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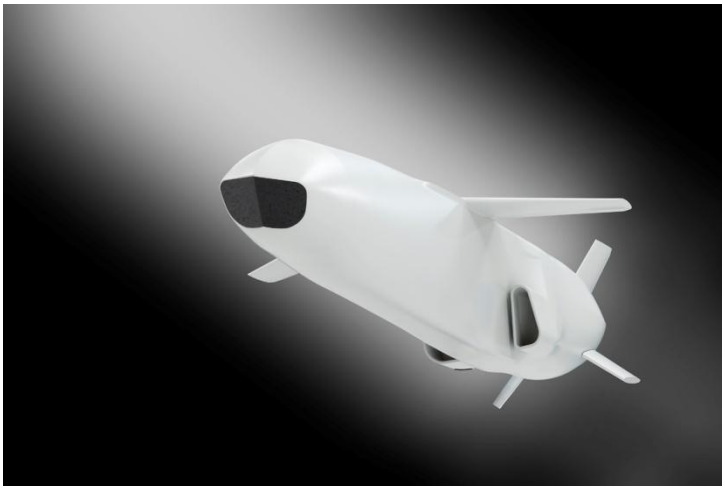

Supplier-customer collaboration from an open innovation perspective

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A comparative case study of four small and medium-sized supplier firms in high-tech defense industry

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Abstract

In modern society, with the rising focus on change and rapid development, the ability to innovate has become crucial. With limited time and internal resources available, companies are increasingly realizing the value of collaboration. Open innovation is one way of collaborating, using external actors as key players, and gaining access to knowledge and technology through these external resources.

This thesis presents a comparative case study of collaboration through an open innovation approach in the Norwegian defense industry. By studying four small and medium-sized enterprises (SMEs) that deliver products to a larger customer, I explore whether there could be positive knowledge outcomes from being part of a company's open innovation strategy. This approach turns the focus towards the SMEs as suppliers, asking whether it is possible to add a new dimension to the open innovation model, one with the focus on the suppliers.

The context here is the development of Joint Strike Missile (JSM), a missile produced by Norway's Kongsberg Defense Systems (KDS), a major defense supplier and one of the divisions of KONGSBERG (Kongsberg Gruppen). The SMEs in question are four of many suppliers that develop products for the JSM project, as a part of the KDS' innovation strategy.

By exploring this collaboration between customer and supplier, the thesis argues that the open innovation approach can lead to knowledge diffusion for all parties involved, not only the larger company. This adds a new dimension to the open innovation model, showing that being part of a company's open innovation strategy can be advantageous for the external technology providers, giving them access to know-what, know-how, know-why and know-who in the process. This knowledge is gained either directly from the customer, or as a consequence of independent work done by the suppliers. The knowledge relevant for future work is dependent on the supplier itself, and may differ from one supplier to another. Thus, there is more to the open innovation model than generally presented in the literature.

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Abbreviations and acronyms

CRS – Corporate Social Responsibility

IPR – Intellectual Property Rights

JSM – Joint Strike Missile

KDS – Kongsberg Defense Systems

KPS – Kongsberg Protech Systems

NSM – Naval Strike Missile

R&D – Research and Development

SMEs – Small and Medium-sized Enterprises

1 Introduction

1.1 Background

Companies today need to innovate, and quickly – this has become critical in the era of knowledge economy. With limited time and resources, companies are increasingly recognizing the advantages of collaboration. Several studies have identified this as a factor influencing the innovative performance of a firm (Haugland, 2004; Wang & Han, 2011).

In 2003, Henry Chesbrough (2003a) introduced the concept of *open innovation*. According to Chesbrough, innovation is a key factor in enhancing performance, allowing a company to retain a competitive position in the market. By opening up the innovation process, companies collaborate with others in developing new products and processes.

Figure 1 depicts the open innovation model. We see that ideas and solutions may come to the firm from both internal and external sources in the process of innovation (Chesbrough, 2003a; 2005).

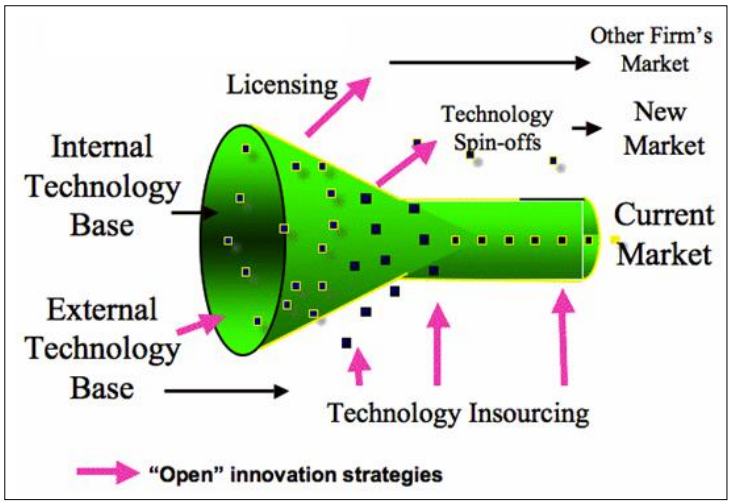

Figure 1. The model of open innovation (Chesbrough, 2005)

A Parliamentary White Paper from 2007 (Forsvarsdepartementet, 2007) emphasized the importance of developing competencies in Norwegian industry to support the needs of the defense sector. The Norwegian Armed Forces are a large and important institution in Norwegian society, and depend on collaborating with companies and other institutions in carrying out their work. Through this collaboration, technology and skills can be further developed. The Norwegian defense sector must introduce innovative and advanced technological products in order to maintain its success (Forsvarsdepartementet, 2007). This

fact reflects the demands of society today, with the heightened focus on continual development.

Most companies in Norway are small or medium-sized enterprises (SMEs). As central source of jobs and income, SMEs constitute an important part of the country's economy (Nærings- og Handelsdepartementet, 2012; Street & Cameron, 2007; Wang & Han, 2011). Nevertheless, most of the research on open innovation has focused on larger companies (Nærings- og Handelsdepartementet, 2012; Van de Vrande, de Jong, Vanhaverbeke & de Rochemont, 2009). By contrast, this thesis looks into some of the possible benefits that may accrue to smaller firms from collaborating with a larger company within high-tech industries. Can being part of a larger company's open innovation approach bring knowledge enhancements for the suppliers involved?

1.2 Research question

The open innovation literature has focused on how external sources are exploited to innovate in companies (Chesbrough, Vanhaverbeke & West, 2006; Powell & Grodal, 2009). This thesis turns things around, examining the potential positive outcomes for SMEs that deliver products to the innovating company. I do not consider how knowledge is used to make innovative products for a company. Rather, seeking to add a new dimension to the open innovation model, I focus on the benefits that SMEs as suppliers may experience from collaborating with a larger company.

My research question is twofold:

Based on an open innovation approach, how does collaboration take place? Further, what type of knowledge is involved?

I wish to see how the companies work together to achieve development through the open innovation approach, in addition to the knowledge achieved by the suppliers. By examining how companies collaborate, I may be able to determine if the suppliers experience knowledge enhancement in the process. Further, I investigate what knowledge emerges from this collaboration, and see whether this knowledge is of benefit to the suppliers also beyond the specific collaboration project.

Therefore, the research question will be applied in relation to two objectives: the development of the product itself, and the strengthening of the company in terms of future assignments.

Through these questions I explore whether there is more to the open innovation model than generally presented in the literature. Perhaps is it possible to extend the model, and identify additional positive outcomes from using the open innovation approach to innovation.

Open innovation is the theory perspective of this thesis, with the focus on possible knowledge benefits for SMEs as suppliers. Since the literature and attention towards open innovation is already so substantial, I examine only one possible outcome, using Lundvall's framework (Lundvall & Johnson, 1994; Lundvall, 1996) of four types of knowledge (see chapter 2). Throughout this thesis, I explore whether the open innovation approach can be an advantage for the SMEs that deliver products to the innovating company.

SMEs were chosen because of their importance to Norwegian society, and the lack of previous research in this area (Nærings- og Handelsdepartementet, 2012; Van de Vrande et al., 2009). I also wanted to focus on the defense sector in Norway, due to the distinctive nature of this industry, with complex and high-tech products being made within an apparently closed market (Forsvarsdepartementet, 2007). Moreover, earlier work has indicated that this sector does not apply an open innovation approach (Gassmann, 2006) – a point which I doubt.

1.3 Presentation of the case study

Open innovation is regarded as a necessity for companies today in order to expand and remain cost-efficient. Within knowledge-intensive industries, and given the high amount of competencies required to innovate in this field, the open innovation framework has been presented as especially fruitful. A technology-intensive industry may require higher amounts of knowledge in order to innovate, which in turn could bring need for external knowledge (Chesbrough et al., 2006).

A "high-tech" company has certain key features, such as offering products at the cutting edge of technology, having a high expenditure on research and development (R&D) and developing innovative products at frequent intervals (Balkin & Gomez-Mejia, 1984). Examples include the computer, aircraft and pharmaceuticals industries, which all emphasize the importance of R&D expenditures relative to production output (OECD, 2012).

The Norwegian defense industry is undoubtedly a high-tech industry. It includes all industries in Norway that deliver products and services to the Norwegian Armed Forces (Forsvars- og Sikkerhetsindustriens Forening, 2012). The Norwegian government has recognized the importance of continual development of innovative products within this sector, which in turn necessitates substantial investments. The government has acknowledged that developing advanced technological equipment will require greater resources for R&D, making this a complex and expensive matter (Regjeringen, 2000). Because of demands from customers and the requirements to be met in developing products in this sector, companies must invest in knowledge, competencies, and R&D in order to remain competitive. For that reason this industry is also classified as knowledge-intensive, as well as high-tech (Fevolden, Andås & Christiansen, 2009).

1.3.1 Kongsberg Defense Systems, Joint Strike Missile and supplier involvement

KONGSBERG (hereafter referred to as "Kongsberg") is a major corporation associated with the defense sector. It is an international technology group, delivering high-tech products to customers in a range of sectors, including the merchant marine, the oil and gas industry, and the defense and aerospace industry (Kongsberg, 2012a).

The group has four divisions, of which Kongsberg Defense Systems (hereafter referred to as KDS) is one. KDS is Norway's main supplier of defense and aerospace-related systems (Kongsberg, 2012a).

KDS is now working on the development of a Joint Strike Missile (JSM), to be integrated into the US fighter aircraft F-35 developed by Lockheed Martin. JSM is designed to be carried both externally and internally in the bomb bay of the aircraft and is intended primarily against naval targets. Completion of this development can entail numerous possibilities for Norwegian industry, as well as demonstrating that Norway's defense industry can deliver products and technology of world-class quality (Kongsberg, 2012b; Norsk Industri, 2012).

Figure 2. The aircraft F-35 with Joint Strike Missile (JSM). © Proprietary rights/reproduction: KONGSBERG Defence Systems. © Proprietary rights/reproduction: Lockheed Martin Corporation.

JSM development is a large and complex project, and KDS has been working both upwards[1] and downwards[2] throughout the process. Many companies have been involved in supplying products of varying size and complexity. In this thesis I examine four such suppliers: Eidsvoll Electronics AS (Eidel), Kongsberg Devotek AS, Berget AS and PartnertPlast AS. They deliver complex products within various fields for the JSM project: telemetry, rotation of plastic, mechanical parts and engineering (Executive Vice-President Business Development, KDS; Procurement Manager, KDS). (See chapter 3 for further presentation).

Even though these companies have entered as suppliers producing parts for JSM, they work closely with KDS. That makes it possible for me to examine this form of collaboration through an open innovation lens. Moreover, the JSM program is a development program, necessitating continuous communication and collaboration (Executive Vice-President Business Development, KDS; Procurement Manager, KDS).

1.4 Thesis outline

This introductory chapter has presented the topic and research questions of this thesis. The specific subject-matter chosen for investigating these research questions has also been introduced. The next chapter provides a full description of the theory concepts used. I review

[1] *With higher actors within defense, both foreign and domestic, such as the Norwegian government, the Norwegian Defense Establishment (FFI) and the US company Lockheed Martin.*
[2] *With small and medium- sized enterprises, in Norway and abroad.*

the theory of open innovation, collaboration and knowledge - all central concepts in this thesis. Chapter 3 focuses on methodology. I present the methods chosen to conduct the research so as to clarify the work process and strengthen reliability. In this way, the reader can evaluate the strengths and weaknesses of the thesis. The third chapter concludes with a presentation of the case and the four suppliers in focus on this study: Eidel, Berget, Kongsberg Devotek, and PartnerPlast.

