (Nahuis et al., 2012, p. 1123). (2) **Broadening**, which refer to “broadening the debate about emerging technology, to open up spaces for learning and probing” (Nahuis et al., 2012, p. 1123), it can improve the understanding, how the innovation affect others, and can contribute to the success of an innovation (Nahuis et al., 2012, p. 1123). (3) **Characterizing users**: Firms try to determine user needs and requirements with the feedback links between design and marketing, without marketing, they will try to construct an image of the users in perhaps a more implicit way. They present a concept of user representation, which captures both explicit and
implicit modes. When a product is new and there is not established a market for it, techniques like; personal experience, experts, comparison to other products, surveys, user testing, and user feedback can be useful (Nahuis et al., 2012, p. 1123).

(4) **Upstream involvement**, this linkage refers to active user-agents, that participate in the innovation process. This process often involves learning for both parties, because the users do not have the knowledge, demands, needs and requirements in advance. *Enriching* is an important element in this UPI, and refers to the complexity and problematic innovation process that is challenging to control. But in time, it will increase the understanding of the complexity of the process, and their role in it. It is important to involve spokespersons or representative organizations, and articulation of concerns is more important in addition to the articulation of needs in the innovation process of ambiguous and/or costly technologies. Thus, upstream involvement comprises both demand articulation and acceptability articulation (Nahuis et al., 2012, p. 1124).

(5) **First user enrollment**, market researchers tend to focus on lead users, their perceptions and preferences can serve as need-forecasting for marketing research. Lead users can also gain competitive advantage under increasing returns to adoption. This UPI overlaps with some other types of UPI, but it puts its emphasis on strategies of producers vis-à-vis competitors, and this type of UPI is crucial, just before market launch (Nahuis et al., 2012, p. 1124). (6) **Feedback**, this could be *learning by using*, high degree of systemic complexity makes it hard to predict the outcomes of interactions and contingencies in user context, and refer to the technological characteristics. The characteristics and capacities of users, meaning teaching and encouraging users to explore the opportunities of new technology, and refers to the user characteristics.

(7) **Downstream innovation**, refers to innovation or new technology where the users have been actively involved in the innovation process (Nahuis et al., 2012, p. 1125). There are three types of user involvement: (1) When a user optimizes or customize the innovation, to make it fit better into the local environment. (2) **User innovation** is another term, referring to the recognition of design possibilities. “That is: enthusiast and skilled users are dominant agents in all phases of the innovation process” (Nahuis et al., 2012, p. 1125). (3) “when industry fails to recognize a need or design possibility”, can lead to the emergence of new manufacturers or existing manufacturers acquiring knowledge to adjust (Nahuis et al, 2012, p. 1125).
3.7.3 The context of user producer interactions

Nahuis et al. (2012, p. 1125) says that the context or circumstances shaped by; (1) Type of technology, refers to how the affordances and limitations of the use aspect of a technology can give some suggestions of how the technology should or could be used (Oudshoorn & Pinch, 2003). This type of learning process can also induce further technological innovation. The interrelatedness of system components, the level of standardization, and the stability of performance parameters will affect the affordances and limitations of the technology. “It is crucial to understand the role of UPI in technology development” (Nahuis et al., 2012, p. 1125).

Fleck (1988) divides technological artifacts into three different types; (a) Discrete technology, which refers to “products the end user can make use of in a direct and immediate way (e.g. matches or Aspirin)”, most likely, the users will not have any significant degree of impact towards the producer on products like this. But user characterization and providing feedback could be important, because of the design and use of the technology (Nahuis et al., 2012, p. 1125 – 1126). (b) System technologies, “are complexes of component technologies that mutually condition and constrain each other” (Nahuis et al., 2012, p. 1126). The affordance and limitations are shaped during the development phase, and often require collaboration between different actors, such as experts and developers. They propose that these types of technology require a lot of social learning about how to implement the technology in a given context (Nahuis et al., 2012, p. 1126; Fleck, 1988). (c) Configurational technologies consist mutually interaction components. The affordance and limitations are shaped during the implementation phase, and is the main difference from the systematic technologies. This type of technology emphasizes the importance of downstream innovations. User participation and local experience is important in order to figure out how this new type of technology could meet the user needs, and how it should be configured (Nahuis et al., 2012, p. 1126; Fleck, 1988).

(2) the phase of technology development, in the innovation process of technologies, the artifact of the technology might change during the different phases in the process of innovation, and can be one reason for employing a different UPI (Nahuis et al., 2012, p. 1126). (3) the heterogeneity of user population, heterogeneous user groups might have different needs and concerns. They might also have different capabilities and knowledge bases. These concerns make it complicated to align technological opportunities to user demand (Nahuis et al., 2012, p. 1126).
3.8 The Process of Innovation, in collaboration between firms

The different innovation models reviewed in the thesis, gives an overview of what the different phases in the innovation process involves. The simplified model of innovation process (Tidd & Bessant, 2014) and innovation processes (Garud et al., 2013) presents linear models of the process that can be misunderstood, and might imply that the innovation process is less messy than it actually is. They do emphasize that the innovation process most likely will not occur in this linear form. The chain-linked model (Kline and Rosenberg, 1986) succeeds to some extent, explaining the intricate process of innovation. At least it gives a better explanation of the messy process than a linear model of innovation does. A weakness of the simplified model of innovation process (Tidd & Bessant, 2014) and the chain-linked model (Kline & Rosenberg, 1986) is that the models do not say anything about how the relationship between different knowledge sources and firms work together in the development process. They do note that the development process can be outsourced to other firms, but fails to tell us something about how this difficult transaction between firms unfolds and the actual relationship.

Garud et al. (2013) give an overview of the innovation processes complexity in different levels (within a firm, multi-firm network and communities). They emphasize that one way to address the complexity of the innovation process, is by starting with the implementation phase. This might increase the chance of a successful innovation process. The model fails to tell us something about the linkages between those different levels and stages, and what one should do, starting with the implementation phase. One way facilitating for a successful innovation process, starting with the implementation phase is to address the user needs (Von Hippel, 1976, 1977, 1982, 1988). Deploying UPIs into this intricate process of innovation, attempts to explain the interaction between user and producer (Nahuis et al., 2012) and the linkages between the different levels presented by Garud et al. (2013). The theoretical framework of Cooperative IORs, from formation through negotiations, formal bargaining and execution stage (joint-development), explains the difficult transaction between the firms in collaboration, that the innovation process models fail to address (Ring & Van de Ven, 1994).

3.8.1 Analytical framework

In this analytical framework, I want to explore the dynamic links between the different levels and firms, when partnering for innovation. The model will be the analytical framework forming the basis of the empirical analysis and discussion.
The model has a stippled frame marked with the end user. This is as, Acha and Cusmano (2005) said; they act as nexus agents in the network of the petroleum industry. With the frame, I want to emphasize the important role of these nexus agents. The end-user forms the basis for the different innovation and development processes in partnership between user and producer. The
next elements in the model is inspired by Nahuis et al.’s study (2012). I have added different types of UPIs like upstream and downstream, and research and knowledge. These elements are inspired by the schematic presentation of the connection between user and producer. Different types of UPIs vary, and will be marked with arrows illustrating the linkages.

In the center of the model, I have placed the IOR model (Ring and van de Ven, 1994) to see how the relationship between the involved firms has been formed, developed and dissolved through time. This element is assembled with the process of innovation, inspired by the innovation process models. I decided to make this process circular in the model, to illustrate that the process of innovation is a continuous process of the different phases involved (Kline & Rosenberg, 1986; Tidd & Bessant, 2014; Garud et al., 2013). This new model, might look a little bit like the description of the innovation process model, given by Garud et al. (2013). Even though their innovation processes model emphasis different levels, they do not say anything about the interaction between the different levels. Adding UPI and IORs to the innovation process model, I explore the formation and collaboration between firms, and the interactions between user and producer within the process of innovation.

3.8.2 Defining the elements
I will start defining what I mean with producers and users. Producers can according to Pavitt’s taxonomy (1984) divide producer firms in to four different categories: Supplier-dominated firms, scale-intensive firms, science-based firms, and specialized suppliers, where the latter one is most relevant for the thesis case study. When I define users, I mean, individuals, groups of individuals or organizations. Organizations are the type of users I am studying in this case. The users can also be divided into different types of users. Lead users represents future users. Users as co-producers, are users that actively participate in technology development. Users as implicated actors, are users do not interfere with the technology development phase, but are affected by the innovation, or potential users of the new innovation. The end-users are in this case the oil-operators (Nahuis et al., 2012, p. 1122).

Research and knowledge, refers to the R&D work related to the innovation process, but also to acquiring knowledge, and the technological capabilities. As Kline and Rosenberg (1986) notes, this is not something that is related solely to the invention phase, but interacts through the whole process of innovation. In the circular innovation process model, I added “based on customer
needs” in the “potential market” phase. With this I suggest that the end-user has an overview of the market incentives. The producer and lead-user of technology need to adjust to the end-users need, in the exploitation and exploration of a potential market (Acha & Cusmano, 2005; Garud et al., 2013). The innovation process as usually seen, is about the different phases from idea to market (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013). These phases are represented in the circular innovation process in this analytical framework too.

The assessments for engaging in this type of relationship, refers to why companies decide to collaborate. The assessments are not only based on efficiency and equity, but also to address the end-users needs. The different stages presented are negotiations in the formation of an IOR, commitments when engaging in a relationship, and the execution stage where the companies’ entries the development process. This execution stage, refers to role- and personal- interactions and are connected to the different UPIs. Upstream and downstream refers to some of the interactions presented by Nahuis et al. (2012). Where both the producer (upstream) or the user (downstream) can be the initiator of the joint innovation process. There are also other types of interactions, like feedback. The type of UPI that should be employed in the innovation processes, differs between the context of the study, like projects and/or type of user producer involvement (Nahuis et al., 2012). Therefore, the arrows of feedback and interaction between user and producer, will be added in the extended analytical framework.

3.9 Summary

I find that innovation is complex, and the emergence of a novel idea, development, and the final product itself is just a part of the entire process of innovation. The link between the levels and phases are connected in various ways. Previous theory on innovation furthermore tells us that innovations are seldom developed by one person or company alone, but in collaboration with others. There are different types of collaboration between firms. Why they choose the one or the other, is connected to the reason for initiate in a joint venture, and context. The innovation process will most likely not occur in a linear form, and will be determined influenced by the cultural setting and the context it unfolds in. The use of simple linear models may provide a simplified view of a messy process, and important generative forces of the process might get lost. Hence, it is crucial to recognize the complexity.
4 Methodology and Research Design

In this chapter I account, and reflect upon, the choice of a qualitative case study.

4.1 Qualitative research

Qualitative research method is characterized as “…viewing the world through a wide lens and quantitative approaches as viewing the world through a narrow lens” (Brennen, 1992a; Hay, 2010, s. 16). Qualitative research method is concerned with elucidating human environments and human experiences within a variety of conceptual frameworks. Research is here used as a term for the whole process; from defining the topic and research question, to analysis and interpretation. Method is used as a much more specific term for the investigative techniques employed (Hay, 2010, p. 5). Qualitative researchers have two fundamental questions they are concerned about, either with social structures or individual experiences. These questions can be challenging to differ, but is important in the explanation of the topic researched. An individual’s experience and behavior may be determined not so much by their personal characteristics, but their position in the social structure, associated resources, constraints or rules (Sayer, 1992, p. 93; Hay, 2010, s. 5). There are three models used in social science research: Positivism, Naturalism and Constructionism, where the latter has similarities with naturalism, but differs in the way that it wants to find different perspectives. The thesis research question asks; how has the innovation process…? This is a typically constructionist study where the aim is to seek about the how (Silverman, 2014, p. 22-25).