The fourth chapter presents the empirical accounts related to each of the four cases. For each case I discuss the work methods and outcomes of their work with the JSM project. At the end of chapter 4, a cross case-analysis compares the four cases to highlight differences and similarities between them. In chapter 5, I analyze and discuss the empirical cases through the lens of the theory framework to answer the research question and determine the possible presence of an added dimension to the open innovation model. Finally, I conclude with a summary of the main findings and implications for further research.

2 Theory framework

This chapter presents the theory concepts and perspectives used in the thesis. First, the concepts of open and closed models of innovation are defined, and then we turn to "open innovation" and "collaboration" as regards SMEs.

I then introduce the terms learning and knowledge, highlighting Lundvall's framework of four types of knowledge, with his definition of know-what, know-how, know-why, and know-who. In this thesis I explore how collaboration can take place through an open innovation approach, in addition to what type of knowledge this could lead to, to see whether knowledge enhancement can be achieved by suppliers that deliver technology developments to a customer. By using these four types of knowledge we can see if different suppliers can obtain knowledge enhancement relevant for future work, from collaborating with a larger company. This can contribute to the discussion on whether it might be possible to add a new dimension to the open innovation model.

I conclude the chapter by relating the concepts of open innovation, knowledge and collaboration to each other, to provide a summary and overview for the reader.

2.1 Open innovation

Over the last decades there has been an increased discussion on the topic of innovation in society. This has been a powerful force for production, development and growth, and can appear in many different forms: in manufactured products, the service industry, the high-tech industry, as well as in public services. In a quickly changing world, it is crucial for companies to manage innovations of every size and industry. This is vital to maintain a competitive business, and necessary for emerging businesses (Abernathy & Clark, 1985; Chesbrough, 2003a; Tidd & Bessant, 2009).

The phenomenon of innovation may refer to the emergence of a new product or service, or to an improvement of an already existing product or service. This can occur at the process level, as well as at product level. In short, innovation is about finding new ways of doing things. Almost a third of Norwegian enterprises with more than five employees introduced innovative products or processes in the period from 2006 to 2008, proving the focus and importance of

innovation for companies today (Abernathy & Clark, 1985; Edquist, 2006; Johannessen & Olaisen, 1995; Wilhelmsen, 2011).

The open innovation paradigm has received a significant amount of attention and coverage in academic literature and beyond (Trott & Hartmann, 2009). According to Chesbrough (2003a; 2005), it is no longer sufficient to innovate in isolated companies. The way new ideas are developed and brought to the market has been undergoing an enormous change, where the paradigm has shifted from a closed to an open model of innovation.

2.1.1 The logic of closed innovation

Previously, the dominant view was that successful innovation requires control and the realization and development of new ideas must occur within the borders of the firm. This also applied to the building, marketing, financing and distribution of products or processes (Chesbrough, 2003a; 2005).

In the closed innovation model, research projects are launched from the science and technology base of the company and go through a closed "funnel" where they progress through the process of innovation. Some of the projects are stopped on the way, while others are selected for further work and chosen to go on to the market. This is illustrated in figure 3, where ideas are brought from the internal science and technology base (Chesbrough, 2004; 2005).

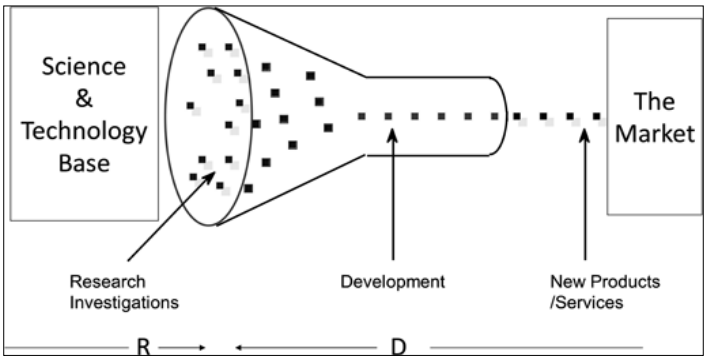

Figure 3. The model of closed innovation (Chesbrough, 2004)

The logic behind the closed innovation paradigm was an internally focused one: the best and brightest people are hired to work in the company and it is necessary to control research and development (R&D) and the intellectual property rights (IPR) to inhibit competitors from profiting from their ideas (Chesbrough, 2003a; 2003b).

2.1.2 Open innovation as a new paradigm

Over the last years a fundamental change has occurred in a variety of businesses. There has been a shift towards focusing on an open innovation approach for creating and managing new ideas. This refers to a continuous process to gain insights and ideas from the company's surroundings and exploit these insights to improve the performance of the organization. Open innovation has emerged as a way for companies to deal with globalization and expanded competition in the market (Chesbrough, 2003a; 2003b).

By applying an open innovation approach, organizations can spend less on R&D, as well as making sure both internal and external ideas and concepts contribute towards making new profitable products or services. By using this model, a company can gain advantages from people working outside its own organization and can come up with solutions to problems in a more cost-efficient way (Chesbrough, 2003a; 2003b).

Most research done with the open innovation model involves companies in high-tech industries. There are several reasons for this. The technology intensity has increased in industries, making it challenging for companies of all sizes to innovate on their own. The rapid technology change in high-tech industries characterizes the environment these companies operate in, making it difficult to develop technology without seeking out external sources of capabilities. With knowledge becoming an essential resource for firms and with the enhancement of diverse research for innovating, existing capabilities in one company may not be enough to develop successful innovation (Chesbrough et al., 2006; Gassmann, 2006).

2.2 Open innovation in the Norwegian defense sector

The nuclear and military industry is pointed out as typically working through a closed model of innovation. One of the reasons for this is the importance of protection and secrecy of the products in question (Gassmann, 2006). This was emphasized in a Norwegian official report, on the industry towards 2020, where the Ministry of Trade and Industry refers to the defense industry as one with a special focus on protection because of particular features related to its area of work (Nærings- og Handelsdepartementet, 2005).

However, in 2007, the Department of Defense published a White Paper on how the Norwegian Armed Forces will need to collaborate with several companies in the industry in order to produce complex weapon systems (Forsvarsdepartementet, 2007). In addition, in a

speech in April 2012, former Defense Minister Espen Barth Eide pointed out the importance of enhanced collaboration in order to further develop the defense industry in Norway. This cooperation included the authorities and various industries, both foreign and domestic (Regjeringen, 2012b). It is desired that companies experience positive outcomes, such as an enhancement of knowledge and competencies, through this collaboration (Forsvarsdepartementet, 2007; Regjeringen, 2012a).

The concept of open innovation seems appropriate in industries containing many of the developments and trends found in the defense sector. These areas include technology intensity with complex and compound products, technology fusion with the boarders of fields shifting or even disappearing, and knowledge leveraging, where knowledge is an important resource for the firm (Gassmann, 2006; Nærings- og Handelsdepartementet, 2005).

Open innovation, being a broad concept, encompasses many dimensions and there are many ways of working through this approach. One is by technology insourcing, as shown in figure 4 (Chesbrough, 2005; Van de Vrande et al. 2009).

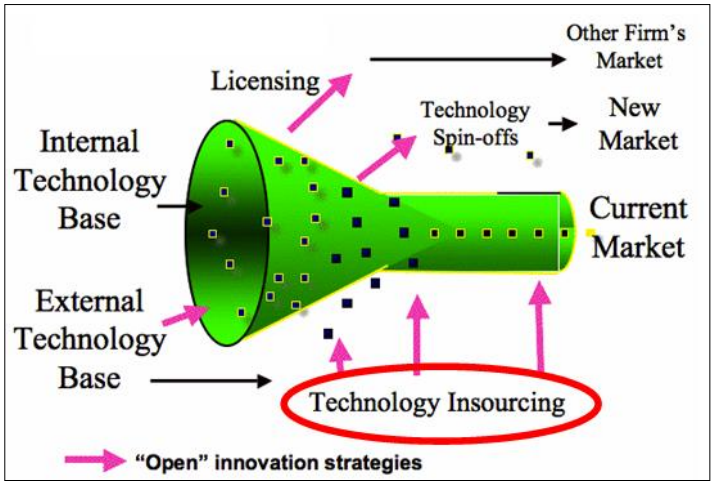

Figure 4. Technology insourcing in open innovation (Chesbrough, 2005)

In open innovation, technology insourcing refers to the use of external sources to enhance technological development through purposive inflows (Chesbrough, 2005; Van de Vrande et al. 2009). This knowledge can be provided by suppliers that deliver products to a company (Chesbrough et al., 2006; Von Hippel, 1988) especially using small and medium-sized enterprises (SMEs) could be advantageous (Chesbrough, 2005; Van de Vrande et al., 2009).

2.3 Open innovation through SMEs as suppliers

There are many ways of defining small and medium-sized enterprises (SMEs) (Finansdepartementet, 1995; Hanna & Walsh, 2002; Street & Cameron, 2007; Van de Vrande et al., 2009). Because this thesis deals with Norwegian enterprises, the definition provided by the Norwegian government is used. According to this definition, "small" businesses have maximum 50 employees and "medium-sized" businesses have between 50 and 100 employees (Finansdepartementet, 1995).

In fact, over 99 % of all companies in Norway are SMEs, making them a large and substantial part of society (Nærings- og Handelsdepartementet, 2012).

There are multiple benefits from using suppliers in product development, including access to complementary skills, external knowledge and technology (Corswant & Tunälv, 2002; Hoegl & Wagner, 2005). When choosing a supplier, smaller businesses have advantages that could benefit a larger company. Many SMEs have specialized technical knowledge in a particular area (Chesbrough et al., 2006; Corswant & Tunälv, 2002; Hoegl & Wagner, 2005) making them highly skilled in certain fields. This ability can be an advantage for larger companies who may be seeking this knowledge. Smaller firms can also make quick decisions, move faster than larger ones, and adapt more easily (Chesbrough, 2011), which may be necessary in an ongoing project with a larger enterprise. According to Chesbrough (2011, p. 152), "Large companies are increasingly interested in collaborative innovation partnerships with smaller firms because a smaller firm's expertise and focus can accelerate the completion time for a larger firm's innovation initiative."

Nevertheless, SMEs can also face challenges because of their size. Being a smaller enterprise means having fewer assets to distribute, but many competitors to work against (Hanna & Walsh, 2002; Street & Cameron, 2007). Because of their size, the boundaries of their organizations can create constraints that larger companies may escape. The increasingly knowledge-intensive and complex industries with shortened product life-cycles can make innovating even more challenging than before (Van de Vrande et al., 2009).

Collaboration may therefore be a way for SMEs to obtain the resources not already available within the firm and maintain their competitive position in the market. They may get access to these resources through their role as suppliers to product development projects (Corswant & Tunälv, 2002; Hanna & Walsh, 2002; Hoegl & Wagner, 2005; Street & Cameron, 2007). An

example of resources achieved through collaboration is *knowledge*, an asset necessary for staying on top in an area of expertise (Madhavan, Koka & Prescott, 1998; Powell & Grodal, 2009).

However, the focus of collaboration through the use of technology insourcing is on the resources coming *from* the external sources *into* the company exerting this approach: in this case *from* the supplier *to* the customer. The open innovation approach places focus on mutual knowledge sharing and enhancement in networks or alliances, but not through the use of external resources for technology insourcing (Chesbrough et al., 2006). This is described as unintended knowledge spillovers, an unwanted side effect from the collaboration (Chesbrough, 2005; Chesbrough et al., 2006; Van de Vrande et al., 2009). However, Chesbrough and colleagues (2006) argue that it is more important to seek outside the boundaries of the firm for opportunities for innovation than to prevent knowledge spillovers to the external sources in the process. Therefore, it could be possible for SMEs to achieve knowledge as suppliers on product development projects, by collaborating with larger customers, but it is not a desired outcome.

2.4 Collaboration with suppliers

There are many forms of inter-organizational ties available to Norwegian firms and the type of collaboration is dependent on the company's innovative goal (Chesbrough et al., 2006). In recent years there has been growth in various forms of collaborative agreements (Powell & Grodal, 2009), and according to Statistics Norway, most enterprises choose to collaborate with suppliers and customers (Wilhelmsen, 2011).

Definitions of collaboration vary in the literature (Franck & Huitfeldt, 1991; Haugland, 2004; Heide & John, 1990; Tidd & Bessant, 2009). It can be defined as people working together to achieve a goal, as a platform for exchanging resources, knowledge, ideas and skills (Powell & Grodal, 2009; Tryon & Winograd, 2011). A company can team up with other companies to develop new technologies, and choosing collaboration may result in strengthening the company (Chesbrough et al., 2006, Franck & Huitfeldt, 1991).

A central part of collaboration is communication, and by communicating openly, collaborating parties can achieve set goals (Franck & Huitfeldt, 1991; Petersen, 1995). An open environment for communication and flow of information can foster innovation processes

in organizations. Here, face-to-face communication can serve as an important function for innovation (Dollinger, 2002; Johannessen & Olaisen, 1995). Within supplier-customer collaboration, communication across the organizational boundaries is vital, especially when working on a product development project (Hoegl & Wagner, 2005). When suppliers are a part of the product development, information lines can be critical, demanding good communication between the parties. This includes making sure that the companies have a common understanding of each other and the task at hand, so as to avoid misunderstandings and confusion (Dollinger, 2002; Hoegl & Wagner, 2005; Johannessen & Olaisen, 1995).

As noted earlier, SMEs are often characterized as having limited resources. This includes resources to develop competencies within the enterprise, as well as expanding R&D and creating new innovations (Franck & Huitfeldt, 1991). Hence, collaboration may provide assets to a firm and therefore expand the possibilities of the enterprise.

It should be noted that, although Chesbrough introduced the concept of open innovation as recently as the last decade, companies have long been collaborating with external partners of various kinds (Powell, Koput & Smith-Doerr, 1996). Cohen and Levinthal pointed out the importance of opening up the innovation process in their introduction in a paper from 1990 by claiming that external sources of knowledge are often critical of the innovation process, but without using the term "open innovation" as such (Cohen & Levinthal, 1990). There has been an extensive discussion on whether open innovation is truly a new paradigm, or simply an old concept with a new name (Trott, 2009). While this is not a debate to be explored in this thesis, it remains a relevant area for further investigation.

2.5 Knowledge and learning

In today's economy[3] the importance of knowledge, creativity and competence is evident (Kunnskapsdepartementet, 2001). According to the Norwegian government, the European Union has recently focused on the knowledge triangle where knowledge, research and innovation are the primary components for development in society (Regjeringen, 2012c). Further, knowledge is widely regarded as the most important determinant for economic growth and the primary production factor in the modern economy (Beijerse, 1999).

[3]Characterized by rapid technological development, enhanced competition, easier flow of information, and a larger mobility of funds, products and services.

According to Lundvall and Johnson "Knowledge is the central resource and learning the fundamental process" (1994, p. 23). The term knowledge is a general concept for the gathering of facts, principles and other types of information (Morris, 1992). Knowledge can be understood as something developed through research, where the process acquiring knowledge itself is learning (Karlsen, 2008). This definition implies that the two concepts of knowledge and learning are related to each other, but do not mean the same thing.

By opening up the innovation process, firms are given access to external knowledge. The main purpose of these knowledge flows is to incorporate external knowledge to fill in a specific knowledge gap, but unexpected knowledge spillover benefits may also occur through the establishment of formal ties between companies. Unforeseen knowledge may originate from collaboration (Chesbrough et al., 2006).

Mechanisms for applying knowledge in own companies are decisive, and a firm must be able to integrate, protect and exploit the knowledge accessible (Styhre, 2002). Therefore, relevant knowledge enhancement is not guaranteed by collaboration. If the knowledge is within an area of little or no interest, or the collaborating companies do not possess relevant knowledge, the knowledge will be useless for the company in the future (Corswant & Tunälv, 2002).

2.5.1 Four forms of knowledge: know-what, -why, -how, and -who

According to Lundvall and Johnson (1994, p. 24) learning includes those processes "which lead to new knowledge and those which spread old knowledge to new persons."

This definition encompasses both the creation of new knowledge as well as the transfer of knowledge from one person to another. It includes learning for both individuals and organizations (Lundvall & Johnsen, 1994).

In addition, Lundvall and Johnson distinguish four categories of "knowledge": know-what, know-how, know-why, and know-who. This separation has been made to understand what different forms people and organizations can learn from (Lundvall & Johnsen, 1994). Importanly, no form of knowledge is superior. Each is important in different circumstances and can be applied at both the individual and the organizational level (Johnson, Lorenz & Lundvall, 2002; Tidd & Bessant, 2009).

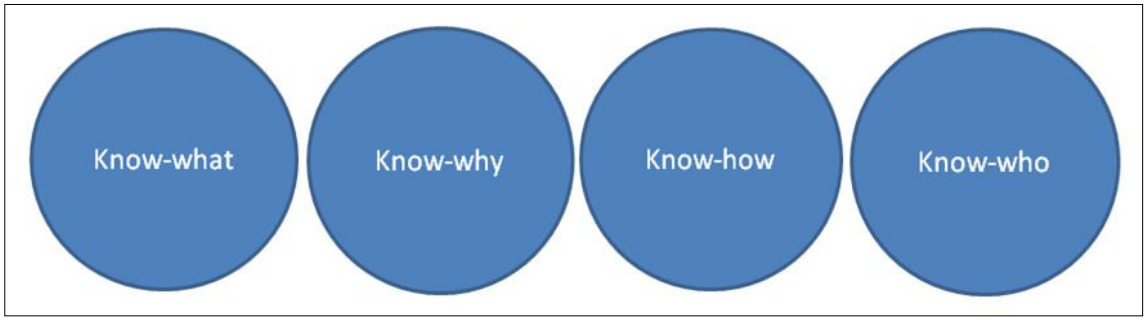

Figure 5. Four types of knowledge

Lundvall presents one of many classifications specifying different kinds of knowledge (Lam, 2000). One of the most fundamental subdivisions is between tacit and explicit knowledge where new knowledge is created through the interactions between these two types (King, 2009; Nonaka, 1994; Nonaka, Toyama & Nagata, 2000). Explicit knowledge can be codified, and may be found in documents or databases. A simple example of explicit knowledge is knowledge of the ingredients for making a cake. Since this knowledge can be written down, it is also easy to transfer between people. Tacit knowledge, by contrast, is more difficult to write down and communicate, being intuitive and hard to define. An example of tacit knowledge is the ability to speak a language (King, 2009; Nonaka, 1994). Since the definition of tacit and explicit knowledge is such a widely recognized one, I use it to contribute to the understanding of the four types of knowledge: know-what, -why, -how, and –who.

Know-what

The type of knowledge included in know-what is related to facts and can be compared to pure information. Examples of this type of knowledge can include what the capital of Norway is, and how many meters make up a kilometer (Lundvall, 1996). Know-what is therefore considered an explicit or codified type of knowledge, something transferable in formal, systemic language. It can be embedded in standardized procedures, is easy to acquire, and can be exploited quickly (Lundvall, 1996; Nonaka, 1994; Nonaka et al., 2000).

As it is an explicit type of knowledge, know-what can be broken down into bits, and can be understood by, for example, reading a book. Through databases or search engines, know-what can be acquired, though it may take time to find the appropriate information in written material (Lundvall, 1996; 2006). Acquiring this type of knowledge is not cumulative or path-dependent, making it possible to learn independently of prior experience (Garud, 1997). The

characteristics of know-what are easily codified and thereby also transferable between people or organizations. Such codification is also possible with know-why (Lundvall, 1996).

Know-why

Know-why represents a comprehension of the principles underlying a phenomenon and can be labeled "learning-by-studying". Through this type of knowledge an understanding of the constructions of components and interactions is included, making it possible to understand why something works the way it does (Garud, 1997). It includes scientific knowledge about principles and laws of motion in nature, in human mind and society. By knowing the reason behind a certain product or development, it may be easier to make advances in technology at a faster rate as well as reducing errors in procedures of trial and error (King, 2009; Lundvall, 1996). Like know-what, know-why is an explicit kind of knowledge. The information leading to know-why can be codified; further it can be captured in various types of records, like books or databases. Through know-why, an understanding of the underlying causal factors or logic occurs, making it possible to apply this logic in new contexts, transferring the knowledge to different areas (King, 2009; Lundvall, 1996; Tidd & Bessant, 2009).

Know-why can be useful for organizations because prior knowledge can shape the way challenges are understood, the methods used to solve this challenge and solutions that might appear. Consequently, the more know-why possessed, the easier it may be for companies to solve challenges of the same kind (Garud, 1997). Through a process of cumulative synthesis, know-why may lead to "bisociation" – meaning that knowledge from several scientific and technological fields may cross to create knowledge. This is possible through an understanding of know-why, where knowledge from different sectors is transferrable (Garud, 1997; King, 2009).

Know-how

The ability to do different things on a practical level requires knowledge of know-how, and refers to skills possessed. Having know-how requires an understanding of the proceedings necessary to make different components as well as an understanding of how they should be put together to perform as a system (Garud, 1997; Lundvall, 1996).

If required know-how is unavailable internally, an employee must either develop it himself or acquire it from or through others. As developing knowledge internally can be both expensive and time-consuming, it may be preferable to seek this from outside sources (Von Hippel, 1987). The transfer of know-how between firms by sharing or combining elements of it is a major reason for participating in networks or inter-organizational relationships. In fact, the amount of know-how and competence developed through interaction and sharing between companies is quickly growing (Lundvall, 1996).

Rothwell (1994) characterizes the access to external know-how as a significant factor in successful innovation. Because of its characteristics, know-how is a form of knowledge that can come through active participation. It is not explicit and easily codified, like know-what and know-why, making it harder to transfer between people and organizations. Know-how is tacit knowledge, an abstract form of knowledge with a personal quality, making it hard to formalize and communicate (Ireland, Hitt, & Vaidyanath, 2002; Nonaka, 1994; Nonaka et al., 2000). Know-how can be gained only through learning by doing and interaction with other experts in the same domain, making it a tacit form of knowledge (Lundvall, 1996). Skills and capabilities needed to engage in operations in making products and services need to be based on experience. This experience needs to be obtained in learning processes involving trial and error (Lundvall, 2008).

Note that it is misleading to characterize know-how as mainly practical and not theoretical. Both skills and personal knowledge may be needed to acquire know-how in a new field or to transfer know-how from one person to another. Solving a math problem is a typical example. Through knowledge within the field, intuition and skills may be applied to recognize patterns in the math problem to find the answer. Theoretical skills are therefore also included, not solely practical (Johnson et al., 2002).

Know-who

Know-who is becoming increasingly important in business today. It is a combination of both information and social relationships and signifies the creation of special social relationships in order to gain access to experts in a range of areas. This involves knowledge about who knows what and who knows how to do what. By forming a work team based on knowledge of their capabilities and strengths, benefits in production may appear (Clarke, 2001; Lundvall, 1996; 2006).

This type of knowledge is tacit in its nature and difficult to codify. Through social practice and environments, knowledge of know-who can occur, demonstrating its context dependency. Because of its character as socially enclosed knowledge, it is hard to transfer through a formal channel of information (Lundvall, 1996). Even though access to and information about people can be provided through databases and telephone books, these channels of information hardly include that which is needed to obtain an overview of all information necessary (Johnson et al., 2002).

Insights of know-who may create access to information and know-how in different areas, realizing future possibilities through relationships and networks. Through this networking, both tacit and explicit knowledge may be acquired. Know-who can work as a source for new information and emerging technologies (Harryson, 2006). With technology changing at a rapid pace, access to human expertise is crucial, and can provide access to knowledge and resources (Lundvall, 2006).

It is particularly important not to mistake know-who with know-what. Know-who includes insight into people's strengths and weaknesses, an understanding of who can work with what in a certain area. It also includes a social network relationship and learning by interacting, a tacit form of knowledge (Lundvall, 1996). Knowing who is the research manager in the department of physics in an organization is not knowledge of know-who, but merely knowledge of know-what, an explicit form for knowledge.

2.6 Suppliers and open innovation

Based on the theory concepts described above, I have developed the model presented in figure 6. It shows the added dimension of the open innovation model, where the suppliers can gain benefits from being a part of a company's open innovation approach directly from the customer.