4.2 Case study as research design

I have chosen to do a case study as research design because my research aims to explore the partnering in the process of innovation, in the context of technology development processes, in the Norwegian petroleum industry. The regional context of the case study is the drilling part of the oil and gas industry, and the local context is a partnership between user and producer to develop advanced drilling equipment (Hay, 2010, p. 86). A case study is well suited to explain concepts, falsifying existing concepts or develop new concepts. The aim of the thesis is to explore the complexity and dynamism of the partnership between user and producer in the innovation processes. The case study may give a broadening academic understanding about the phenomenon innovation, and the process of innovation in collaboration (Hay, 2010, p. 82). A case study is often used as a research design “…in order to explore in-depth nuances of a
phenomenon and the contextual influences on and explanations of that phenomenon” (Hay, 2010, p. 81). Doing a case-study is a one of the preferred methods, when “…the focus of the study is a contemporary (as opposed to entirely historical) phenomenon” (Yin, 2014, p. 2). “A case study is an intensive study of a single unit for the purpose of understanding a larger class of (similar) units” (Hay, 2010, p. 81). The role of a case study is testing theory and generate or expand theory. This case study will both test-, and contribute to expand- theory (Hay, 2010, p. 88).

4.2.1 The case

Early on, when I had just started the Master program, the different Professors talked about their research projects. The project that caught my interest was the Supplier Industry and Value Creation (SIVAC) project that Taran Thune was in charge of. The SIVAC project is about the suppliers to the oil and gas industry in Norway. From that moment on, I decided that I wanted to write my master thesis within the topic. I found the topic very interesting, but I did not decide my research question at that point. Besides being a student, I have been working as a cater, for 9½ year, on an oil-rig in the North Sea. During my time offshore, I have gather a network of contacts in the industry. I grew up just outside the oil-capitol of Norway, Stavanger. So apart from working offshore myself, I am familiar with the industry, and I’ve seen the spillover effects in good times, and the ripple effects in recession.

When I started with my research design for the master thesis, I wanted to find a topic of interest. I talked to Taran Thune, and decided that I would focus on the drilling –part of the industry. What I found the most interesting was the technology development at the drill floor, from manual-rigs to automatic operated drill floors. There are mainly two companies involved in the process of innovation, the drilling company and the supplier of the new technology delivered. I started talking to some of my contacts offshore, and they all had different perspectives on the selected topic. With good help from my supervisor, Taran Thune, and an article online about new build rigs and automated drilling technology, I decided to do my research study on the process of innovation in the firms, how the different companies work alone, and together to develop new drilling processes and technology.
4.2.2 Research question

A simple definition of what “research” is: “how we find things out” (Silverman, 2014, p. 4). There are four different ways of acquiring scientific knowledge; (1) by reviewing existing scientific knowledge, and find a topic that needs more research, (2) Scientific theories and concepts to formulate research topic, (3) discover new and surprising facts, rather than confirming previously think, and finally (4) to be interested in knowledge itself, instead of solving a practical problem (Silverman, 2014, p. 4). What I seek in my thesis, is the understanding of what is going on in the innovation processes at the firm level in the sector of suppliers in the Norwegian petroleum industry. The thesis aim is to explore the complexity of the innovation process, by studying partnership for technology development in the niche market of drilling. To answer this, I asked the following research question:

*How has the innovation process evolved within-, and between a user and a supplier company?*

This is a question that asks for what firms actually do in *real-life contexts*. To address this, qualitative research method is the best way of answering this subject. The answer to the research question can interpret processes or meaning, and I am using theoretically based concepts to explain it. These things are typically for qualitative research (Silverman, 2014, p. 4 - 5). In contrast, *quantitative* research is a way to generate data, statistical calculations, statistical software and seeks explanations and correlations. It is hard to differ between the methods, and Silverman (2014) has added some assumed characteristics of research to distinguish between the studies. Typically, qualitative researchers answer the research question using words, concerned with meanings, induces hypotheses from data, and case study. Quantitative research on the other hand answers the research question using numbers, concerned with behavior, begins with hypotheses, and generalizations (Silverman, 2014, p. 5). The distinction between the types of studies has however been questioned, because the line between them is blurred. However, there are distinction found between the studies, but it is hard to explain it in simple words.

4.3 Sources of empirical evidence

The sources for the empirical evidence, is collected, mainly through interviews, but also through documentation, and participant observation. A typical example of an interview guide
is presented in Appendix A, and an overview over sources for conducted data are presented in Appendix B.

4.3.1 Interviews
As Yin (2014, p. 110) puts it; “One of the most important sources of case study evidence is the interview… they will resemble guided conversations rather than structured queries”. My interviews have been a mix between semi-structured and unstructured interviews, and have been rather fluid. I have recorded some of the interviews, and I found it quite useful in the process of transcribing them afterwards. Some of the interviews have been more of an unformal conversation. These conversations have not been recorded, but I made notes during, and shortly after the conversations to remember key information collected in the process. All interviews conducted has the time amount around an hour. The unformal conversations varies from thirty minutes, to longer conversations. It was hard to getting in contact with some of my key informants, and those “are often critical to the success of a case study” (Yin, 2014, p. 111). The informants’ answer, and the questions I have asked, has been a mix of getting them to corroborate certain findings, but also conducted the informants own sense of reality (Yin, 2014, p.112).

4.3.2 Documentation
For collection of evidence, I have used different types of documentation. A couple of them are papers written by employees working in the firms of technology development. News - articles about the drilling rigs with interviews of the managers of technology. I have also gotten access to some internal documents from one of the firms. I have analyzed the documentation and found relevant information to conduct valid data for answering my research question. These documents can be helpful to verify information, give insight in the company and give additional information to the study (Yin, 2014, p. 107). Because of the anonymity of the companies involved, and the informants. These documents are anonymized in Appendix B.

4.3.3 Participant-observation
This method is a mode of observation, where I somehow have been participating in the observation study. I have not influenced the object of observation directly, but indirectly. The method has some challenges related to roles and the researches ability to separate from the study. In some cases, the participating role can require more attention than the observer one. It can also be hard to be participating or observing the “right” things, if the company is physically
dispersed. This method can in some studies be the only, or the right way of approaching the study, in others it can be totally wrong (Yin, 2014, p. 115-117). My role as a researcher will be further explained in the part of “ethics” and “my role as a researcher”.

4.4 Collection of evidence

The information and data collected during the interview with the informants from the companies, is what makes the analysis interesting. I wanted to get an insight of the culture and the behavior in the firms, and the content of the informants’ answer is what makes this analysis valuable. Evidence or data collection in a case study can be done from six different sources; “documents, archival records, interviews, direct observation, participant-observation, and physical artifacts” (Yin, 2014, p. 102). Interviews are the main source of evidence collected, but participant-observation and some documents reviews has also been a source. Because of the sensitivity of the data collected, I have decided to give the companies of study, pseudonyms to the make the reader experience better. Offshore Drill (Company A) is a drilling company who performs drilling operations in the North-Sea for Oilop (Company C), and Techcomp (Company B) is a supply company that delivers technology and services to Offshore Drill.

4.4.1 My role - the researcher

I work offshore on a drill rig for a catering company that are doing catering service on a drill rig. I am not directly connected to the drilling operation, but still, my work place and colleagues are some of the sources of this case study. Informal conversations and interviews have been executed on the rig. I have also used my contacts on the rig, where I have been using the snowball method to get in touch with other central informants for my thesis. I have also used Facebook as a source of getting information from informants, as well as e-mails. I have written down notes from the informal conversations at the rig, and I have kept a log of the e-mail correspondence and Facebook conversations. The findings are conducting information about the company and technology development throughout the years. They have also given me an introduction in the technology on the drill-floor, and an introduction in how the technology works, and how it has changed the rig-performance on drilling. In Appendix C, the? researcher’s diary is found, and the progress of the thesis is presented.

4.4.2 Access to data

There has not been done a lot of research within the field of innovation at the supplier firms in the Norwegian oil and gas industry. The SIVAC project has collected some literature in a folder
that I have gotten access too. I have also found articles and books, using Google Scholar to do a literature search containing words such as “Innovation in the Oil and Gas Industry”, “Innovation in the upstream petroleum industry”, “collaboration between supplier industry” and “joint-ventures and collaboration in oil and gas industry”. What I found most valuable for this study is the literature from Virginia Acha, who has done some research in the upstream petroleum industry in the early 2000s.

I started in May 2016, contacting people in the industry and companies that I thought might help me giving me the data I needed for my research and analysis. I started with my closest contacts. I had some unformal conversations with them where I got access to a lot of basic information about the topic. After collecting this information, I furthermore used the snowball method, where they have put me in contact with people they thought could answer my question more in detail, or confirming the information they told me (Hay, 2014). People in general have been very helpful and positive to my study. Most informants are very busy; hence the process of data collection was going on for almost eight months in total. There have been a lot of e-mails, phone calls, messages on Facebook, and LinkedIn to get in contact with the people of interest. I started interviewing people within the technical organization and drilling supervisors. Additional I have interviewed employees from the administrative and organizational department, to address the organizational perspective connected to the implementation of the new technology. Because of an ongoing project in Techcomp, and a tight time schedule of Product Champion 2. I did not get the opportunity to execute the interview as planned. This is an obvious weakness of the thesis that I did not get the opportunity to interview as many informants in Techcomp as planned. This is something that I have taken into account, analyzing the data conducted.

4.5 Data analysis

After conducting interviews, I have transcribed the interviews recorded, where I used the program; HyperTRANSCIBE. For interviews conducted in Norwegian, I transcribed them in Norwegian, but translated the parts of the interviews, sited in the thesis. The conversations and informal talks have been written down in short summaries. Some of the interviews has been conducted by e-mail or texts. I used some time reading the notes from the interviews, trying to get an overview of the content before the analysis. The challenge with analyzing the qualitative data is the overall analytic strategy (Yin, 2014, p. 134). The pattern matching (coding) used in
the thesis is based on the research question. Typical code used is; invention, development in collaboration, implementing, and utilizing (Silverman, 2014). Yin (2014) proposes four general strategies for analyzing your data. (1) Theoretical propositions, (2) inductive study, (3) developing a case description, and (4) a combination of the previous three strategies. The thesis is based on previous literature on collaboration between firms, in the process of innovation. The topic of interest is the oil and gas supplier industry in Norway. The approach used in the thesis is combination of the three approaches. I want to participate in describing the phenomenon; the process of innovation in collaboration between firms. But also make useful connections with the data to analyze and build concept from several conceptual theories because of their rich understanding of their field of study (Yin, 2014, p. 136 – 142).

Yin further emphasizes the use of any of the five analytic techniques; (1) pattern matching, (2) explanation building, (3) time-series analysis, (4) logic models or (5) cross-case synthesis (Yin, 2014, p. 142). The technique I have used in the thesis is a time-series analysis where the information of key events is put into a timeline (Yin, 2014, p. 135; Miles & Huberman, 1994). I have also made a logic model, where I try to explain the intricate interactions in and between companies in the process of innovation and technology development. The empirical evidences are presented in the extended analytical framework (Yin, 2014, p. 150 – 163). Finally, I have gathered information and notes during the process, which turned out to be helpful during the analyzing and discussion part of the thesis (Yin, 2014, p. 135).

4.6 Validity and reliability

Validity and reliability is how the thesis is built up, and why the reader should believe in my study. Validity is about how the study reflects the real world, and how reliable the work presented is. There are different techniques and tools available to construct validity of the study, additional to how I reflect and criticize the methodological and analytical choices made (Yin, 2014, p. 45 – 50).