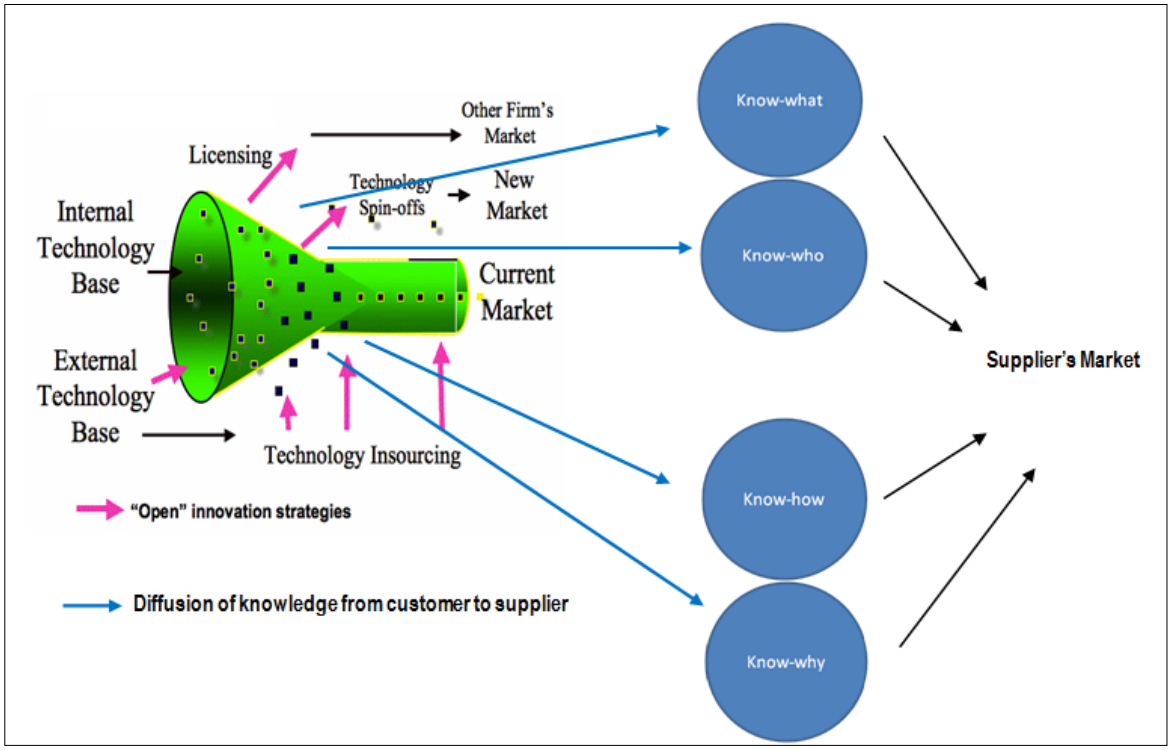

Figure 6. A new dimension of the open innovation model

As the model shows, this thesis will argue that suppliers can gain know-what, know-why, know-how and know-who by collaborating with a larger customer. The knowledge gained from the customer can further be used in the suppliers' market in the future, strengthening the company.

2.7 Summary: Open innovation, collaboration and knowledge

Several theoretical terms and concepts within the open innovation and knowledge literature have been introduced in this chapter. These terms and concepts will be used to answer the research question presented in chapter 1, and to explore the possibility of adding a new dimension to the open innovation model.

The open innovation approach was presented first, introducing the reader to how opening up the innovation process can provide companies with resources available outside their boundaries, possibly making it more competitive in today's rapidly developing society. One way of working through an open innovation approach is by external technology insourcing, using external players for development. In this section of the chapter, the reader was also

introduced to the definition of concepts such as collaboration and small and medium-sized enterprises (SMEs), terms used throughout the thesis.

It is evident that there exists an extensive amount of literature within the various knowledge theories (Lam, 2000). After providing a definition of knowledge and learning, I reviewed Lundvall's framework of four types of knowledge (know-what, know-why, know-how, and know-who), to indicate an outcome that can be achieved by using an open innovation approach.

We now know that a crucial part of open innovation involves bridging both internal and external resources to increase innovation productivity. We also know that knowledge has become an invaluable asset in companies and that much of this knowledge resides outside the boundaries of the companies themselves (Lindegaard, 2010).

One of the primary goals of open innovation is to capture external knowledge (Chesbrough et al., 2006). A way of doing this is by external technology insourcing, where the knowledge initially flows one way. However, since open innovation requires collaboration of some form, consequently between companies contributing with expertise and competency, knowledge diffusion both ways may occur. Through working together, both tacit and explicit types of knowledge may be enforceable, opening up the potential for know-what, know-how, know-who, and know-why to occur.

3 Methodology

In the following chapter, the procedures and choices for the gathering of empirical data for this thesis are explained. This thesis is a comparative case study, conducted using different qualitative methods and I review the use of the qualitative case study as a method itself. Thereafter I elaborate on the gaining of access to data, in addition to the collection of it, using interviews, written documents, and observations. At the end of the chapter, I detail my approach to the analysis of data as well as the validity and reliability of the findings, before the four cases studied in this thesis are presented.

3.1 Qualitative case as method

Qualitative data can be defined as empirical information about the world which is not presented in the form of numbers (Punch, 2005). An important aim of qualitative research is to achieve an understanding of social phenomena (Thagaard, 2009), in this case an understanding of possible outcomes from collaborative work in a high-tech project within the defense sector.

A case study is a research strategy involving the study of a single instance or a small number of instances of a certain phenomenon (Yin, 2009). It should be classified as a methodology, rather than a method[4] due to the important philosophical assumptions underlying the nature of research that support the value of case research. Through a case study it is possible to examine in-depth nuances and contextual influences on and explanations of a phenomenon, since it is intensive rather that extensive research, going into depth rather than width (Baxter, 2010).

According to Yin (2009), the selection of a research method should be determined by the research question. A case study is appropriate as a design when attempting to answer research questions involving questions of "why" or "how", in addition to investigating a phenomenon in its real-life context. With the research question: *"Based on an open innovation approach, how does collaboration take place? Further, what type of knowledge is involved?"* I seek to study how collaboration occurs and will examine the possible outcomes of an ongoing real-life event. For this reason, a qualitative case study is appropriate.

[4] A methodology is a theory of what can be researched, to what advantage it can be researched, and how it can be researched. A method is a mechanism to collect data.

I use four cases to conduct a comparative case study since the techniques of analyzing and conducting theoretical sampling are stronger when there are multiple instances of the phenomenon under study. Through comparative analysis, researchers can examine patterns of similarities and differences across several cases (Ragin & Amoroso, 2011). By researching four of the suppliers involved in the development of Joint Strike Missile (JSM), I will be able to examine similarities and differences that can result from collaboration with Kongsberg Defense Systems (KDS).

All research methods involve ethical considerations (Dowling, 2010), but in this case I also had to be aware of the ethical issues concerning the defense industry itself. I chose to write about the defense industry for reasons stated in chapter 1, but was aware of the existence of various ethical dilemmas associated with this sector before I chose the case. This thesis explores collaboration through an open innovation approach, and the knowledge enhancement that can emerge through this for smaller companies working with larger ones in the defense industry, not the various ethical views within the subject of this industry itself. I do not discuss or elaborate on the possible ethical controversies that may emerge in connection with producing parts for a weapon supplier, although this could be a relevant topic for a different thesis.

3.2 Access to case

Access to a desired field of study is not something a researcher can take for granted. Achieving access to case and relevant information can be a time-consuming and difficult process (Thagaard, 2009). I chose to contact the Federation of Norwegian Industries (Norsk Industri) while considering which sector and companies to select for my case study. I knew that studying a high-tech knowledge intensive industry was important and that I needed a company working with an open innovation approach.

In the beginning of August 2012, I came in touch with Dennis Klausen Fjellseth at the Federation of Norwegian Industries, who advised me in the initial search for companies. Through this connection I was able to make an informed choice of sector and company for this thesis. I considered biotechnology and pharmaceutical companies because of their status as high-tech and knowledge intensive companies, before deciding to contact Kongsberg and Kongsberg Defense Systems (KDS) to write about the defense sector. This decision was

primarily driven by the characteristics of the JSM program. As a product-development project, it required close communication and collaboration throughout the process. This made it relevant to look at this project through an open innovation lens. It has also been pointed out that industries within this type of sector typically work with a closed model of innovation because of the importance of protection and secrecy (Gassmann, 2006). I wanted to write about the defense sector to show that in spite of this, open innovation is applied.

I contacted Christian Hauglie-Hanssen, executive vice-president of the F-35 program at Kongsberg Defense Systems (KDS) and arranged a meeting with him in the end of August 2012. Through this meeting, in addition to a meeting with several actors within the F-35 program in the beginning of September, I was given permission to write my Master's thesis in collaboration and with help from KDS. Hauglie-Hanssen suggested four suppliers I could study after being given a list of characteristics I wanted for my cases. This included their size, length of collaboration, prior relationship with KDS, form of communication and type of company. Through KDS I was given access to my cases and was also assigned a contact person, Håkon Engebrethsen, a procurement manager in the JSM project. Engebrethsen and Hauglie-Hanssen acted as my gatekeepers[5] (Hammersley & Atkinson, 2007), providing me with access to my desired field of study, cases and other necessary resources.

I chose to include only Norwegian suppliers for my case study to limit the scope of the thesis. According to Yin (2009) the selection of cases in a comparative case design should be done carefully and to complete a specific goal. The cases should either be chosen from an assumption that similar results will occur in the cases or from the assumption that different results will occur, but for predictable reasons (Hammersley & Atkinson, 2007). The selection of the companies in my cases was based on the first assumption.

3.3 Collecting data

It is not always easy to gather and interpret information on the experiences of others. I decided to perform a triangulation of methods in the thesis, using multiple methods of data collection (Bradshaw & Stratford, 2010). Through interviews, documents and observations, I obtained information from different aspects to ensure the trustworthiness of the information used. According to Yin (2009) this is one of the inherent strengths of the case study approach.

[5] A "gatekeeper" is someone who controls the researcher's access to the field, informants, and other resources necessary for carrying out a research project.

It was important to have a good understanding of the companies before conducting interviews. I started going through written documents about the companies and the cases before visiting their offices for the first time. Through introductory meetings with each supplier and employees at KDS, I gained the background information necessary to conduct good interviews with actors within the companies. In addition, I attended several meetings to observe the suppliers in interaction with KDS, giving me a greater understanding of the companies.

3.3.1 Interviews

The interviews were the primary source for information for this thesis. An interview is a method for collecting data through a spoken exchange of information (Dunn, 2010) and is appropriate as a source of information about people's experiences, views, and understandings of a phenomenon (Thagaard, 2009). Since I wanted to acquire a rich and detailed understanding of the suppliers collaborating with KDS, and what type of knowledge the suppliers might have gained through this, I decided to conduct several interviews with employees of these companies. Because an interview is a tool with great flexibility where the form is adapted to the aim of the research project (Kvale, 2009; Thagaard, 2009), I found this to be a good way to collect data for my thesis. Being able to catch variations in the informants' views on the topic through qualitative interviews offered a diverse picture of the object under study (Kvale, 2009).

I chose to conduct semi-structured interviews, as this would give the flexibility to ask questions beyond the interview guide and I could adapt the questions to each informant (Dunn, 2010). Through the topics and follow-up questions attached I was given the opportunity to move in different directions throughout the interview, depending on the answers I was given. I wanted to give informants the possibility of adding remarks and views along the way. Since they had more knowledge about both their relationship with KDS and the JSM project than I did, I wanted to leave room for the possibility to address new topics which came to light during the interviews. For this reason, I found this form of interviewing to be the one most appropriate for my research. Had I applied a highly structured form of interview with standardized questions, this would not have been possible (Dunn, 2010).

Conducting the interviews

I made a strategic selection of informants where the choice of interview objects was done according to qualifications or features relevant to the research question and theory perspectives (Thagaard, 2009). Through introductory meetings with each company, I was able to identify who would be relevant to interview. I decided to talk to three or four informants in each company who were central to the JSM project and could contribute valuable information about the project and their relationship with KDS. I also talked to several employees at KDS who had connections to the suppliers and the project. Altogether I carried out 22 interviews, including follow-up interviews[6]. This was time-consuming, but necessary for understanding the four cases, since the JSM project was both complex and comprehensive.

The introductory meetings helped me to prepare for the interviews. I also consulted written documents about the companies and the project. These included the company websites, annual reports, and news articles on the JSM project and suppliers involved. Additionally, I spent time getting familiar with the interview guide to avoid feelings of uncertainty and stress throughout the interviews.

I decided to audio-record my interviews with the suppliers. This allowed for more natural conversation and kept me from being preoccupied with note-taking. This was also preferable since it provided more time to organize the next question and allowed me to be a more critical and attentive listener (Dunn, 2010; Kvale, 2009). All informants were notified about the recorder beforehand and gave me permission to use it. To avoid inhibiting their responses, I informed them that the recorder was solely for my own use and would function as notes for my research. They were assured that I would be the only person who listened to the recording and that it would be erased once the thesis was finished.

I also had to consider whether to keep my informants anonymous. According to Thagaard (2009), in order to secure confidentiality, the researcher must anonymize the informants when the results of the study are presented. However, through regarding the anonymity of the informants, the demands to reliability can be compromised[7]. I therefore chose to identify informants by their job title, not their names, even though some identities could be traced by knowing the person's position in the company. All informants agreed to this method of identification.

[6] An overview of the informants is presented in appendix 2.
[7] The characteristics and demands of reliability will be further elaborated towards the end of this chapter.

Despite my preparations, conducting a semi-structured interview was not without challenges. During the first interview, I was worried something might happen to the recordings and realized this was distracting my thoughts. It also took some time to get comfortable in the role as interviewer and to listen attentively while thinking ahead to plan future questions. After the first few interviews, this became easier and I was more comfortable in the interview situation. Through the introductory meetings, I asked about the possibility of conducting follow-up interviews. In retrospect, knowing I had the possibility to contact the interviewees with further questions reassured me that I could go back if I needed more clarification later.

I conducted the interviews at the company offices. Even though this was time-consuming due to the location of some of the suppliers, I found this preferable to conducting interviews over the phone. I could prepare mentally on the way and felt that I got more out of the interview situation than I would had it been conducted by phone. Through face to face interviews I was able to use visual clues to interpret answers and reactions to questions. It was also easier to establish trust between myself and the informant, making sure there was a productive interpersonal climate in the interview situation. In addition, I knew their time was limited and through conducting the interviews at their workplace they were spending less time than they would have had we held the interviews elsewhere (Dunn, 2010). In addition to establishing trust during the interview, I was also able to meet nearly all my informants during the introductory meetings, giving me the opportunity to introduce myself and my work before the interview.

After conducting the interviews I transcribed them in writing. This was done for the purpose of the analysis, but also gave me the chance to begin the process of analysis during the transcription (Kvale, 2009). Transcription is time-consuming but was necessary for me to complete the analysis. I found it appropriate to transcribe the interview word-for-word so I could easily go back and re-examine the raw material while doing the analysis (Dunn, 2010).

3.3.2 Documentary data

In addition to the information obtained from interviews, I relied heavily upon relevant documents to inform my research. The term "document" can be used for all forms of written sources available for the research including private diaries, government publications, annual reports and biographies (Thagaard, 2009). Yin (2009) points out several advantages to using documents as a source for information. Documents are a stable source from which

information can be retrieved if necessary, they contain precise information, and can have broad coverage by covering a long span of time, many events, and many settings. Since the documents were not created as a result of this specific case study, the researcher does not have any influence upon the text itself (Thagaard, 2009).

However, there are also weaknesses to this approach. Even though the researcher does not have an impact on the formulation of the text, his or her understandings and points of view may affect the interpretation. The researcher may therefore select the texts is a biased manner (Thagaard, 2009). It is therefore necessary to be critical of the sources since documents are written in a certain context for a certain purpose (Yin, 2009).

For the empirical data I used several types of written documents including company websites, annual reports, news articles and government publications. This provided me with a broad spectrum of information and gave me a good overview of the suppliers, KDS, and the JSM project. The documents have functioned as both background information and source material for research. Still, I remained critical to the documents, knowing that they had been written for other purposes than my research.

3.3.3 Observations

Since this thesis deals with a current project, I had the opportunity to include observational instruments as part of my case study, getting permission to assess meetings between KDS and the suppliers. Through observations, additional information may be gained about the object under study, perhaps leading to a better understanding of the context or phenomenon in question (Yin, 2009). To achieve this, I chose to attend meetings to gain a better understanding of their collaboration and how diffusion of knowledge could take place in the interaction between them. During the interviews, I found my informants talking about ways of communication and how they were given inputs and information through workshops and meetings with KDS, and I found it valuable to observe this interaction in order to study whether this could be the case.

Through the introductory meetings I was also shown around the companies and given the opportunity to see how they worked. This was useful for me as it provided additional information about the company and helped me create an image of the cases being studied through elements such as the condition of the work space, products, and office climate (Yin,

2009). I was also able to observe the interaction between employees directly. This was valuable both as preparation for the interviews and in gaining a broader understanding of how the companies work, as well as their goals and values.

While conducting observations the researcher can take on an active or passive role (Fangen, 2009; Thagaard, 2009). Through non-participatory observations at meetings between KDS and the suppliers, I observed the communication between the two parties without participating in the communication myself. During the meetings, I sat quietly in the meeting room listening to the participants talk. The meetings were not recorded, for several reasons. I felt this could affect the execution of the meetings, and the information discussed could be sensitive, making its recordings undesirable for KDS and the suppliers. Furthermore I found it sufficient to take notes since the main objective of the observation was to gain an understanding of the relationship between KDS and its suppliers through their way of communication.

I was aware of the weaknesses inherent to this method, including the risk that the events occurring might be carried out differently due to my presence and the fact that this also is a time-consuming way of gathering data (Yin, 2009). From the introductory meetings, I felt that the trust necessary for the meetings to go along nearly as they would have without me present was established. It was rewarding for me to attend these meetings since they allowed me to obtain a deeper understanding of the companies through them.

3.4 Analyzing data

Analyzing the acquired data was challenging. It was important for me to find the right way of coding and interpreting the information I had been given through reading, talking to, and observing throughout my work.

There are many ways of sorting data in qualitative research, through various approaches and methodological frameworks. Since there is no such thing as one right approach to the analysis, it is important that it be systematic and transparent, making it possible for the reader to understand how the conclusions were reached (Punch, 2005). I am aware that analyzing the same data could result in different results and interpretations, since the researcher is a part of the development of it (Dowling, 2010).

Through transcribing the interviews and correcting my notes after the observations, I had already begun the process of analysis during data collection. I started out labeling the main

points that had emerged through collecting data in each company. This left me with 327 codes. Examples of what was included in these codes are relevant quotes, information regarding the process of work, work method, challenges and opportunities. It took some time finding appropriate categories for the codes, and I also had to figure out what was relevant for answering the research question. By trial and error I narrowed down the codes to two main categories in each of the four cases to use in the empirical chapter: "*finding a solution through collaboration"* and "*knowledge involved"*. By working with the material through categorizing the text, I could summarize a large quantum of data into smaller parts, giving myself a better overview (Thagaard, 2009). Through the coding process I was able to reflect upon the meaning of the material and could rethink earlier ideas and thoughts (Cope, 2010; Thagaard, 2009).

I started the process of analyzing within each case before I went on to analyzing across the cases. By analyzing across the four different cases I was able to look at differences and similarities between the suppliers (Ragin & Amoroso, 2011; Yin, 2009). Through this, I had the opportunity to investigate my concepts and theory by looking at similarities independent of contingencies or context (Baxter, 2010). After I had considered the cases independently, it was easier to identify the variations between them, enabling cross-case analysis.

3.5 Validity and reliability of the thesis

Throughout the research process, I have been considering the demands related to validity and reliability. These considerations are important to the researcher, as well as to the evaluation of qualitative research (Thagaard, 2009).

Establishing reliability in the research refers to ensuring that errors and biases in the study are minimized, that the data are concise and accurate. It is about making sure that your findings can be replicated later by others researchers following the same procedures and case study (Yin, 2009). By presenting a description of the theory framework of this thesis, in addition to giving a detailed explanation of my choices within the methodological approach of the research project, I have highlighted my research project and sought to strengthen its reliability.

In addition to assuring reliability of my research I had to consider the challenges associated with validity: was there correspondence between the data collected and reality? Ensuring

validity refers to measuring what the research question is asking (Bradshaw & Straford, 2010; Thagaard, 2009).

Validity is linked to the interpretation of data provided by the researcher in a thesis, requiring the researcher to explain how the analysis can provide grounds for the conclusions reached. It also concerns whether the observations made actually reflect the phenomenon under study (Bradshaw & Straford, 2010; Johannessen, Tufte & Veiden, 2006; Thagaard, 2009).

I considered potential pitfalls regarding the validity of my research. For one thing, I had to consider the role I had as a representative of KDS. In all four cases, several employees expressed their view of KDS as "an extremely important customer" for their business (Business Manager Defense, Devotek; Design Engineer, Eidel; General Manager, Berget; General Manager, PartnerPlast). Because it seemed important for them to please KDS, I had to make sure the information I was given was accurate, which I did by conducting several interviews with multiple employees in each company, and asking similar questions in the interviews. This helped me ensure that the information was correct and that I had not misunderstood my informants (Bradshaw & Straford, 2010).

I also chose a triangulation of data collection to ensure validity. By collecting data through interviews, written information, and observation, I was able to access data through different channels and could ensure the accuracy of the information provided (Bradshaw & Straford, 2010).

Another challenge related to my connection to KDS. It was important not to be overly influenced by their work style and viewpoints. I constantly analyzed comments and reflections from employees at both KDS and the suppliers to ensure that I would not be guided one way or another through my research. Their ideas and reflections were valuable, but it was essential to make sure I was not overly affected by views perhaps irrelevant to this study. It was important to remain reflective, analyzing my own choices and actions. By asking myself questions along the way, such as: -Why is this happening? Is this influencing the data?- I sought to be self-critical to ensure both validity and reliability in the thesis (Dowling, 2010).

3.6 Presentation of case

Kongsberg is one of the biggest companies associated with the defense sector in Norway (Forsvarsdepartementet, 2007; Kongsberg, 2012a), with more than 6500 employees in over 25 countries. One of the company's strategies is to build on knowledge and competencies, as these are the main components of Kongsberg's competitive parameter (Konsgberg, 2012e). Because collaboration is fundamental to its business, Kongsberg cooperates with international customers with different areas of expertise. By exchanging ideas with suppliers and partners, as well as working closely with customers, Kongsberg strives to retain competitive advantage in the market (Kongsberg, 2012c; 2012d).

Kongsberg Defense Systems (KDS), one of the four divisions that make up Kongsberg, is now working with the development of Joint Strike Missile (JSM), planned to be integrated into the new F-35 aircraft as the first of its kind (Aakvik, Landre & Lorentzen 2012).

Defense material must be produced to the highest standards. The products developed are most likely made to cover critical needs, so mistakes cannot be tolerated. Marginal improvements may have major operative consequences, so it is important to stay up to date with the latest technology available. In addition, products often need to be developed and customized to fit the customers' specific operational needs (Fevolden, Andås & Christiansen, 2009).

The JSM development is no exception. According to Kongsberg employees, JSM is a radical innovation, the first of its kind in the market, with highly complex components and systems. The development of this product requires a substantial amount of highly complex technological knowledge and implementation of the latest technology within different areas of expertise, including domains such as engineering, telemetry and electronics (Executive Vice-President Business Development, KDS; Procurement Manager, KDS).

3.6.1 Four suppliers – four cases

To create this product, KDS has entered into agreements with several suppliers, both foreign and domestic, who will develop components for the JSM project (Executive Vice-President Business Development, KDS). Since JSM is a development program, flexibility and communication with the suppliers is crucial. It is a project associated with both risk and opportunity, and changes may occur on the way, making it necessary to collaborate with suppliers who are able to make adjustments (Procurement Manager, KDS).

With a project as large as this one, the parts delivered by suppliers will vary. Some products delivered are comparable to standard goods, while others are new and more complex. Because of the variations amongst the products delivered, the contact and form of collaboration between KDS and the suppliers will also vary. All four suppliers studied in this thesis are delivering products demanding a high amount of communication throughout the project because of the qualities of the products they develop (Procurement Manager, KDS; Project Engineer, KDS).

Eidsvoll Electronics (Eidel)

Eidsvoll Electronics (hereafter referred to as Eidel) is a small company founded in 1966 and located in the municipality of Eidsvoll. With 16 employees, Eidel specializes in the development of electronics for defense communication and security, data collection, and space. Defense communication has been an important part of Eidel's business the last few years. The company has been working with various businesses in this sector, both domestic and abroad, but does not have much experience with KDS as a customer. The company is developing the telemetry system for the JSM project, making a system for collecting data, performing measurements, and sending this information to the station on the ground (Eidel, 2012; Managing Director, Eidel).