4.6.1 Validity

Constructing validity is one of the critics towards case studies has been directed towards the data collected, and the measurement used in the case study. If the measurements are not defined properly, the reader cannot tell whether the claimed changes in a case study genuinely reflect the changes, or whether they happen to be based on a researchers’ impression only. Therefor it
is critical to the thesis validity to construct good measurements and explain, based on the data, why you conclude the way you are, so the reader do not think you are just jumping to a conclusion (Yin, 2014, p. 46 - 47). The three tactics Yin (2014, p. 47) points out to increase construct validity is; “multiple sources of evidence, establish a chain of evidence and to have the draft case study report reviewed by key informants.” As I mentioned earlier, a problem constructing validity for the thesis is the lack of informants from Techcomp, but the multiple sources of informants in Offshore Drill, made it easier to validate the information given by the informants.

**Internal Validity**

The internal validity is about how you construct the analysis. I have been careful jumping to any conclusions based on the information given. Many of the interviews and conversations have been conducted in order to confirm the information given, and the empirical evidence is built on several informants, confirming the situation in the company. Because of the lack of informant from Techcomp, I carefully used data collected through the informant in the company. In cases where I could not confirm this through the other company of interest, or documents, I decided to leave this part out of the empirical analysis and evidence. Internal validity is about the researchers’ way to construct the analyze and the conclusions, based on which data (Yin, 2014, p. 47-48).

**External Validity**

This is about the generalization of the study. A lot of the criticism towards qualitative case studies has been directed to the fact that it is not generalizable, unlike a quantitative study where you use a survey. In the latter, you can generalize the data from your case study into a broader context. The data from my thesis cannot be generalized, but it can give an insight in how the innovation process unfolds in a partnership between a user and producer, in an innovation process perspective. Additional aspects of the innovation process given in the thesis are connected to the context of drilling suppliers to the oil and gas industry in Norway, and partnering for advanced technology development. This contributes to the literature on the complexity of the innovation process, when partnering for innovation. The thesis forms the basis for future and deeper research on the topic (Yin, 2014, p. 48).
4.6.2 Reliability

“The goal of reliability is to minimize the errors and biases in a study” (Yin, 2014, p. 49). The main goal is to do the study with as many steps as possible. You should be able to do the same case again, and end up with the same result, - if the same procedures are followed. As I mentioned above; “jumping to conclusions”. You should follow the research step by step, and document every step of the way. In this way it will make it easier for the reader, and yourself to see how you ended up from research question, data gathering and analyzing until the final conclusion (Yin, 2014, p. 48 - 49).

4.6.3 Ethical concerns

The study has been reported to Norwegian Social Science Data services (NSD – Norsk Samfunnsvitenskapelig Datatjeneste, 2016), because of the audio recordings of the interviews. I have also notified the interviewees about the study, and they have had the opportunity to withdraw from the study at any time. The interviewees have also been able to keep in touch during the study if they should have any concerns or question. I will send all of them a copy of the master’s thesis once it is printed. I have tried to anonymize the informants in the best possible way. This has been important to ensure reliability of the thesis. Some of the information gathered during the interviews and informal conversations is sensitive information, this is way I have not putted all of the information from the transcribed interviews as an appendix. A typical interview guide can be found in appendix A. The information used in the thesis is summarized in each section of the empirical analysis and discussion chapter, but additional information from the interviews and conversations are excluded.

The thesis is a part of an ongoing project between the University of Oslo, IRIS, Universidade Candido Mendes in Brazil, and Aker Solutions. Supplier Industry and Value Creation (SIVAC) financed by Petrosam2 – program by the Norwegian Research Council. The thesis has had its own research question, and has been an independent study.
PART III – EMPIRICAL EVIDENCE AND ANALYSIS

This part will present the main empirical findings from the case study. I will present and analyze the data collected through interviews, documents, and participant observation. Data collected from interviews will be referred to in general, and because of the anonymity of the informants, direct quotations will be referred to by pseudonyms presented in Appendix B. Chapter (5) will introduce the case study, second, I will present the evidences and analysis structured by the three sub-questions. Finally, all empirical evidence will be summarized.
5 Empirical evidence and analysis

This chapter will first present the case, second, I will present the empirical evidence collected through interviews, conversations, participant observation, and documents.

5.1 The case

This section will give a brief introduction of the companies, and explain why they engage and initiate for collaboration. Figure 8 is a simplified overview of the actors in the segment of drilling, in the Norwegian petroleum industry. The main focus in the case study will be on the companies marked within the red frame.

![Figure 8 The Value-chain of Study](image)

5.1.1 Offshore Drill

Offshore Drill is a leading drilling company in Norway. Their drilling rigs are top-class, highly efficient, and provides cost-efficient drilling solutions to the oil-operators. To differentiate in the market, one of the things they emphasize is, modern and better equipped rigs than others. Before the mid-80’s, their rigs had manual-operated drill-floors. These are not operating in the North Sea anymore. During the mid-80’s, semi-operated drill-floors where introduced. In the early 2000s even more automated rigs where built. The latest supplement to their rig fleet, operating in the North Sea today, is an upgrade of the early 2000s rigs.

... we will never be low-price. I do not think so... So if we want to win a contract, we must differ someway else. And we are doing this with good
Offshore Drill decide whether or not to build a new rig, based on the market needs. They work towards offering great solutions to the oil-operators, keep-, or increase their market share. There are also some specific tax incentives in Norway like; CO2 and NOX, that drives fuel saving initiatives implemented in the technology. The drilling company wants to improve their market share, and differentiate from other drilling companies in the world. They address it with standardization of processes, automatics and new technology development. The rules of engagement to operate in the Norwegian continental shelf are slightly different from the rest of the world. Partly because of the harsh-environment, the Norwegian government, HSE demands, the unions, and therefore the high pay-rate for the workers.

Innovation and technology development is something Offshore Drill work with constantly. There are mainly two fundamental things Offshore Drill stress to address before initiating a business case. The first is how they get paid. They never start building before they have a customer (oil-operator). When a contract between the oil-company and the drilling company is in place, they set-up a project group containing different people from the organization. The drilling company is paid by the oil-operators with day-rates, which means they get paid for being on location, not for drilling faster.

The second, is reducing risk, focusing on HSE. The industry has a tendency to moving towards more standardization of processes, because they want to make the rigs more cost-efficient, and better the HSE performance of the rigs. There are also other projects ongoing financed by the Norwegian Research Council. Another initiative between several actors has started, but are not yet financed. When the market is poor, they search for solutions that leads to an improved drilling process, in order for the oil-companies to start drilling for more oil and gas. The oil-price has dropped before, but the level of cost has increased. The difference is crucial in understanding this latest oil-crisis. “I think the direction of development will lean towards less people, standardization and more efficiency … in general the company’s venue is to do things better. That is the way we were raised in this company” (Technical Organization, 2016).
Offshore Drill are working with technology development in order to improve the drilling process for drilling faster, even though this is not something that pays off in the short run. But they have a better chance of getting new contracts with the oil-operators, in the longer-run, and it is a way to differentiate in the market. In good times, they get contracts at a reasonable price. But when the market changes, like when the oil-price fell in 2014, they are better suited to get new contracts in the poor market. It is difficult to get contracts with the elder rigs. Even though these elder rigs are having a significant lower day-rate they are competing against many other available rigs in the marked. Competing in the same market as new, more equipped, and cost-efficient rigs makes it difficult to rent out the elder rigs. “It’s like a rental car, if you can rent a Fiat 500 to the same day-rate as a Mercedes. You will choose the best” (Director of Engineering, 2016).

5.1.2 Techcomp
Techcomp is a world-leading service company, who delivers solutions and services to both other supply companies, such as Offshore Drill, but also to oil-companies like Oilop. Furthermore, they make products and solutions for the land-based market. In this case, I will focus on products-, systems-, and services related to the offshore segment. Typical products they have made are; automated drilling-machines, different automatic systems related to the drilling process, and other systems like fluid- and completion- systems. Support service system are made in order to complete the product implementation, and goes hand-in-hand with making the product. Delivering a product, practically means that they need to have a service system in place, in order to be able to tackle repairs, and readjustments connected to the product.

Revenue is the most important aspect for Techcomp when initiating a technology development project whether it is service, or product based. The philosophy of Techcomp is to make an automated system in a way that will; improve HSE goals, cost-efficiency, reduce risk, meet their customer needs, and make revenue for both themselves, but also their customers. They work towards offering relevant and better technology and services to both drilling companies and oil-operators. The idea of development in Techcomp, is to reduce stress, and try streamlining the processes of drilling, to make the system more seamless and clean. They are trying to eliminate the human errors in drilling operations, and replace it with technology. They are constantly improving existing technologies, at the same time as they are developing new technologies.
5.2 Collaboration between Offshore Drill and Techcomp

The industry is moving towards more outsourcing and specialization. To solve these complex problems, Offshore Drill and Techcomp work together, and often with other actors as well. They pursue innovations they could not, or would not pursue alone. They do this in order to reduce cost, and acquiring knowledge from customers or experts. The flow of information is important in a cooperation, and both companies acknowledge the importance of good communication within-, and between- the parties. Offshore Drill and Techcomp emphasizes the important role of the oil-operators, the specialization, the complexity of the industry, and pay attention to innovation activities across firms, and other organizations. The complexity, the governmental rules of engagement, and the oil-operators focus on HSE, has led to an increased importance on service supply firms’ role in technology development.

The process of innovation starts with Offshore Drill getting a contract with an oil-operator. After a contract is in place, Offshore Dill tender for a shipyard to build the new rig, and they decide a design for the rig. The next step is to start negotiations around the contract, and the structural design of the rig. The design of the drill-floor, and how the components of the rig are put together is usually a thing that is decided by the drilling company itself. These decisions are mainly made by the Technical organization in the firm. Offshore Drill has been in a joint-venture, JIP, or strategic alliance with different suppliers delivering technological equipment to the drill-floor. They start negotiations regarding type of technology, and equipment they can deliver, and/or, they start an initiative to develop new technology. A typical relation is that the drilling company, or the supply company has got an idea for improving the drilling technique, and they engage in a committed relationship.

In order for Offshore Drill, or Techcomp to develop new technology, they are reliant on each other in order to organize for innovation. The type of contract between the actors vary, but mainly, the relationship builds on negotiations, commitments, and executions. The collaboration is based on standardizing processes for; cost-efficiency, reducing risk, and HSE. Offshore Drill has a philosophy of being a cost-efficient and a high-tech drilling company in order to differentiate in the market. Furthermore, they are reliant on other service and supply firms, in order to address the breadth of technologies applied, and the knowledge connected to the specialized industry. The niche market of drilling is complexed, and it is impossible for any individual firm to pursue all potential research areas, including the oil-operators. It is important
to consider this context of Offshore Drills and Techcomps strategy and the structure of the oil and gas industry. Figure 9, presents the outcomes of previous technology development projects between the companies of study.

This timeline presents key events in three different layers. (1) New methods in the drilling company, referring to organizational changes, and rearrangements done within the drilling company due to new technology, or/and improvements in the process of drilling. (2) Improvement in drilling processes, refers to the operational mode of the drilling process, and utilizing of new technology, or organizational changes. (3) Drilling technology development, shows specific new technologies on the drill rigs, and presents the outcomes from the innovation processes in collaboration.

The boxes with numbers are placed in different layers, and represents these key events explained in the box. Some of the numbers are presented in several layers with a line connecting them, this indicates that the key-event affects different layers. Key event (1) is the first co-development initiative I have mapped in the case study. The technology developed is one of the first step towards automatization of the drilling process. This technology lead to a radical change in the semi-skilled workers daily work-routine. It has also lead to an improved HSE conditions for the employees. (2) In the beginning of 1990s’, Offshore Drill opened a training
center for the drilling personnel. This was in order to scholar the employees, and train them for handling more advanced equipment on the drill-floor. (3) In the mid ‘90s, the drilling company managed to both drill, and produce at the same time. Multi-tasking lead to improved efficiency. (4 – 7) All these events are somehow connected to each other. On the rigs that were developed in the early 2000’s, there were several systems and technologies that were developed. Some of them are Offshore Drill inventions, and others Techcomp. These technologies are related to rig-design, and more automatization of the drilling operation. Together, these technologies improve the working condition for the employees, but also addresses HSE aspect, and makes the drilling process more cost-efficient.

In the early 2010s’ (8 – 11) these key events are implemented on some of the rigs. Number 10 is a further developed, and improved version of key event 6. With new equipment and improved technology, the drilling process has led to; advance in drill depth, and improved efficiency. Key event 11, is a new technology. They want to make the rigs even more automatized, and standardize the processes. Key event (12) is an ongoing project, and is not yet implemented. Looking at the timeline, we can see that the outcomes from the collaboration work, has been more extensive these last years. These key events have led to; improved conditions for the workforce, new and improved technology, automatization, a more cost-efficient operation, and organizational changes.

5.2.1 Partnering for innovation
Offshore Drill and Techcomp are companies searching for new opportunities in the marked to compete with the other actors in the industry, getting a better position in the market, and gain profit. Offshore Drill has some idea campaigns where they ask all employees for ideas. They do have a system searching for ideas from the employees on the rigs, and emphasize that ideas can emerge in the whole organization. They do have a system for capturing these ideas, but the system is rarely used. This is something they are looking into, and might want to develop further. There are examples found in the workforce of good ideas emerging from the employees, that has not been brought up to the administration level. There are different reasons why these idea does not reach the administration level. That could be; section-leaders kill the idea at it emergence, and/or because of the lack of system catching these ideas. The company is working towards cost efficient solutions, innovative products, standardization, and automatization. They have also started a group of people that gathers information, and data from the whole
organization. This initiative could help them bridging the gap between the different units in the firm.

Offshore Drill has come to see that in the complicated niche their operating in, with drilling advanced wells, and complicated tasks, they need to invest in great equipment and technology in order to keep up with the world of tomorrow. These things might have an effect on the drilling process. Their main focus is not necessarily to drill faster, but to standardize these processes because they want to know the exact amount of time the different processes take. Knowing this, they can optimize the logistics around the different processes. In order to do so, they are trying to map the processes, and gather data around these. This also leads the company to look into some technologies that helps them improve the process. One of their goals is to reduce the workforce onboard, because of two main targets. “First, because of the costs related to having people on board the rigs, second, less people equals less risk” (Director of Engineering, 2016).

Techcomp have a pool of ideas, and they try utilizing these ideas, and develop technologies that fit into the possible opportunities. They normally come up with technology-push based ideas, rooted in customers need. They seek for opportunities, and needs in the marked that their customers might not be aware of yet. But these ideas seem to be embedded in the company’s, and the customers core value. Techcomp is also involved in the process of gathering this information with their team of process engineers, mud engineers in the field, but also an in-house team. They guide them in the direction of different matters in production they can move at, in dialogue with Offshore Drill. This information contains; how to deliver technology, the use, maintenance, and how to increase drilling productivity. The oil companies emphasize; productive drilling, reducing risk, and HSE. These end-user needs are important aspects for supply firms in order to start an innovation process, because to reduce the risk of a failure, they need to fulfill the oil-companies need. The invention phase in the companies are technology based on modifications, and new systems in order to perform new tasks, or old tasks in a more efficient way. Both Offshore Drill and Techcomp use their knowledge base in order to co-develop new technologies, or search for existing knowledge somewhere else.

Techcomp also search for customer needs without Offshore Drill telling them explicit what their needs are. They just focus on their customer needs, trying to characterizing users, and search for opportunities in other industries. They search for systems or technologies that can be
transformed into new technologies in the oil and gas industry. Another example of search is to use the in-house group that collects information about their customers, feedback from customers, and feedback from their own service personnel doing maintenance on the drill rigs. Internally they have a process group working with new ideas. If the idea is not mature yet, they log it, and maybe if the time is right, they take some of these key elements into ideas and develop them into an innovation concept when the idea is mature for the market. In this way they keep innovating things regularly.

I mean, there is one thing that we have to remember; the needs always come from the customers. I mean, we have always ideas in our mind, but these ideas only click when we see their problems. I mean because if customers have no need, why would they come to us and buy our product actually? So that is always a driving factor, and the customers drives us. (Product Champion, 2016)

Communication between the company, and users are important aspect to the invention phase. The idea is rooted in the customer needs, where HSE is one of the key elements that are taken into account. “So we always listen to their feedbacks and we try to see how much we can incorporate those things with our effectiveness of the systems (Product Champion, 2016)”. The idea of a technology is rooted in the needs of the end-user or lead-user of technology, but both Offshore Drill and Techcomp can be the inventing firm.

5.2.2 Negotiation between user and producer

When they initiate a joint development project, they start negotiation. Whether it is Techcomp, or Offshore Drill who has the idea; reducing risk, standardizing processes, HSE, and cost efficiency are important aspects for both companies involved, in order to address the end-user needs. They have been in different types of development projects (presented in figure 9), because of this they already know much about one another, have good communication regarding what they are going to do, and why.

The choice of selection when initiating a project for both companies is strategic. Offshore Drill base their choices on getting a competitive differentiation, and to better their market position with acquiring new, better, and cost-efficient technology. The other strategic choice is
embedded in their core values which are; reducing risk, HSE, and cost effective operations. The ideas chosen from the search and selection phase, is the ones that fit best into these core competencies, and company values. With these strategic choices in mind, they form their ideas into innovation concepts. Feedback between the different phases is extremely important between the two companies involved. They constantly work together in order to make the best use of technology.

5.2.3 Commitment between user and producer

In the next step in the development of the relationship between the companies, they commit. This stage is the formal draft of a legal agreement, and a formal contract between the companies always start defining the IP rights. This did not used to be the practice between the companies ten years ago, but because of the increased competition and the positioning in the market, the focus about IP rights has increased. The more formal bargaining includes negotiation of the benefits for the companies involved, and the benefits of the end user– the oil operators. When they have a formal draft or legal agreement between the companies, including IP-rights, costs and roles in the project, they commit. In some cases, cost issues, and/or role of the actors in the project have created some friction in the psychological-contract bargaining process. It seems that neither Offshore Drill is willing to invest if they do not have a contract with an oil-company, or Techcomp if they do not have a buyer for the technology. Even though they previously have engaged in joint ventures, the type of contract they decide on, is dependent on type of technology, or which company who initiated the project. The formal contract is an important stage of the relationship, and for starting a JIP with the involved firms. It is also important in order to avoid misunderstandings and legal impediments. The contractual agreement between the companies, regarding e.g. cost-, and responsibility has changed, as well as evolved during the years. It contains elements like who is going to pay for it, and how will this benefit the end-user. Both companies’ emphasis the importance of a common understanding, and good communication around the product, or focus of improvement. Because they want to capture some kind of value from the new technology. Together they set some criteria at focus, where they discuss equity of both Techcomp and Offshore Drill, and how this specific JIP can facilitate for new contracts with the oil-operators.

5.2.4 Technology development in collaboration

When the formal bargaining between Offshore Drill and Techcomp are settled, they move into the the last stage of formal agreement. This is when they start working on the technology
development process. Sometimes the companies need to renegotiate the formal contract during the execution stage in order to move forward. A collaboration like this can additional to specialization create a creative room for exploitation. They might start over again in the search for other, or new opportunities, trying to make the original idea better. The reason why many of these JIPs is initiated, is to reduce risk, by distributing risk between the companies involved. The thesis finds evidence that implicates that the evolving relationship with several joint development projects, and events has turned into a longstanding relationship. Even though the need for a legal contract have not been reduced.

Involving the lead-user in the creation, and development process have given both companies a big advantage. Offshore Drills perceptions, and preferences is important for both companies in order to develop a successful technology. Offshore Drill has also gained some competitive advantages acting as a lead-user. The knowledge, both explicit, and tacit are important aspects in the development process of technology. User feedback, having people searching, and gathering information from the field, is also crucial to the design of the technology. Both upstream-, and downstream- involvement have a central role in different development projects. The model they use for technology cases varies. Offshore Drill has gotten new technology at reduced price, and the supply company get a test platform in order to develop, and improve technology. In other cases, Offshore Drill has gotten the technology for free, and/or Techcomp has gotten a free platform for product testing. If Offshore Drill is satisfied with the product, they can buy it at reduced price. It is hard for supply companies to sell technology and products if they are not tested, but with a test platform like this, they have a better business case in selling the product to other drilling companies.

Offshore Drill give us a platform, we would walk as a partner with them and experiment this top conceptual pre-work, so for them, we are very grateful, and we see them as a great partner, actually. And they are still helping us to give some new ideas, what experience they are gaining and getting benefited from their feedback as well. (Product Champion, 2016)

Offshore Drill has the knowledge about the drilling process, and Techcomp has the knowledge about producing high-tech drilling equipment. The performance is affected by knowledge, both tacit and explicit. This bond or constructing linkages between the user and producer is crucial,
and can be further developed through a longstanding relationship between the user and producer. The companies have frequently worked together in technology development, and innovation processes (see figure 9). Their role in developing new products is not solely connected to one, but changes between different projects, and between the different phases of technology development. There are also different types of interaction between Offshore Drill and Techcomp, depending on type of technology, and initiator of the JIP.

In the cases where a supplier delivers the technology, the drilling company interferes in the technology development process with their experience in drilling. Offshore Drill make suggestions, based on their knowledge, how the systems should work. In addition to this, they constantly work with projects to make the rigs; better, more cost-efficient, reduce risk and stress. They are working towards making the process more; streamlined, standardized, and to better the rigs HSE performance. Another project Offshore Drill are working with is a project for upgrading elder rigs. This project is something Techcomp might will deliver the solution to, but Offshore Drill does not rule out the possibility for another supply company to deliver this solution.

When Techcomp invents, and develop, they gather detailed information about the users, and the usage. Offshore Drill interferes in the design of technology development, in order to make the technology fit in to the existing organization. Techcomp emphasize that it is important to pay attention to the user-needs when developing. Sometimes the technology design needs readjustments, because it is hard to collect all the information needed in order to develop the perfect product. In some cases, they have a limited amount of time when developing before delivering. It is difficult to do all the testing and readjustment within this time-frame. Furthermore, it is difficult to get feedback from customers about how the technology works, before it is implemented. In many cases they need to do the readjustments after the technology is implemented. When the technology is implemented on the drill rig, they get feedback from the users. With this knowledge, they readjust and make the product better in an existing product line, or develop a new product. The development department of products in Techcomp keep working on their products in steps towards making the rig more automatic, in order to make the whole process of producing and drilling oil more cost-efficient.
In some cases, Offshore Drill make a concept for a technology and contacts a producer, explicit telling them what their needs are. This is a typically downstream involvement, which is a configurational technology, where the drilling company’s experience and knowledge is what initiate the new technology. Offshore Drill invented and conceptualized product X before they contacted the supplier, in this case, they got IP-rights on the product before it was manufactured by a producer.

In the early 90’s we had IP rights on product X, we developed it together with a company. But we actually owned the product. But we, how should I put it... We didn’t actually use the IP-rights on it. It ended up with us selling it to Techcomp ten years later, I think... And everyone uses that product today in drilling ... This is actually an Offshore Drill patent, or it was an Offshore Drill patent. (Director of engineering, 2016)

If product X had been developed in this market situation, Offshore Drill would probably use it more actively, because of the increased use of IP-rights. At that time, it was not that interesting. Though, they sold it to Techcomp for $6 million so there is definitely money in the IP-rights business. But it is even better business to keep the IP-rights, and gain a competitive advantage in the market. Offshore Drill is being more protective over product-concept developments within the firm, because of the emergence of increased focus on IP-rights. In a few years back, the need for a IP-right agreement between the companies was not crucial in order for the companies to partnering for innovation. But because of the increased competition in the marked, the activity around IP-rights has more or less exploded.