Berget

Berget AS is a company for fine mechanics, delivering components of differing scale and scope for customers in various industries. The product groups are mainly within the offshore market, car producers, defense industry, and medical companies. 48 employees work in the company, which manufactures prototypes and the production of mechanics (Berget, 2012; General Manager, Berget). Berget has extensive experience delivering products for the defense sector and has previously produced parts for KDS, within several areas of KDS' expertise. Berget provides the JSM project with several prototypes in various forms of metal, mostly aluminum (General Manager, Berget).

Kongsberg Devotek (Devotek)

Kongsberg Devotek (hereafter referred to as Devotek), with its 103 employees, qualifies as a medium-sized company (Devotek, 2012b). This is a development enterprise delivering

advanced technology solutions and products to customers in a range of sectors, including defense, oil and gas, automotive, maritime, and industry. Devotek conducts technical development, from beginning to end, and their main area of expertise is engineering (Devotek, 2012a; Program Manager Defense, Devotek).

Though the company could remain competitive by targeting its work towards the oil and gas sector, defense is an important part of Devotek's business, and the company often works in collaboration with different divisions in Kongsberg on various projects. Devotek's main involvement in the JSM project is in creating the container for storing and carrying JSM (Business Manager Defense, Devotek; Program Manager Defense, Devotek).

PartnerPlast

Located in Åndalsnes on the west coast, PartnerPlast AS is a leading specialist in construction, design, and rotational casting of plastic. The company manufactures to customers all over the world, offering a wide range of products in three categories: seismic, offshore and subsea, and industry (PartnerPlast, 2012). With 38 employees, PartnerPlast AS is a small company focused on delivering high quality technology and design to its customers, continuously placing focus on working with demanding customers and projects (PartnerPlast, 2012; Managing Director, PartnerPlast).

PartnerPlast did not have experience delivering products to the defense sector prior to working on the JSM project (Project engineer, KDS). The company is producing the plastic fuel tank for the missile, a task never before performed by PartnerPlast (Managing Director, PartnerPlast).

3.7 Summary

This chapter has provided background information and explanations for the choice of methodological approach in this thesis. I have elaborated on my choice of conducting a qualitative case study and reviewed my three methods for data collection: conducting interviews, reviewing documents, and observing meetings between KDS and the suppliers.

I have explained the decision to use the case study method and how I gained access to KDS and the suppliers analyzed, as well as how I worked with analyzing and interpreting the data

collected. The intention here has been to enable the reader to evaluate the logic underpinning the conclusions reached in this thesis.

I have also reflected on the validity and reliability of my work, and how I sought to ensure high quality. Finally, KDS and the four cases have been presented, giving the reader an introduction to the empirical case to follow.

4 Empirical findings and analysis

This chapter presents all four suppliers. I explain their work with the JSM project and their relationship with Kongsberg Defense Systems (KDS). In each case, I review how the companies work to develop their delivery to the project. Then, I review how the JSM project can strengthen the company through the future possibilities that may emerge. I present the empirical case and conduct the analysis within each case to answer the research questions: "*Based on an open innovation approach, how does collaboration take place? Further, what type of knowledge is involved?"* An overview of the data sources used is presented in appendix 2. This is the source used in this chapter, unless otherwise noted.

Finally I carry out a cross-case analysis of the four cases, to investigate whether there are differences and/or similarities between the companies.

As noted in chapter 3, JSM is an extremely complex product. There are many suppliers delivering parts to be integrated into the same system for it to function. Certain parts are required before others can be made, making communication and a good overview of each supplier essential for KDS as a customer. KDS holds the overall knowledge of the complexity of all parts, the requirements of the product itself, and the method of development. Therefore, the company needs to work closely with each supplier, keeping track of development along the way and provide them with relevant information.

4.1 Eidel

4.1.1 Finding a solution through collaboration

Eidel started working with the JSM program in August 2010, developing the telemetry system for the missile. The company has experience making this type of product, but not with the standards required for it to work in JSM. According to the general manager, "the telemetry for JSM is a lot harder both at the engineering and technological levels[8]" (Eidel). One of the challenges in making a system for this type of product is the environment in which it will be operating. Among other factors, the system needs to function in extreme heat, cold, velocity, and altitude, making it a highly complex product. According to a design engineer in Eidel: "This is the spearhead of technology", pushing the company to its limits.

A project engineer in KDS expressed the company's task and their qualification for the project, pointing out that "Eidel will deliver a system customized to [KDS'] complex needs (…) The company had the base, now they need to adjust it". Since Eidel worked with developing similar components for a previous project the company had knowledge relevant for this job, making it highly qualified for developing the telemetry system for the JSM project. With the core skills and product base already available internally, Eidel works closely with KDS on the development.

Frequent communication is an important part of KDS' work method. Most of this communication concerns clarifications and needs provided from KDS to Eidel. It is important to be clear as to the demands of the environment and product in which the telemetry system will be operating. This also allows for Eidel to communicate challenges and possibilities present throughout the work, enabling KDS to keep track of status along the way. This form of collaboration also allows Eidel to ask questions if something unexpected occurs, or if they need further information. Since KDS is familiar with what Eidel does, it is easier to communicate concerning the status quo, challenges, and possibilities.

It was clear during observations that communication between them is open and they understand each other well. This was also expressed by company employees and was stated as important for Eidel. As stated by the technical director: "KDS is a professional customer who knows what they want (…) the company holds expertise, and we can discuss with them.

[8] All citations in this chapter have been translated from Norwegian by the author.

Sometimes you have customers who don't understand the issues ... and don't really understand the challenge" (Eidel).

Most information goes through the project manager in Eidel and the project engineer responsible for Eidel in KDS. Their communication is on a weekly, sometimes daily basis, over telephone and e-mail, of both a formal and informal character. In addition to frequent communication channels, formal milestone meetings are set up for reporting status quo. Along the way, clarification meetings can be carried out to discuss possible changes, updates, and other matters. This is necessary since the JSM project is a development project where changes can occur along the way. Technical workshops are also conducted, either predetermined or by demand.

The technical workshops, conducted with employees from both KDS and Eidel, can be a place for discussing technical solutions to the product. KDS developed the telemetry for Naval Strike Missile (NSM), an anti-ship missile (Kongsberg, 2012c), and can therefore contribute feedback and input to the development of the telemetry for JSM. This was expressed by the technical director in the company: "During the study phase we [Eidel and KDS] had discussions about how to solve things. We all had skills within the area (…) and they could provide inputs in discussions so we might get ideas for solutions with them". Through channels of communication Eidel can receive valuable information, possibly making it easier to make the telemetry for JSM. This was also expressed by a design engineer working on the project: "At the workshop there were two people [from KDS] who knew what I know. So I received input related to my work from them" (Eidel).

As pointed out by a project engineer in KDS: "We will not give any detailed guidelines when it comes to how they'll solve things". Although employees from KDS can assist with ideas, they will not guide Eidel specifically in one direction or work with them through solving problems. Eidel has signed a contract to produce for JSM internally, not in direct collaboration with KDS. So even though KDS is able to contribute information, employees at Eidel are the ones working with the product.

According to the technical director in Eidel "We are the ones with detailed knowledge on the subject. This is what we do". Through work done internally they are using their own skills and experiencing how to work to achieve a solution. This is something employees do by themselves, something KDS is not a part of. KDS can contribute inputs, experience, and

ideas, but the employees at Eidel are the ones with expert knowledge on telemetry and the ones working with the system.

4.1.2 Knowledge involved

In connection with work on development for JSM, there is a considerable amount of knowledge in circulation, both from KDS and within Eidel. According to the managing director "There is a lot of learning for us. (…) this is a knowledge boost for the company". This knowledge may be used to strengthen the company to open possibilities for future assignments and could be a way of entering new project areas. That the employees should enhance their knowledge is also a desired outcome for KDS in the process, and the company actively provides knowledge to Eidel employees.

Eidel has been in the defense industry for many years and is well known in the field. However, because of its small size Eidel may miss out on contracts with customers, despite being qualified for the job. The technical director described one instance where they lost the contract precisely because of matters related to their size: "We scored 100% on the technical skills and capabilities for the project, but due to the financial side we lost the project (…) Calculated risk was too low" (Eidel).

Working with the JSM project can open new doors for Eidel, both with KDS and other actors. This is also expressed by interviewees; for example "KDS can lead Eidel into new product areas" (Managing Director, Eidel). The managing director described how Eidel has an ambition of becoming an actor in the encryption environment: "KDS is an important force for me to progress as regards other aspirations … to become an encryption provider in Norway" (Eidel). Contact with KDS can help inform employees of future possibilities for Eidel. This contact can also provide the opportunity of getting in touch with relevant actors within the field, in addition to gaining a deeper understanding of KDS as a customer.

Via the contract with KDS, Eidel has been in contact with the Norwegian National Security Authority. Through information relevant for developing the telemetry for JSM, Eidel can use what is learned within coding and algorithms for other purposes as well. This has been a driving force for Eidel's future possibilities in this field and the managing director noted the importance of the JSM project: "It's not certain we would have gained access to the most modern solutions within coding and algorithms if we hadn't worked with KDS".

By working on the JSM project, employees at Eidel are developing competencies and acquiring knowledge transferable to other projects. As stated by the design engineer: "That knowledge is transmittable to all sorts of things" (Eidel). Since the demands for the telemetric work on this project are so extensive, the technology acquired for producing it is comprehensive and parts of it may be applied in future projects. According to the technical director: "the core of the JSM project can be used in all new projects, as a core to build from". If employees gain an understanding of why something works the way it does, it is possible to take that knowledge and apply it in different areas.

The managing director of Eidel noted, "it is important to achieve good solutions that can be reproduced". However, not everything can be used on other products. Even though Eidel has intellectual property rights (IPR) of the products the company cannot go to competitors of KDS and deliver to competing missile products, but can apply it in products unrelated to KDS' niche, limiting the future use of the solutions.

4.1.3 Outcomes – close collaboration and knowledge for entering a new field

It is evident that close collaboration between Eidel and KDS is essential in the making of the telemetry for JSM. The challenge faced by Eidel is developing one complex system with the requirements set by KDS. Close collaboration and frequent communication enables the companies to work together to achieve this, even though Eidel holds the overall responsibility for development. The competencies employees at KDS have within telemetry combined with their role as systems integrator could contribute to achieving a satisfactory product. So even though Eidel holds specialized knowledge within the field, the knowledge KDS possesses may also be an advantage through the collaboration.

Since both KDS and Eidel are accustomed to working in the defense sector and both parties have knowledge within the field of telemetry, they have a mutual understanding of the work done, easing the collaboration. This advantage is evident even though employees at the two companies have no previous experience working together. With time, Eidel learns how KDS works and vice versa, facilitating communication throughout the process.

Eidel experiences knowledge enhancement through the collaboration, transferable to future areas of work. But even though knowledge is transferred from KDS or created by Eidel

through the development of JSM telemetry, not everything is relevant or usable beyond this project. The knowledge relevant is that related to Eidel's wish to enter the field of encryption, and through the knowledge obtained via the JSM project, Eidel can transfer knowledge into their work in the encryption world.

4.2 Berget

4.2.1 Finding a solution through collaboration

Berget has been working on products for the JSM project since January 2012, making prototypes in different forms of metal for KDS. With highly specialized knowledge in this field and having experience with delivering quality components to demanding customers, Berget is a suitable supplier for this job. The products for JSM are similar to previous products made in the company, even though the shapes and demands are making these prototypes more complex. The general manager in Berget described how limits are pushed through the JSM project, sometimes in the very borderland of what is possible with the machines available to them: "It's very demanding. Challenging both programmatically determined, technically and documental. These are demanding parts." (General Manager, Berget).

Berget is a supplier often used by KDS and other divisions in Kongsberg, and the way of work does not differ for the JSM project. According to the general manager: "We are used to having KDS as a customer, and having rigorous demands" (Berget). Both companies are aware of each other's competencies, demands, and work methods. This was noticeable at the meeting observed, where the requirements to new parts for JSM were discussed. Employees from the two companies seemed to have a mutual understanding of the goals, challenges, and possibilities for development. The atmosphere was positive and both parties discussed items openly with each other.

The way of work with the creating of each prototype for JSM is the same for Berget. Employees are first given drawings of components developed at KDS in order to create the different prototypes. The parts are not completely predetermined, making communication between KDS and Berget essential, since changes may occur along the way. Berget has the opportunity to question possible adjustments with the products and make changes if approved by KDS. Through e-mails and phone calls, communication occurs on a weekly basis, creating a continuous dialogue. If additional information is required, KDS can provide this information to Berget, and there is a mutual understanding that Berget can contact KDS whenever necessary, with questions or updates on the development. In addition to this, meetings are set up for reviewing the prototypes made, before, after, and during the development process.