For Techcomp the interaction with the customers, and experiences from their own service personnel is important in technology development. Both companies emphasize that they should have a better team for collecting user data. Techcomp gets feedback, but they do not have a team exploring opportunities in the way companies like Apple and Samsung has. Offshore Drill would also like to improve their system of collecting information within their own organization. In the past, the interaction between Techcomp and Offshore Drill did not used to be this close. But lately Techcomp has started to invite the lead-user in for training of personnel, where they educate and showcase the technology. The information from Techcomps own service personnel are also valuable, in order for Techcomp to develop new technology. This feedback and interaction both between Techcomps development team and service personnel, additional to
feedback from the lead-user, has given Techcomp the opportunity to make better products. Offshore Drills act as a lead-user in the execution stage, or the technology development phase. They test technology and Techcomp invite Offshore Drills personnel in for training. This is also in the producer’s interest, to see how the users interact with the new technology, and how they use it optimally. The feedback they get from customers in the test phase, and in using the technology, is crucial in order to make user-initiated improvements in the three design processes; demonstration, make-ability, and redesign for altered specifications. This is typically for system technologies; it requires a lot of social learning about how to implement the technology in the drilling process. Techcomp has used Offshore Drill as a lead-user when designing, and developing different types of technology systems. This may lead to a differentiation between lead-user, and other potential user needs. Other users may emphasize different types of needs. Within a big organization such as Offshore Drill, the different users in different crews might have different opinions regarding needs. In order to reduce the heterogeneity of users, Offshore Drill works with employing a culture within the whole organization, and Techcomp works stresses to tune the technology and black box the invention.

There is a joint path, moving towards cost-effective initiatives, and keep HSE elements in safe balance when making new, and/or better technologies. These technologies are typically configurational technologies which are complexed technologies consisting components in correlation that are dependent on one another. And are dependent on the user producer interaction to increase the understanding, and reduce the complexity of the processes. This addresses both the user producer interaction between Offshore Drill and Techcomp, but also in collaboration with oil-operators. The upstream involvement has increased these last years, since the oil price fell in 2014. There is now an increased focus towards more cost-efficient operations in the North Sea working together towards standardizing, streamlining the production, and reduce costs.

Offshore Drill presented some ideas for the oil-operators somewhere in between 2011 – 2013. The oil-companies did not find the solutions interesting, because there was not a need for these new innovations. They did not want to experiment with these new opportunities, they just wanted Offshore Drill to focus on one thing, the drilling. But time changes. When the oil-price dropped a change of focus emerged among the oil-operators, where there is a will to save money, and review the processes. According to Senior Drilling Supervisor (2016) in Offshore Drill, the latest oil-crisis has led to a closer relationship with Oilop. They are also involved in
some innovation projects, because both parties want to make the processes of drilling better, safer, more streamlined, and efficient in order to save costs.

\[ \text{We have seen more willingness to look at our processes, and what we actually do. But oil-companies as well, and the producer has more emphasize on how we can improve the rigs. And we know, as well as Techcomp now, it is limited how much technology they are going to sell, so we need to tune those drill-rigs we have got to day, in the best possible way. (Director of Engineering, 2016)} \]

5.2.5 Implementing and utilizing innovation

In the development phase, Techcomp succeeded in having a close interaction between the market analysts, and the technological development departments. This is an important aspect in order to meet the user needs, and gather information from the market in preparation for implementing the innovation. The communication between the companies has been extensive, and the early involvement between the user and producer has decreased the degree of uncertainty in the implementation phase of the innovation. Techcomp did not just deliver a product, or a technology system to Offshore Drill. They also supported in training of personnel, such as onshore training, and courses. This part of Techcomps service solution is quite new. When implementing new technology, the personnel on the rigs have a matrix of courses they need to complete before they start working on the rigs. Offshore Drill have their own initiative for coursing and training their personnel as well.

\[ \text{A comment regarding training. I think... if we look back, where things are more visible and clear. I think we are training our people a little too little on the equipment. I don’t think we are good enough explaining to our people how they can maximize the equipment both between crews on the rigs, and between rigs ... but we are improving, we now have a team of people traveling around on the different rigs, and crews and learning them to tune people’s ability to operate the system. (Director of engineering, 2016)} \]

Due to the oil-crisis that occurred, a lot of people in the companies has lost their jobs. There have been 102 changes of personnel in Offshore Drill, since October 2015. Because of this, they have implemented a training-program for new personnel. This training-program consist both onshore- and offshore- training. Even though there has been a lot of changes in the
different crews, the rig performance has maintained at the same level. The culture, and the team spirit has been kept on the rigs, even with the new personnel. Because of the seniority principle in Norway, it is not that flexible in terms of letting people go. So Offshore Drill emphasize that the compositing of people and crews is the key to success. Impediments is considered how to put together crews in the best possible way. They have a system where each person gets feedback and an evaluation every year. Personality test and type categorizing is used by the section leaders, and form the basis for personal portfolio. The crews are put composed based on the personal portfolio, Offshore Manager, section leaders, and human resources.

These technical solutions have led to some organizational changes as well, which one comes first is hard to tell. The organizational changes made by Offshore Drill are done in order to remove the silo-thinking with three different sections: Technical, Drilling and Deck operations. Changing the organizational map, was in order to tear down some barriers, and avoid bad communication between the different sections. The changes made, and the implementation of new technology has additional led to improved working conditions for the employees. According to the semi-skilled workers, the HSE working condition is much better on these rigs. These new rigs require less physical demands in the drilling operation. The climate in such exploration mode, help the employees to think out of the box, working towards making the processes better. On the elder rigs it is more “…business as usual, where we are following an old tested method that might not be the best, but we know it works” (Semi-Skilled worker 1, 2016)

The reason Offshore Drill decided to initiate the business case was to capture market shares with a competitive advantage because of the new technology. The market situation due to the drop in oil-price is both positive, and negative for Offshore Drill. They have become more cost-efficient when drilling with the new technology, but the expensive equipment leads to high day-rates, and makes the competition hard in bad times. Furthermore, it has led to spillover effects in terms of the working condition on the rigs. This is related to the companies’ focus on the end-user needs, when developing new technology. The technology is cost-efficient, the employees involved in the drilling operation have gotten a better work experience because of the new technology, the automatization requires less attention from semi-skilled workers, and reduces risk. Techcomp uses Offshore Drill as a test platform to tune the technology. They get valuable information and knowledge, both explicit, and tacit, in order to produce more cost-
efficient, and better technologies. Due to the oil-crisis, Techcomp are changing the marketing model, in order to meet the market with a better solution.

According to the Rig Manager (2016) the reason Offshore Drill perform better than expected, is because of the efficient rigs, and they are an advantage for winning contracts in this poor market. The focus is sharper, and there was a tendency towards a culture in this niche market of the oil and gas industry. It is not the most expensive solutions that necessarily are the best solutions, but addressing the basic needs is the most important aspect. New technology has given the management a competitive advantage, because of the cost-efficient performance of the rigs. At the time the idea was initiated and developed, there were other areas of focus than cost-efficiency. Because of the oil-price, a shift of focus has occurred.

> When we started this, we didn’t have this in our mind. It was more to automate the system. And we have experienced from the stories on the rig that, people are making a lot of mistakes. The idea was to make a framework of this product keeping that in mind. And apparently there’s an endodontic result of it, that you can see, cost saving ... but it’s one of the key things that we started to see as a benefit of it. But our first intention was not that actually. It was to automate the whole process to take these arrows away. And apparently to bring the costs down on the whole production is one of the way we now started to see that ... Involving less human, less stress, and less shifts, and that will also mean that we need to automate the rig complete. (Product Champion, 2016).

The technology developed by Techcomp, and implemented on Offshore Drill rigs, have got some other contracts as well, but one was cancelled due to the oil crisis. It was not a direct failure, but due to the situation in the market. The technology where initiated and developed before the oil-crisis struck. At the time the technology system was developed and initiated, nobody cared about costs. But when the product was tested, and implemented at the drill-rigs, the market conditions were different. Techcomp has started to remarketing the product. They are changing the business model for the technology, and they make different packages for the customers like; rental of the technological system or pay-while using. But when Techcomp has seen the outcome of this innovation, they still say that this technology is something they believe in, and they would have made it regardless of the market situation. “We would not reduce the costs on this, we would have invested more. This is something… very future. No industry
supplier in the market have done that” (Product Champion, 2016). But the market strategy would probably be different from the beginning. They are making the 2.0 edition of the technology at this moment, so they are still investing money in the project. They have been able to make it into a functional technological system, but it still needs adjustments in order to be a fully automatic system.

New technology and the successful implementing, and maybe due to the oil-crisis impact on cost-efficiency, has led to a closer relationship between the companies. Additionally, this has led to a cost-saving of twenty percent under budget in one year. One of the informants said that they drilled about 13 wells in a year, but original they were supposed to drill 6. But the reason why they were that cost-efficient, was because the rig? Or should the operational drilling plan have been revised? Even though the rig drills about 50% faster than planned, Offshore Drill ask themselves; what did we do? This question has led to the company initiating for a big-data concept within the company, to gather data on how the practice of the technology systems are operated.

After the implementation of the technology systems on the rigs, both Offshore Drill and Techcomp has seen that there is a potential for making the products better. This opportunity has emerged due to the increased interaction between the firms in training of personnel, and there is at the time a project ongoing for updating and fixing these bugs. Feedback to the product developers comes from users directly in the new arena of training initiated by Techcomp, additional to Techcomp own service personnel that gives feedback from the rigs. They have been analyzing how the drilling personnel make use of the technology, when the personnel operate the system. They have seen that they actually operate the system faster than the system does automatically. This is important feedback to Techcomp, in order to make the technology better than the original concept were made, and it is a kind of a win/win situation for both parties.

Knowledge and technological capacity, forms the basis for the process of streamlining and standardizing the processes. In order to do so, they gather knowledge from the different crews to make the processes better. Offshore Drill has a team working on gathering data on processes offshore. At this point there is a lack of data on this. Some concerns are made regarding these systems. The function of the systems could have been developed better, the practice of operating in could have been better, and the use could have been more efficient. They have
started an initiative to better the systems, where they want to send out a team in the field gathering data. They want to do this in order to make the personnel operating the technology getting a standard on how to operate the systems. An initiative on the rigs are video recording of personnel handling the new technologies, in order to see why some of them perform better than others. This is not because they want to put a finger at someone, telling them that they are doing a bad job. But their intention is to tell the “worst-performing” crew that there is a better way of doing it. Eventually the processes hopefully become more streamlined. Another project they are working on, is to automate the whole process.

Reducing the workforce on the rigs are difficult. Even though they have reduced some positions, other positions in technical department has increased due the automated system. Also, there is some operations on the drill floor that requires the involvement of six persons in order to do that exact process. To reduce the workforce on the drill floor with two or three semi-skilled helpers, the process needs to be automatized. “We are still missing the last processes, but when those are automatized, then we can have our price, so to speak. We are not there yet, but we will succeed, it just takes time” (Director of engineering, 2016).

How the different rigs are doing, compared to each other is hard to tell because of the complexity of the wells we are drilling. This is also affected of effectivity. The equipment on the rigs are definitely a good advantage for both oil-operators and Offshore Drill. There is a database where the oil-companies presents anonymized weld-data, the performance and HSE, all these things are drivers for the performance of the rig. (Rig Manager, 2016)

The successful implementation of the technology system, was that both Techcomp and Offshore Drill managed to; meet the user needs, training of personnel, the company culture created, and maintained within Offshore Drill, composition of crews, additional to the organizational changes made. The successful implementation is not only seen in a management perspective, but has also led to improved working conditions for the employees on the rigs. Utilizing innovation in both companies, are done by using new technology as a strategic advantage for gaining a better position in the changing market. Even though the technology systems and products implemented are not fully developed to its potential, they do not see this as a failure. They use feedback as a source to proceed in the cycle of innovation for new inventions or re-inventions. Having the user needs in mind; HSE, reducing risk, and cost-efficiency as a core-
element in the innovation process makes the innovation adopt to several demands in a changing market. Maintaining, and enhancing their market position, and utilize the spillover effects from new technology is the value created and captured by the companies through partnership in the process of innovation.
PART IV – DISCUSSION & CONCLUSION

In this part (chapter 6), I want to reframe the evidence found in the empirical analysis and start presenting the main findings. In the literature review chapter, I presented different types of models of the innovation process. To contextualize the case study, I will revisit this chapter, shed a light, and discuss how these empirical evidences can be seen in the context of previous literature. Further I discuss the main empirical evidences implication for the innovation process literature in a partnership. I will end the discussion part, presenting and explaining the evidence in an extended version of the analytical framework presented in the literature review chapter. Second, I will conclude the study, starting with answering the thesis research question. Finally, I will present limitations of the study, and make suggestions for further research.
6 Discussion

The aim of the thesis is to explore the complexity of the innovation processes in collaboration, and the dynamic links between a user and a producer. The empirical evidence was conducted through interviews, documents, and participate-observation. First, I will present the main empirical evidences, second, I will present the empirical evidence implications for literature on innovation processes, additional to theory on collaboration between a user and producer in an IORs.

The complexity of the industry, and the specific niche market creates a need for collaboration between the different supply firms. The evolving relationship between producer and user emerge in the search for knowledge acquisition to address this complexity. The market and competition between the firms, the use and focus of IP-rights have increased the last years. The need for a legal document when initiating an innovation process has increased, but the relationship between the companies has still grown into a longstanding relationship, and evolves through key events. The innovations are in most cases configurational technologies, where user participation is important in order for the technology to be successfully implemented. Most JIPs found in the study was initiated by Techcomp, but some evidence of Offshore Drill as the initiator in development projects are also found. Even though the initiator of different projects varies, the driving factor is always rooted in the user needs, whether it is the end-user (the oil-operator), or the lead-user (Offshore Drill).

Offshore Drill and Techcomp initiate innovation projects due to the company’s strategic plan, where the oil-operators’ needs are embedded. The focus lies on HSE, cost-efficiency, and reducing risk. In order for Offshore Drill and Techcomp to keep and better their market position, they need to mobilize and meet these customer needs. Standardization, new technology and automatization is one of the factors leading to reduced risk, bettering HSE, and reducing the level of cost. These factors are drivers for the companies to engage in the innovation process. When the idea is developed, they need to test and implement the idea. I found that training of personnel and the organizational perspective are crucial factors for a successful implementation of new technology. Offshore Drill have shown a great capacity to change and adapt to the changes of implementing new technologies. Meeting the lead-user needs is crucial in order for Techcomp to succeed when implementing a new product. At the same time, it is crucial for
Offshore Drill to meet the end-users need, in order to get new contracts with the oil-operators. The spillovers from implementing new technology is related to the working conditions for the employees (improved HSE), it also opens up the opportunity to move further in the cycle of innovation process; inventing new products or a recombination of new and old products. Both companies have captured some kind of value from implementing the technology, even though the value created turned out to be something else than the companies predicted when engaging in the partnership for one of their latest development projects. Rooting the innovation in both end-users and lead-users’ needs, led to value creation, even when the market changed. Meeting the user needs seems to be a crucial driver in order for the companies to succeed.

What I find interesting is that one of the main reasons the companies engaged in one of the latest joint ventures was to; reduce the workforce, reduce cost, and do things more cost-efficient. Additional to this they added elements to improve HSE and reduce risk which are the end-users’ main needs. Reducing the workforce has not been the case yet, instead; new innovation has led to a reorganization of the organizational structure. The solution offered contains more automatization, less semi-skilled workers to operate, but acquires more attention from technicians. Even though they did not manage to reduce the workforce, the companies have managed to capture value from the innovation. The companies have strengthened their market position, become more cost-efficient, reduced risk, and they have improved their HSE performance. The next sections will present empirical evidences implications for literature.

6.1 Partnering for innovation

The contextual strategy and structure found in the thesis when partnering for technology development processes, correlate with the study of Acha (2002) that there is a need for collaboration between the firms, in order to develop advanced technology, in the complex industry. The oil-operator (end-user) have an important role in the innovation process, as the earlier studies of the industry has shown (Acha & Cusmano, 2005). The end-user needs: HSE, reducing risk, and cost-efficiency, and the need for specialized equipment to perform advanced drilling processes in the North Sea, forms the basis for suppliers to collaborate when developing high-tech drilling technology. The content is the same as user driven innovation theory (Shaw, 1994, p. 276; Nahuis et al., 2012, p. 1124; Von Hippel, 1976, 1977, 1982, 1988; Urban & Von Hippel, 1988). The context of the case study, is important to notice when analyzing, as Ring and Van de Ven (1994, p. 112 – 113) emphasize.
The end-user needs and the specialized industry forms the basis for the complexed problems related to the innovation process. The thesis agrees with Garud et al. (2013, p. 784) that argues that these problems often emerge within niche markets like this case study of the innovation process in drilling technologies. In order to solve the key challenges related the breadth of technologies applied to address the end-user needs, the drilling company and supply company are reliant on each other’s technological capabilities and knowledge. Offshore Drill has the knowledge about how to perform the drilling process, and Techcomp has the technological capabilities in producing advanced drilling equipment. The thesis find that the reason companies decide to collaborate for innovation, is because of the complexity of the innovation process, and industry. The thesis finds that this is the same content as found in the study presented by Acha (2002), and theory related to technological capabilities addressed by Garcia et al. (2014, p. 27 – 28).

Another reason for collaboration between the companies of study, is that they want to reduce cost and risk connected to the complexity of the process of innovation. The need for outsourcing and collaboration between companies are crucial in order to address the complexity of the innovation process. It is also impossible for companies to pursue this type of innovation process alone in the complex Norwegian petroleum industry. The content is the same as emphasized in innovation process theories, why firms decide to collaborate. Companies collaborate in order to reduce cost, acquiring knowledge from customers, or experts, and; the process of innovation rarely occurs within the boundaries of one individual firm (Chesbrough, 2003; van de Ven, 2004; Garud et al., 2013; Tidd & Bessant, 2013; Nahuis et al., 2012; Miles et al., 2005, p. 19).

### 6.1.1 Negotiation in an emerging IOR

The negotiation stage and formal agreement when engaging in a JIP is crucial in order for the companies to be willing to engage in such relationship. When the negotiations and the formal agreement is settled, they initiate for the development phase of the innovation process, or execution stage. The thesis finds that the assessments in an IOR are based on cost-efficiency and equity. These joint assessments are the foundation for collaborating when addressing the complexity of the innovation process. The thesis finds that joint expectations and assessments are crucial in order for the companies to engage in a joint-venture, additional to communication between them is important. Because both companies want to capture some kind of value from
when collaborating for innovation. The thesis finds that the emergence of the IOR, the companies develop joint assessments and define what benefit the companies will gain from such a partnership. It crucial that the companies agree to terms, before engaging in a joint venture, and the content is the same as the IOR theory presented by Ring and Van de Ven (1994). The reason for engaging in a partnership for innovation, is to address complexity, and reduce risk by distributing risk between the companies involved. This is the same content as found in the innovation process theories, and the thesis agrees with previous research on why firms collaborate, or outsource the development process to others (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013). The thesis does not find that IORs emerge through small, informal deals with low risk, which require little reliance on trust, and this contradicts with the study of IORs presented by Ring and Van de Ven (1994).

6.1.2 Formal document of collaboration in IORs

In the next step of the development of IORs they commit (Ring & van de Ven, 1994, p. 97). This stage is the formal draft of a legal agreement. The formal contract between the companies of study always start defining the IP rights. The competition and the positioning in the market, has led to an increased focus regarding IP-rights. These empirical findings contradict with the study of Ring and Van de Ven (1994), and do not find that a longstanding relationship in an IOR will decrease the need for a formal document. The thesis finds that IP-rights, and formal documents has a strengthened position in an IOR and agrees with the study of Acha (2002) that the focus on IP-rights is related to the competition in the marked. The reason could be that the study of Ring and Van de Ven is from 1994, and the contractual relationship in an IOR has changed, or it can be related to the context of the niche marked of study. According to one of the informants in the study, this formal document, and focus on IP-rights did not use to be the practice in the industry ten years ago, but due to the market situation and competition, the focus has changed.

This formal contract also includes responsibilities such as costs and roles. Typically cost issues can create some friction in the psychological contract bargaining process because; neither companies are willing to invest if they do not capture some kind of value from it. This is the same content as found in the innovation process theories and IOR theory. Companies collaborate in the innovation process to capture some kind of value from it and gain benefit (Hamel & Prahalad, 1990; Ring & Van de Ven, 1994; Tidd & Bessant, 2014; Kline &
Rosenberg, 1986; Garud et al., 2013). The companies that have engaged in different joint ventures, but the formal contract seems to be determined by initiator for the project, or type of technology. This is an important stage of the development of an IORs, and the thesis agrees with the theory that this contract is important in order to avoid misunderstandings and legal impediments (Ring & van de Ven, 1994, p. 98).

The thesis does agree with Ring and Van de Ven (1994) that a long-lasting relationship is developed through key events, but suggests that the commitment stage of IORs might have changed since the study of Ring and Van de Ven (1994). The thesis finds that the need for a legal document is not reduced in a longstanding relationship between the companies in an IOR. But the need for a legal document has increased during the years, and is not related to the longstanding relationship, but agrees with the study presented by Acha (2002), that this is related to the market situation and competition level between different companies in the industry.

6.1.3 The dynamic link between a user and producer
The thesis finds that different phases described by the innovation models presented in the literature review gives a good overview of the search and invention phase of the process (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al. 2013). But the linear models fail to illustrate how the entire innovation process between and within these companies unfolds. These models do not address the relationship between the different companies in the different phases, even though they emphasize that innovation rarely occur within a firm alone (Dodgson, 1994).

Garud et al. (2013) succeed to some extent explaining the different phases when firms or communities collaborate for innovation. But separate from the multi-perspective of the entire process, they fail to address the interaction and dynamic links between the levels and phases. The thesis has explored the dynamic links between the end-user, lead-user and producer of technology. The initiator for engaging in such a relationship can be both end-user, lead-user and producer. The motives are to address needs such as; (1) better their strategic position in the market, (2) cost-efficiency to gain profit, (3) differentiate in the market, (4) reducing risk, and/or (5) better the HSE performance. The reason companies search for new opportunities in the marked, are in order to be able to compete with the other actors in the industry. They want to gain a better position, profit, strategic advantage, with new technologies based on modifications, or new systems; in order to perform new, or old tasks in a more efficient way.
The companies have embedded the end-user needs in the companies’ strategic choice, which are crucial in order to succeed in the process of innovation. These reasons are the same content as found in the existing theory of managing the innovation process (Tidd & Bessant, 2013, p. 22; Kline & Rosenberg, 1986, p. 292).

Most innovation processes are initiated by the producer, who has a technology-push strategy. They try to characterize users, where they interpret what the user needs are. This is based on: their knowledge of the market situation, their own technological capabilities, former innovation processes between the companies, and feedback from both users and own service personnel. The thesis finds the innovation process as user driven, like the theory of Von Hippel (1976, 1977, 1982, 1988). He defines innovation as user driven, when the innovation is rooted in the user needs (Von Hippel, 1976, 1977, 1982, 1988). Even though the producer in some cases try to address user needs that are not communicated explicitly by the users themselves. The thesis finds that in order for the companies to succeed in the innovation process, they seem to be reliant on their knowledge base in order to co-develop new technologies or search for existing knowledge somewhere else, and agrees with former innovation process theory (Tidd and Bessant, 2013, p. 90; Kline & Rosenberg 1986, p. 291; Garud et al., 2013).