At meetings with KDS, Berget employees can receive input and ideas for development. The fact that KDS has competencies within the field and understand the substrates makes communication easier throughout the process. Since KDS also works with machining, employees can exchange experiences with Berget and provide information that may help them to develop the prototypes. This was expressed by the general manager: “They provide inputs all the time … saying what is and is not possible and what we could do” (Berget).

Even though KDS has knowledge within mechanics, Berget is still the specialist company in this area, possessing expert knowledge within the field. The majority of communication is in the form of clarifications and explanations related to the missile itself, where KDS is clear as to what is required of the prototypes. It is through working with the products themselves that employees at Berget can achieve a solution as to how the prototypes can be made. According to the managing director: “it is demanding hitting the right production method on the first try. It requires experience” (Berget). This can be a difficult process, and these skills are produced internally through this work.

By brainstorming and thinking outside the box, solutions are achieved even though employees initially may think that creating the prototypes is close to impossible. The quality manager at Berget expressed their experience with development: “Sometimes we think it’s impossible, but then we manage anyways”. Through the work done, employees are able to develop products for JSM with challenging requirements and qualifications.

4.2.2 Knowledge involved

Berget has been in the defense sector for many years and is well known within the system. The company has worked with KDS on many previous projects, the JSM project not being much different from these. As mentioned earlier, the difference lies in the complexity of the products required.

Much of the knowledge provided to Berget is gained from all forms of collaboration with KDS and other divisions in Kongsberg. This was expressed by the technical director, stating that: “It is not the JSM project in isolation we learn from through KDS” (Berget). Had it not been for this collaboration, Berget would probably not have gained the competencies and equipment it has today. Berget has achieved a new level through all its work with the company. Further, by providing good products, Berget maintains a good name at KDS and

other divisions in Kongsberg, and continues to work with them. With over half of its production being for this company, Berget is heavily dependent on this collaboration. As the general manager noted: “We are dependent on having a good relationship with [Kongsberg and KDS]” (Berget).

Since Berget often works with KDS, the company is a part of a corporate social responsibility (CSR) project, with focus on developing CSR for suppliers in the defense sector. This project is arranged by KDS and aims to transfer knowledge from the company to the ten participating suppliers. It is a desired outcome that frequently used suppliers strengthen their knowledge base, to increase the quality of products for Kongsberg. Through joint sessions at Kongsberg, the suppliers get a chance to both strengthen their knowledge of CSR and develop relationships with each other. This project provides an opportunity for Berget to increase knowledge of the participating suppliers, by developing knowledge of these businesses.

However, projects conducted in isolation can also lead to new relationships. Berget is now delivering parts for Eidel, an opportunity that came about due to their JSM participation. This is solely for the JSM project at the moment, but can open up possibilities for further collaboration between Eidel and Berget.

As a frequently used supplier for mechanics to KDS, Berget is often challenged through the development of prototypes. Through the work accomplished in the company Berget is increasing their skills, finding solutions to making complex products in different projects. Employees at KDS also continuously provide Berget with inputs, to enable solutions. Through this, Berget can enhance the knowledge base and become more skilled for different types of projects with demanding customers. An important outcome of this experience is to achieve cost-efficient solutions for themselves and the customer, ensuring this while maintaining the quality of the prototypes being made. The general manager points out the importance of this, something being done through experience and work with the equipment available: “We are getting better at exploiting our equipment 100% … finding cost-efficient solutions” (Berget). This equipment is the same used in different projects, therefore strengthening the company in general. Since the JSM project demands extremely complex products, the company is forced to push the limits. The solutions created through the JSM project can be transferrable to other projects, the methods of production being the same.

It should be noted that since JSM is such a unique product, much of the experience gained could only be applied to that specific product. In addition to this, due to intellectual property rights (IPR) and secrecy, Berget has to avoid using parts of the product in other projects. However, the experience and mindset itself can be reapplied and the knowledge acquired through experience is transferable to other projects.

4.2.3 Outcomes – close collaboration and strengths from frequent collaboration

Throughout the work on the JSM project, close collaboration and communication is central. Since Berget has worked with KDS previously, the requirements and channels of communication have already been developed. From the beginning of the process, KDS knows how Berget works and vice versa, so the need for an introduction period between the companies was unnecessary.

Berget delivers various prototypes for JSM, for different parts of the missile. As this is a complex project, there is a lot of knowledge in circulation through the work done on the various prototypes, both from KDS and within Berget. KDS contributes relevant input, transferring knowledge to Berget in the process, ultimately strengthening Berget.

The JSM project strengthens Berget in distinct and valuable ways. By being a frequently used supplier by KDS and other divisions in Kongsberg, Berget gains advantages from collaboration with the company in general, not solely through working with the specific JSM project. As most of Berget's work projects are for Kongsberg and KDS, the knowledge obtained by employees is due to work done towards these collectively. Given the possibilities and advantages stemming from frequent collaboration, it is particularly important for Berget to retain KDS as a customer.

4.3 Devotek

4.3.1 Finding a solution through collaboration

Devotek has been charged with creating the container for JSM, in order to store and carry the missile. Being highly skilled within systems engineering projects and product development, Devotek contributes specialized knowledge for the JSM project. The company is used to developing complex products for demanding customers, but according to the business manager within defense: "the main challenge here is the time" (Devotek). With little time to complete the project, the development is particularly challenging and employees are working hard to finish the development within the deadline.

In light of this, communication is an especially important factor. KDS and Devotek need to establish a common understanding of the work being done and the requirements for the container. Because of the time pressure, frequent communication is essential when challenges or questions arise. This also allows KDS to maintain an overview of the status quo and provide Devotek with necessary input and updates along the way. The significance of this was expressed several times in the interviews: "Communication is extremely important when working the way we do" (Business Manager Defense, Devotek). Devotek's business strategy is to have a team working closely to meet the needs of the customer as expressed by the business manager within defense: "Learning about the customer is important here" (Devotek). Through this contact, they achieve business knowledge of the customer. This is the strategy in the JSM project as well, where the team in charge works 100% with the container for JSM.

Communication between Devotek and KDS occurs most often between the project manager at Devotek and the project engineer responsible for Devotek at KDS on a weekly basis, with scheduled meetings approximately every Friday at Devotek's offices. These meetings are for reporting status quo, leveling expectations, and establishing future plans. They function as an arena for exchanging information about the development of the container. In addition to this, meetings are set up as needed and communication by e-mail and phone occurs frequently, with Devotek having the possibility of contacting KDS whenever necessary. This was expressed by the business manager within defense, stating that "We collaborate well with KDS" (Devotek). At the kick-off meeting the companies clarified their work methods, plans and expectations for the project. There seemed to be a mutual understanding of the goals and

possibilities of the collaboration. The procedures and form of communication were clear, and it was evident that the two parties knew what to expect from one another.

According to the program manager within product development (Devotek): “KDS can bring in specialists to help achieve solutions to the development”. This was also stated by a project engineer in KDS: “We have brought specialists to meetings (…) who have shared thoughts and knowledge [with Devotek]”. Through these specialists, Devotek is given input through experience and counseling, relevant for the production of the container.

This indicates that KDS can provide Devotek with information relevant to achiving development solutions. KDS has produced containers before, and this has given them useful knowledge and experience. Through this knowledge, KDS can assist with work done on the JSM project, making it possible to complete the project on time. At the meeting observed, employees from KDS also gave suggestions regarding possible companies Devotek could use in the development, providing information of relevant suppliers: “We have good experience with NN (…) “You could check with NN” (Project Engineer, KDS).

Overall, the work done with the development and the overall responsibility of the container itself is on Devotek. Even though KDS has experience and knowledge in the field, Devotek is the party with special engineering expertise, in charge of the completion of the product. Through the work done internally, the company is using its own expertise and knowledge to develop the container for JSM on time.

4.3.2 Knowledge involved

Defense is one of many sectors Devotek works with and employees know what it takes to work with companies in this field. The work methods of the JSM project are similar to previous projects completed by Devotek, but through new projects, new knowledge can be developed: “Kongsberg and [KDS] is a very demanding customer and the JSM program is very demanding. There is always a learning effect from that, useful for later purposes” (Business Manager Defense, Devotek).

Working in different fields can be an advantage for Devotek if knowledge gained from work within one sector can be appplied in another: “We want to use knowledge, acquired knowledge, across different sectors (…) our project members work in different sectors” (Program Manager – Product Development, Devotek). By working with a demanding

program, knowledge can be transferred and re-applied if employees gain an understanding of the technological solutions underlying the development. Here, there can be a challenge as regards intellectual property rights (IPR) and limitations on what can and cannot be re-applied in new projects. Devotek cannot deliver the same solutions to competing products. However, the knowledge acquired - both generally and in terms of mindset - is reusable, opening up the possibility of transferring technical solutions to future projects.

But as expressed by the business manager within defense at Devotek: "I don't think [Devotek] is the one company experiencing most learning from [KDS], we are already at a technologically high level". With the company already at the desired level, knowledge provided through the JSM project is not necessarily of interest to Devotek. But as further expressed: "We do learn a lot from KDS" (Business Manager Defense, Devotek).

Since Devotek works with various divisions in Kongsberg on many different projects, the company gains advantages and knowledge enhancement through frequent collaboration. Devotek is now part of a corporate social responsibility project (CSR), with focus on developing CSR for suppliers in the defense sector. Here, Devotek can obtain advantages by establishing contact with other suppliers and learn more about CSR. The business manager within defense described this: "They created an arena so that we, as suppliers, could meet and get to know other companies delivering [to Kongsberg]" (Devotek). Since it was arranged for communication and mingling between the participants it was possible to establish relationships with, and knowledge of, other suppliers.

Although Devotek has experience working with different divisions in Kongsberg, this does not include the whole company. Devotek has most experience with Kongsberg Protech Systems (KPS), a different division from KDS. Devotek has had a close relationship with KPS, resulting in being chosen for many different projects with this division. Hopefully, through the work done with the JSM, Devotek can establish the same relationship with KDS, as expressed by employees: "By doing a good job here we are expecting to be chosen for the next round.(…) We are sort of looking at [the container for JSM] as an investment" (Business Manager Defense, Devotek).

The work done with the container is in part for gaining experience, reference, and knowledge. Because of the size and scope of the company, Devotek is dependent on working through

bigger customers to enter larger projects like the JSM program. This is how the company operates.

Even though Kongsberg has a way of working with suppliers, this can vary between the different divisions. According to the group leader for systems at Devotek: "many things are different when it comes to working [with KDS]". There is a different way of work with documentation, demands, and follow-up, in addition to the general mindset of the employees. By using the same team working with KDS, employees at Devotek will gain understanding and knowledge of the people involved in the JSM project. Employees need to know who knows what to understand where their competency and expertise is required in KDS.

Therefore, the work on the JSM project is important for Devotek. By delivering a satisfactory product to JSM, this could open up for future projects with this division in Kongsberg. "We are hoping that this is an entry point. If we deliver according to expectations we can secure a form of collaboration [with KDS]" (Program Manager – Product Development, Devotek). In this case, it is also important that KDS learns about Devotek. If KDS is familiar with the knowledge and resources at Devotek, the firm will stand better chances of being considered for future KDS projects.

4.3.3 Outcomes – close collaboration, establishing contact and future projects

Devotek, with specialized knowledge in engineering, develops the container for JSM. Through close collaboration and frequent communication, KDS is able to keep track of status quo and is able to provide Devotek with necessary inputs and information along the way. This is essential for the companies, with the main challenge being to complete the development on time.

Through the work done with the container, Devotek experiences a knowledge enhancement, both directly from KDS and through the work done internally. However, all knowledge gained is not necessarily relevant for Devotek beyond the JSM project, and employees mentioned that the company was already at a desired technological level, even though knowledge enhancement is always desirable.

It seems that the most important knowledge is that of KDS as a customer. The JSM project is in many ways a long term investment for Devotek, where the knowledge relevant is in turn

useful in establishing a relationship and status in the whole system. Through working with the container, employees at Devotek are hoping to develop a closer collaboration with KDS, and to be chosen more frequently as a supplier for projects within this division of Kongsberg. This also includes KDS obtaining knowledge of Devotek. Therefore, through the JSM project, Devotek is hoping to establish contact and knowledge of KDS for future collaboration and projects.