The links between the users and producer in the case study are dynamic, but varies between different phases of the innovation processes. This is related to type of involvement, the role of the end-user, lead-user, and producer. The links in such a joint-venture, occurs in a dynamic form, related to different phases of the innovation processes. In the search and initiation phase, it can be both upstream- and downstream- links between the user and producer. The relation between the user and producer in the innovation process are related to both knowledge and technological capabilities. The performance in such a relationship is affected by knowledge, both tacit and explicit. These dynamic links are addressed in the study of Nahuis et al. (2012) where they explore different types of interactions between users and producers. They emphasize that these interactions most likely will change between the different phases of the innovation process. The thesis agrees with previous literature, and find that these dynamic links between the user and producer is crucial when managing, and planning for a successful innovation process. These interactions between user and producer evolves through a longstanding relationship (Orsenigo et al., 1988: Powell & Grodal, 2005, p. 56 -79; Nahuis et al., 2012, p. 1123; Ring & Van de Ven, 1994).
6.1.4 Technology development

In the development phase, feedback between the user and producer is the most common link. But feedback is also found between user and producer in other phases of the innovation process. In sum, the links are dynamic in the way that they change between the different phases and stages, when collaborating for innovation. The links varies from different type of projects initiated. In the development phase the thesis find that it is important to have a close interaction between the market analysts and the technological development department, furthermore, between the user and producer. These links are crucial in order for the innovation process to succeed, and is the same content as found in innovation process theory (Tidd and Bessant, 2014; Nahuis et al., 2012; Kline & Rosenberg, 1986; Garud et al., 2013). The thesis finds that the joint path must maintain in safe balance between the lead-user and producer in order for the technology development phase to succeed.

The thesis finds that involving the lead-user in the creation and development process can give a big advantage to both producer and lead-user. The lead-user perceptions and preferences are important to the producer in order to succeed in the technology development process. The dynamic link between lead-user and producer towards the end-user seems to have an increased importance in a poor market. Meeting the end-users’ needs are crucial in order for the invention to succeed. The lead-user have gained a competitive advantage, such as strengthening their market position, especially in a poor market, with more efficient technology, that leads to cost-efficiency. The thesis agrees with previous literature, and emphasize the importance of involving the lead-user in the innovation process. This can facilitate for the invention to become a successful innovation (Shaw, 1994, p. 276; Nahuis et al., 2012, p. 1124; Von Hippel, 1976, 1977, 1982, 1988; Urban & Von Hippel, 1988).

6.1.5 Implementing new technology

The thesis finds that the dynamic links between are crucial in order for IOR in JIP to succeed in the innovation process. The early interaction between the user and producer and legal document (based on negotiations), has decreased the degree of uncertainty in the implementation phase of the inventions. The thesis finds, and agrees with existing innovation process theory; this is the key phase of the innovation process, in order to turn a developed invention into innovation (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013). This phase is both crucial to the producer, but also the lead-user. The producer delivers technology, and the first user enrollment is the lead-user. The thesis also finds that in the
producer supplements the technology by delivering services, and more recently training of lead-users. The theory suggest that the companies should have a plan for implementing a new technology in an organization. This plan is supposed to facilitate for the implementation phase to proceed more smoothly. This can be done by adding elements like e.g. training, organizational structure, company culture, and good communication internally, but also externally between the user and producer. The plan can reduce uncertainty when implementing a new technology (Tidd & Bessant, 2014, p. 94; Garud et al., 2013, p. 790; Lam, 2005, 133 – 137; Kline & Rosenberg). The thesis finds, and agrees with previous literature; that the lead-user capacity to change and adapt when implementing a new technology is crucial in order for the implementation of a new technology to be successful. The management has done extensive work in order to create a team-culture amongst the employees. Compositions of crews, associated with the culture aspect in a company are based on feedback, personality tests and evaluations, in addition to organizational changes within the company. Training of personnel is one of the things both companies have found as a key factor when implementing a successful innovation.

The heterogeneity of users can implicate the implementation phase due to different needs and concerns. Involving the lead-user, gives the producer an opportunity to test technology, and adjust according to specific needs. The feedback between user and producer in the test phase is crucial in order to make user-initiated improvements in the three design processes; demonstration, make-ability and redesign for altered specifications. Configurational technologies require a lot of social learning about how to implement the technology in the company, and are shaped during the implementation phase. This can make the technology even better, additional to create some problems related to the diffusion of the innovation. The customized technology might not fit other potential users’ needs. The producer might have to standardize the technology, in order for the invention to become black-boxed (Nahuis et al., 2012; Kline & Rosenberg, 1986; Shaw, 1994, p. 277; Garud et al., 2013; David & Greenstein, 1990; Phillips et al., 2004; Porac, 1997; Rosa et al., 1999). The thesis agrees with the complexity associated with the heterogeneity of users and implementation of new technology. Furthermore, it suggests that reducing heterogeneity by embedding the end-users need and keep/create a good company culture could be one way to address this complexity.
6.1.6 Capturing Value

Either it is the end-user, lead-user or the producer who is the initiator for collaborating for innovation. They want to capture some kind of value from it. Both the producer and lead-user want to capture market shares, and gain a competitive advantage. For the companies to capture value, the invention must be successfully implemented (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013). The thesis finds that in order for the lead-users, and producer to capture some kind of value, it is crucial for the innovation to meet the needs of the end-user. It seems like embedding the end-users need in the different phases of the innovation processes, leads to innovations that can adapt to different market situations. IP-rights in order to gain an advantage in the competing market is another way for both users and producers to capture value from innovations.

Spillover effects, like re-inventing, re-combination of new and old technologies, or new technologies might occur, and initiate for the cycle of innovation to proceed. In one of the latest joint-ventures between the firms, they planned to capture some kind of value. Due to changes in the market, user needs, or other environmental changes, the thesis finds that it is hard to plan the outcome the innovation process. Even though the process itself can be planned, and reduce the risk of failure. And collaborating for innovation, will improve the chance of succeeding. The value created in such a process cannot be seen before the innovation is successfully implemented. The thesis agrees with the existing literature on capturing values from innovation, and finds that it is hard to plan the value creation through the innovation processes (Tidd & Bessant, 2014, p. 95; Garud et al., 2013; Kline & Rosenberg, 1986; Rubach, 2011; Fagerberg, 2005, Borrås; 2005). The thesis find that the companies utilize the implemented technology as a source to continue the cycle of innovation. They keep re-inventing, and improving existing technologies, and search for new opportunities to improve the holistic process of drilling.

6.1.7 Summarizing implication for the literature

The petroleum industry in Norway is complex. The complex industry, additional to the complexity of the innovation process is partly the reason why companies decide to collaborate for innovation. Other reasons are to reduce cost and risk, and in order to capture some kind of value (Hamel & Prahalad, 1990; Ring & Van de Ven, 1994; Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013; Dodgson, 1994). Joint expectations and assessments are crucial before the companies engage in a collaboration project (Ring & Van de Ven, 1994). The
thesis finds that the need for a legal document has increased during the years, and is not related to the longstanding relationship. This contradicts with the study presented by Ring and Van de Ven (1994). The thesis find that the legal document is related to the market situation and competition level between the companies in the industry, and agrees with the study presented by Acha (2002).

The thesis finds that different phases described by the innovation models presented in the literature review gives a good overview of the search and invention phase of the process (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al. 2013). These models do not address the relationship between- and within- the companies in the different phases, even though they emphasize that innovation rarely occur within a firm alone (Dodgson, 1994). The models fail to address the interaction and dynamic links between the levels and phases. When collaborating for innovation, the links are dynamic in the way that they change between the different phases and stages in innovation process. The thesis agrees with Nahuis et al. (2012), and finds that the interaction between the user and producer is crucial when managing for successful innovations. These interactions between user and producer evolves through a longstanding relationship (Orsenigo et al., 1988: Powell & Grodal, 2005, p. 56 -79; Nahuis et al., 2012, p. 1123; Ring & Van de Ven, 1994). The thesis emphasizes the importance of involving the lead-user in the innovation process to facilitate for the invention to become a successful innovation (Shaw, 1994, p. 276; Nahuis et al., 2012, p. 1124; Von Hippel, 1976, 1977, 1982, 1988; Urban & Von Hippel, 1988).

The early interaction between the user and producer, and legal document (based on negotiations), has decreased the degree of uncertainty in the implementation phase of inventions. The thesis suggests that user heterogeneity can be reduced by embedding the end-users needs and keep/create a good company culture. It is hard to plan the outcome of the innovation process, even though partnering and planning can facilitate for value creation. The value created in such a process, cannot be seen before the innovation is successfully implemented.

6.2 Extended Analytical Framework

The innovation process does not occur in a linear form, but it is an on-going process with dynamic links between the user and producer. The relationship is based on former products, knowledge- and technological- capabilities between-, and within- the different firms. The
extended analytical framework I present appears to be less messy than the actual innovation process. First, the framework illustrates and explains some of the interactions between user and producer, previously presented by Nahuis et al. (2012). These links are seen in the light of the innovation process theory (Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013). Second, it addresses the evolving IOR in the innovation process (Ring & Van de Ven, 1994). Figure 10 is an extended version of the analytical framework presented in the literature review chapter. The main difference is that I have added the empirical evidence from the case study to illustrate how the empirical evidence implicates previous literature. There are two elements added. First, the names of the companies of study. Oil-op are the nexus-agents, or the end-user. Oil-ops’ needs form the basis for the different collaboration initiatives for innovation and development projects between the producer; Techcomp, and lead-user; Offshore Drill. Second, arrows with numbers represent the dynamic links between the user and producer. The numbers connected to the arrows will be further explained. I have also added arrows between the different phases of the innovation process to illustrate that the process occurs in a non-linear form, the process seems to be a continuous circle of innovation, that moves back and forward from the different phases.
The relationship between Offshore Drill and Techcomp has been formed because of the complexity of the innovation process, and are typically based on configurational technologies. Both user-, producer-, upstream-, and downstream- initiatives has motivated for the formation
of the IOR. The assessments are rooted in end-user needs, cost-efficiency, and equity. A long-term relationship has occurred between the producer and lead-user, because of the complexity of the industry and innovation process. The user and producer initiate for collaboration projects because the companies did not have the knowledge, and technological capability to develop the innovation without external resources. The relationship has developed over time through different key events of JIPs between the firms, and was presented in figure 9 (Timeline of Key Events). The need for formal contract has not decreased, rather increased over time. This is not because of a trust issue between the parties, but because of changes in the market conditions. To ensure the assessments; equity, cost-efficiency, and user needs, this formal contract is crucial in order to maintain trust between the parties and facilitate for a successful innovation process. For each JIP they start with the formal contract, starting with the IP-rights, even though both parties have engaged in a longstanding relationship. The IORs are highly connected with the process of innovation, and are the formal agreement between the companies before engaging in the execution stage, or the development phase (Ring & Van de Ven, 1994). This process evolves over time as the technologies develops as; new information, skills, technological capabilities, and market conditions changes. The thesis finds that the foundation for collaboration, is the legal document before engaging in the innovation work. It further explores the different phases of the innovation process executed within- the company, and in collaboration.

I will now explain the eight different arrows, marked with numbers. Some arrows have got the same numbers, and are connected to the same type of dynamic links. Different types of UPIs are found in the case study and explores the interaction between user and producer, in different levels and phases in the innovation process (Nahuis et al., 2012). (1) This arrow refers to downstream innovation and to Offshore Drill as the concept-developer and initiator to the JIP. But the lead-user still needs a producer to manufacture the product. These concepts are mainly based on the end-users needs, but also according to their own company’s core value, strategy, and the technological capacity within the firm (Nahuis et al., 2012; Garud et al., 2013). (2) Upstream involvement is characteristic for the industry. Even though Oilop do not seem to interfere directly in the innovation process, their needs are considered before the development, and innovation process continues. More directly upstream involvement is also found, where Oilop in a project actively participate in the development process of the product (Product Champion, 2016; Director of Engineering, 2016). Characterizing users and constructing
linkages between the producer and user, is also interactions that facilitates for a successful innovation process in collaboration (Nahuis et al., 2012).

(3) Research and knowledge are connected to the whole process of innovation in collaboration and refers to both technological- and knowledge- capabilities and acquisition. The research and knowledge facets are connected to the phase of search and selection, development process, but also when implementing a new technology to the market. But in this case it refers to the research about customers, market analysis, and searching for new knowledge or existing knowledge in order to invent, develop, and implement new technology and innovations (Nahuis et al., 2012; Kline & Rosenberg, 1986).

(4) The feedback and training, both internally and between Offshore Drill and Techcomp during the different stages of development, has increased these last years’. The cultural aspect and training of personnel is crucial in order to have a successful implementation of the new technological system, which both companies emphasize (Nahuis et al., 2012; Tidd & Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013). (5) The innovations do offer some spillovers like working conditions, and solutions that are able to adjust to the changing market conditions. Furthermore, it gives the opportunity for the user to give feedback to the producer, and start re-inventing. These spillovers appear to be related to the fact that the innovations are rooted in the users need.

Type of UPI varies between different JIP, but the connections are illustrated with arrows in the extended version of the analytical framework (Nahuis et al., 2012). Even though some of the arrows are connected to different phases of the innovation process, I emphasize that these arrows are not surely connected to one phase. Additional to these UPIs, feedback between the user and producer are found in all phases of the innovation process. Type for UPI addressed by the companies differs during the phases of the innovation process, interaction between user and producer are indicated with arrows connected to the different phases and between the innovation process (Nahuis et al., 2012; Kline & Rosenberg, 1986; Garud et al., 2013). The innovation processes of technology development have been a success between-, and within- the companies. Innovation takes time, it takes several rounds in the cycle of innovation process moving back- and forwards, and between the different phases working towards their end-goal (Kline & Rosenberg, 1986; Garud et al., 2013, p. 782; Tidd & Bessant, 2014).
6.3 Conclusion and implications for theory

This thesis has explored the complexity and dynamism of the partnership between a user and producer in the innovation process. The research project has through a case study of a longstanding partnership between two companies, examined how the companies plan and execute the innovation process to reduce risks, and increase the potential for value creation. In order to do so, I asked the following research question: *How has the innovation process evolved within-, and between a user and a supplier company?* Next, I will answer the research question, and explain how this contributes to the existing theory on innovation processes in collaborative technology development projects.

The thesis find that the complexity of the industry and innovation processes creates a need for collaboration between users and producers. The analytical framework attempts to explain why and how the companies decides to engage in different types of joint ventures, and how the process unfolds in a partnership. They do this in order to develop advanced technology equipment related to the drilling process, and address the complexity of innovation process. The need for a formal contract between the companies has increased these last years, and is essential in order for them to engage in such a joint venture. The competition level, and the marked structure in the industry has led to an increased need for such contract. The thesis suggests that the changes in the commitment stage are related to the context of the case study, or the stage has changed since the IOR study of Ring and Van de Ven (1994).

The management plan and UPI can reduce the risk of failure in an innovation process. The interaction between user and producer are dynamic, and varies between the different phases of the innovation process. This is the same content as found in previous literature where they emphasize the need for employing different UPI, in different phases of the innovation process (Nahuis et al., 2012). The companies’ plans are based on experience from previous partnerships in advanced technology development. But a company alone, or in a partnership cannot realize the outcome and the value from in the process of innovation before the innovation is successfully implemented. The thesis suggests that there are certain key factors, when partnering for innovation, that seems to facilitate for successful innovations: (1) The user needs embedded in the different phases of the innovation process, (2) good communication, (3) involving the lead-user through the phases of the innovation process, (4) company-culture, and (5) training. This contribute to existing innovation process theories, on how companies should
manage, and plan for successful innovation processes. It further emphasizes the importance of
the interaction between user and producer when managing the innovation process (Tidd &
Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013; Nahuis et al., 2012).

The companies keep working towards a more streamlined operation, more standardization and
automatization of the drilling processes, and hope that they eventually will reach their end goal.
The thesis does not find that the companies are there yet, but the companies do not see the
innovation processes as a failure. The thesis suggest that the companies managed to employ
these key-factors in the innovation process, and explains the success stories of the inventions.
This contributes to an increased understanding of the complexity of the innovation process, and
suggest how the companies should plan and manage the process in order to capture some kind
of value from the innovation process. The longstanding partnership evolves through different
joint ventures, and they keep working towards their end goal, which both companies think
eventually can be done. They address this with improving existing technology and processes,
and initiate for new innovation processes. This is the same content as found in previous
presented innovation process theories, how the companies capture value from their innovation
work. The value created through the process of innovation, cannot be seen before the
technology is successfully implemented. But the longstanding relationship between the
companies has engaged in a cycle of innovation process in order to reach their end goal (Tidd
&Bessant, 2014; Kline & Rosenberg, 1986; Garud et al., 2013).

6.3.1 Limitation of this study and suggestion for further research

The extended analytical framework presented can occur more systematic than the process itself
actually is, and the model can give the impression that there is a tidiness that do not exists in
such a system. Mapping the process in detail is almost impossible, because of all the factors
and variables that effect directly or indirectly. This is factors such as e.g. humans, systems, and
company-culture, and are difficult to document even for the companies themselves. The
extended analytical framework could have benefitted of being extended to an extra layer of
marked incentives like the oil-price, competition in the rig marked, governmental rules, or other
factors that influence innovation and advanced technology development in partnership.

As mentioned in the methodology chapter, an obvious limitation of the study, is the lack of
informants from the producing company, Techcomp. It has also been difficult to get access to
data from Oil-op. Furthermore, it could have been interesting to analyze several business case studies between other drilling- and supply- companies, compare these partnerships, and see if these somehow correlate. This could have given greater implications for literature, but because of the time frame of writing this thesis I have not done a comparative analysis between several case studies. Hence, more research to the field is required in order to generalize how the supply companies in drilling act towards managing the innovation process internally-, and in partnership. Further research may explore the user-producer driven innovation perspective, and interaction between companies in a partnership in other industries, or do a comparative analysis with another case study in the same context.
References


Appendix A – Example of an interview guide

1. Can you tell me a little bit about your position in company X, and what you do?
2. Why did the firm choose to initiate for new technology development? And how do you search for new ideas?
3. How has the collaboration between the companies involved unfold during the development process?
4. How has the oil-price affected your company?
5. How do you work towards implementing new technology?
6. Has the company gotten any benefits from this new technology?
7. How does the new technology fit into your organization?
Appendix B - Collection of data

Companies involved

<table>
<thead>
<tr>
<th>Operations</th>
<th>Company</th>
<th>Pseudonym</th>
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<tbody>
<tr>
<td>Drilling company</td>
<td>Company A</td>
<td>Offshore Drill</td>
</tr>
<tr>
<td>Supply company</td>
<td>Company B</td>
<td>Techcomp</td>
</tr>
<tr>
<td>Oil Operator</td>
<td>Company C</td>
<td>Oilop</td>
</tr>
</tbody>
</table>

Informants in the study

<table>
<thead>
<tr>
<th>Informants</th>
<th>Type of interview/Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informant 1</td>
<td>Drilling Supervisor</td>
</tr>
<tr>
<td>Informant 2</td>
<td>Retired Senior Drilling Supervisor</td>
</tr>
<tr>
<td>Informant 3</td>
<td>Senior Drilling Supervisor</td>
</tr>
<tr>
<td>Informant 4</td>
<td>Skilled worker 1</td>
</tr>
<tr>
<td>Informant 7</td>
<td>Technical Organization</td>
</tr>
<tr>
<td>Informant 8</td>
<td>Director of Engineering</td>
</tr>
<tr>
<td>Informant 9</td>
<td>Human Recourses</td>
</tr>
<tr>
<td>Informant 10</td>
<td>Rig Manager</td>
</tr>
<tr>
<td>Informant 11</td>
<td>Skilled worker 2</td>
</tr>
</tbody>
</table>

Techcomp

| Informant 12| Product Champion 2 | e-mail correspondence, no interview |

Oilop

| Informant 13| Chief of Operations | Interview/4.2.2016 |
| Informant 14| Drilling Engineer   | E-mail correspondence/11.29.2016 |

Documents

<table>
<thead>
<tr>
<th>Company</th>
<th>Type of document</th>
</tr>
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<tr>
<td>Offshore Drill</td>
<td>Company-internal magazine</td>
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<tr>
<td>Offshore Drill</td>
<td>News article on the firm</td>
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<td>Offshore Drill</td>
<td>Organizational map (old and new organization)</td>
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<tr>
<td>Offshore Drill/Techcomp</td>
<td>Product description article</td>
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<td>Offshore Drill/Techcomp</td>
<td>Development process article</td>
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<td>Offshore Drill</td>
<td>Internet-website</td>
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<td>Techcomp</td>
<td>Internet-website</td>
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Appendix C – Researchers Diary

Spring 2016
I started writing the research design for the thesis during spring, 2016. I also started contacting people from the different companies, trying to get in touch with key informants for the study. I started talking to people at work, and gathering basic information about the different companies of study. I started working with the thesis research question, and applied for supervisor. I also contacted Taran Thune, managing the SIVAC project, who helped me narrow the area of focus. She also gave me some tip about starting the process of thinking, and choosing the topic of interest.

Fall 2016
I started contacting informants, trying to set dates for interviews. During the summer I had gathered information about which persons I should get in contact with, within the different companies of study. Getting in touch with these people was not an easy job. Some informants were very busy, and hard to get in touch with. When I reached contact, they had a lot of stuff going on, on their agenda, and it was hard to set a date for interview. At the same time, I started reading theory, around the topic of research. Innovation and collaboration between firms for innovation. I got access to the Dropbox folder of the SIVAC study, and found some really helpful articles in this shared folder. It was difficult to find theory around collaboration between the firms, and I also needed to collect some data from the informants, in order to establish what kind of relationship the collaboration between the companies involved was about. In this period, I managed to interview some of the informants, and managed to set a date for interviewing the key informants of the study. I also started writing parts of the thesis in this period. A little bit about the theory around innovation processes, but also on the methodological chapter.

Winter 2016/2017
During the winter, I conducted the last interviews. I transcribed and wrote notes from the conversation, right after conducting the interviews. In early January, the process of writing started for real. In this period, I got a lot of help from Taran Thune, helping me search for articles, explaining the theory around the topic of study. By the end of this period, I had a rough draft of both the theory and methodology chapter for the thesis.
Spring 2017

I started this period with analyzing data conducted from interviews and documents, and started writing on the analysis and discussion part of the thesis. I got some great feedbacks from my co-supervisor, Jakoba S. Gonzalez at this point. Her quick response and good comments, really helped me moving further in the process of writing. After finishing up a draft of this part, I spent some time on structuring the thesis. I also spent a lot of time going through the chapters of theory when writing the thesis discussion and conclusion. Taran also gave me great guidance in helping me develop the analytical framework, presented in the thesis. The models used in the thesis, was also completed in this period of time. Structuring and proofreading of the thesis took a lot of time. The thesis was completed after schedule, and was delivered the 29th of May both online, and to the student administration at the TIK Centre.

Anna Maria Yun Bjørkhaug - May 2017