4.4 PartnerPlast

4.4.1 Finding a solution through collaboration

PartnerPlast entered in the JSM project in January 2012, producing the plastic fuel tank for JSM, with raw materials not previously used by the company. This has been challenging as it requires the production and testing of a product in an unfamiliar material. According to the managing director: "We have brought out [this material] in conjunction with this project. That makes it exciting and challenging for us" (PartnerPlast). As such the project is a constant learning process for employees. The material chosen for the fuel tank acts differently from other types of plastic, requiring new solutions from PartnerPlast.

The demands of the project, specifically those involving the environment in which the fuel tank will be operating, are new to the business. Not having worked in the defense sector before, PartnerPlast had to adapt its work methods to meet a different set of requirements. This was expressed by the engineer managing the workshop: "There are new things to relate to [within the defense sector] when it comes to security and other things" (PartnerPlast). However, being a leading specialist in construction, design and rotational casting of plastic, PartnerPlast is a highly qualified supplier for the JSM project. The company has expert knowledge within its field of work, and applies this in developing the fuel tank.

Since PartnerPlast lacks experience in production for the defense sector, the company has been faced with many new demands. Certain parts of JSM have extremely high requirements and working with KDS includes different demands within quality, documentation, and equipment. Due to this, PartnerPlast had to gain an understanding of these requirements, something which proved an intensive learning process in the early stages. However, even though PartnerPlast is unfamiliar with the defense sector, they are accustomed to working on projects requiring confidentiality, and in this regard the company's behavior towards KDS is no different from its behavior with other customers.

Communication is an important part of the collaboration. Employees at PartnerPlast have been able to ask questions along the way, clarifying whether solutions they come up with can be implemented in the product. According to the company's materials technology engineer, communication between KDS and PartnerPlast takes place mostly between her and the project engineer responsible for PartnerPlast in KDS: "I have quite a lot of contact with [the project

engineer in KDS]" (PartnerPlast). Their communication occurs frequently and PartnerPlast has the possibility to contact KDS whenever necessary.

Through meetings and other forms of communication, such as e-mail and phone calls, KDS mostly contributes with clarifications and updates throughout the process. Status quo, challenges and possibilities, in addition to future plans and roadblocks, are expressed. When employees from both companies meet, the communication between them is open, honest, and clear, giving KDS a good understanding of the present state of the work. This was evident at the meeting observed between the two companies, in addition to it being stated by PartnerPlast employees. It was clear that both parties had an understanding of the needs of the final product. Since communication occurs frequently, KDS has an overview of status at all times, making it possible to give feedback whenever necessary.

KDS can contribute technical solutions and assistance, but not within rotational casting itself. This is something for which PartnerPlast is the leading manufacturer of and of which KDS does not have substantial knowledge. This was stated by project engineers in KDS: "No one [in KDS] is a rotation expert" and the managing director at Partnerplast: "They haven't given any inputs towards the material … That has been up to us [to decide]". However, by making PartnerPlast aware of the background and critical needs of the product, KDS has been able to keep PartnerPlast on track throughout the development process. Employees from KDS have been clear about the necessary qualifications of the fuel tank, being specific about possibilities and restrictions.

Through working with the material, employees at PartnerPlast are trying to produce a prototype of the fuel tank in the material chosen for JSM. They try different solutions and work towards finding a way to produce a tank that meets KDS' requirements. If a challenge with the material occurs, they start by looking at the problem, trying to analyze it to determine the cause of the challenge. Then, they try to modify the product, making a single change each time, documenting their progress to find a solution. The skills necessary to achieve a solution is acquired by PartnerPlast itself, without the help of KDS.

However, KDS is good at making PartnerPlast aware of the background and what environment in which the fuel tank will be operating, ensuring their focus within the development. Employees at PartnerPlast experience KDS as being well organized and skilled in expressing the information necessary for the project. According to the managing director,

PartnerPlast has the ambition of always trying to reach out to working with technically demanding projects. The company is challenged through the work with KDS and JSM, something he considers necessary for PartnerPlast to succeed.

4.4.2 Knowledge involved

As expressed by PartnerPlast's managing director, "we have a strong focus on competence development … and we want to learn from [working with] JSM.". Here he stated PartnerPlast's wish to be challenged when it comes to new customers and product types. Therefore, perhaps the JSM project could open a door to new markets and customers for the company. "It is a general competence development, especially as regards production... and towards documentation. It will also pull us a long way in material technology".

Participating in the JSM project can lead the company to a new potential market. This was also expressed by the KDS project engineer responsible for PartnerPlast: "[The JSM project] probably creates a market-foundation [for PartnerPlast]". KDS is expecting and hoping that PartnerPlast will increase their knowledge base from participation on the JSM project.

Through the JSM project, employees at PartnerPlast are learning about the capabilities and skills of employees in KDS. This can be relevant if the company wants to pursue future projects in the defense sector, now having knowledge of people within the field. Therefore, the collaboration with KDS has led to achieving a larger understanding of this sector and the people working within it.

According to the managing director, PartnerPlast is also growing more aware of the facts related to corporate social responsibility (CSR). PartnerPlast has been in contact with the department responsible for CSR in Kongsberg, for further information on the subject. Kongsberg can help employees at PartnerPlast understand how to work with CSR and why this aspect is important and through this transfer valuable knowledge to the business. This knowledge is also relevant fot the company's work in the offshore sector, their primary field.

As offshore is PartnerPlast's main area of work, knowledge from the JSM project and KDS could be transferred to this area, strengthening the business in this sector. An example is ideas and contributions from the JSM project and the defense sector being added into their new IT system. This information has helped modify some of the demands and added a few new criteria, strengthening the system.

Additionally, employees at PartnerPlast are experiencing work with a new raw material through this project, learning how to rotate a different type of plastic. Through this, they can use the same product in different settings, the offshore sector among them, within other applications with equivalent challenges as the fuel tank for JSM. This was also expressed by the managing director: "It is desirable to take items and transfer it to offshore too, making that even better" (PartnerPlast).

The managing director in PartnerPlast also talks about the JSM project's importance in terms of strengthening the business itself: "Both technically and developmental this means a lot for PartnerPlast". Having KDS as a customer and the JSM project as a reference is an advantage for the company. The boost the project provides within Kongsberg is valuable for future possibilities. Kongsberg is a big company, working within different businesses (Kongsberg, 2012a), and through the project PartnerPlast is creating a name in the broader Kongsberg-system. Kongsberg Maritime is one of the four business areas in Kongsberg PartnerPlast has worked with previously, and the JSM project could be a positive reference for further work with them, in addition to other areas in KDS.

4.4.3 Outcomes – close collaboration, new sector knowledge and knowledge transferrable to existing sectors

With no previous experience from work in the defense sector, PartnerPlast collaborates closely with KDS throughout the development of the fuel tank for JSM. Frequent communication is expressed as a necessary factor for the accomplishment of the fuel tank for the missile, and the two companies work closely together to achieve development.

PartnerPlast employees pointed out a desire for knowledge enhancement through participating in the JSM project, and expressed this occurring through the work done. It was further stated the project leading to knowledge relevant for PartnerPlast in various areas of work, in both existing and new areas.

Not having previous experience in the defense sector, the knowledge gained through the project can strengthen the company's work in their main area: offshore, but also introduce them to the defense sector, a new field of work for PartnerPlast.

4.5 Cross-case analysis

In this section I consider my cases in relation to each other to see whether there are differences and/or similarities between them. As noted in the methodology chapter, I expect to find similarities between the suppliers collaborating with KDS.

I present the similarities first, before elaborating on the differences between the four cases. Through this analysis I explore the possibility of an added dimension to the open innovation model, by further elaborating the collaboration and possible knowledge enhancement achieved in the process.

4.5.1 Similarities

Even though the four suppliers differ in relation to their experience with KDS and the defense sector, type of delivery for JSM, in addition to the challenged faced through the work towards JSM, there are several similarities between them.

Finding a solution through collaboration

All the suppliers are producing necessary and central parts required for JSM to function. These companies are an essential part of the making of the missile - key players in the project.

The four suppliers examined in this thesis have highly specialized knowledge in their field of work: Eidel in telemetry, Berget in machining, Devotek in engineering and PartnerPlast in rotation of plastic. Through collaboration, KDS is given access to products requiring knowledge in these fields. Since there are many suppliers involved in the project, communication is essential, requiring KDS to clearly inform the suppliers of its needs and requirements along the way.

Because the products delivered need to be integrated and function in an overall system, KDS may have knowledge of restrictions and possibilities unknown for the suppliers and has to communicate the required information to them. This is necessary in all cases and KDS follows the same method of communication with all four. Single point of contact is the general rule and the suppliers can contact KDS whenever necessary. Some formal meetings are set up beforehand, while other are arranged whenever necessary along the way. The way of communication remains similar despite the fact that the products delivered are very

different, as are the challenges faced in development by each company. PartnerPlast is delivering a product for the defense sector for the very first time, Devotek is working under great time pressure, Eidel is delivering a very complex system, and Berget must develop several prototypes for KDS.

Close collaboration and communication gives KDS and the suppliers the opportunity to communicate if questions arise, KDS being able to clarify possibilities and restrictions for the development. In this way, the parties are able to fully inform one another of new situations, enabling necessary remedies. With frequent communication, the project members are better informed, being able to incorporate up-to-date information in their own work. The only information provided is that necessary for development, avoiding possible information overload for the suppliers. As the JSM project is a product-development project, questions may arise underway so it can be an advantage to work with smaller companies that are able to adapt quickly.

An apparent similarity between the cases is the challenges presented because of their size. It was pointed out by the suppliers that the size of the business could create restrictions when it came to being chosen for projects by potential customers. This makes it necessary to work with bigger customers on larger projects. This is not necessarily related to their compatibility to the job itself, but to various reasons related to their size. An example here is Eidel's experience of not being chosen for a project because of calculated risk due to the size of the company. Eidel was qualified technically, but their size caused them to lose the project.

Actually, the size of the suppliers could be an advantage for KDS. The fact that they are all smaller companies allows them to adapt easier and adjust in relation to the requirements set along the way. Since the conditions and demands change over time, it could be convenient working with flexible suppliers that are able to adapt more quickly to the requirements from KDS. This is an advantage present in all cases examined in this thesis. Their size contributes to favorable qualities facilitating the work with KDS.

Knowledge involved

All four suppliers expressed their desire for knowledge enhancement and recognized the JSM project as a way to accomplish this. They all expressed an increase in knowledge on different levels, provided by KDS and in particular through the collaboration on the JSM project. Here

it is important to note that the supplier is the party with specialized knowledge within their area and the ones contributing to the development of JSM for KDS. Therefore, even though knowledge can be strengthened through work with KDS, the suppliers still remain the experts, possessing most knowledge regarding the project.

The knowledge provided by KDS was shared intentionally to assist the suppliers in achieving development of the parts for JSM. Knowledge enhancement for the suppliers was described as a desired outcome for KDS, and the company contributed with information throughout the development of the parts for JSM. Much of this information is valuable beyond the JSM project itself. Examples of this type of input include the information received by PartnerPlast in their new IT system, the information Berget and Devotek received in different settings through CSR assemblies at Kongsberg, and information Eidel received from both KDS and the Norwegian National Authorities.

In addition to knowledge in the form of information or input, a consistent similarity between the suppliers was the way in which their work with JSM led them to increase skills and capabilities of company employees. This work was done without participation from KDS, in a setting where the suppliers worked with the product independently. Since an enhancement of their skills and capabilities was done internally, this could be achieved through working on other projects. The difference between working on the JSM projects versus other projects lies in the complexity of the JSM project.

Since JSM is such a complex product, it follows that the technology applied is extremely complex. The knowledge achieved through it can therefore be transferred to future projects, of equally or less complexity. Had the suppliers developed products to less demanding customers, the knowledge gained may not have been of the quality acquired with the JSM project. Through developing transferrable solutions, the companies can take the knowledge achieved and implement it in other projects. Examples of this includes PartnerPlast taking parts of the knowledge and transferring it to work in offshore, and Eidel reusing parts within encryption. If the companies deepen their understanding of the constructions of components and solutions, it is possible to apply parts of this knowledge in other settings

It is nevertheless important to note that the quality of the JSM project itself may affect what is reusable. Since the project requires technology that is very complex and specific, many of the

things learned cannot be re-applied on other projects. The mindset and ways of work may be reused, but not necessarily the technology itself.

These parties' status as smaller companies may require relevant contacts to move forward in the business and be selected for work. All suppliers described the JSM project as positive for either establishing or expanding relationships and knowledge of people within the defense sector. Through CSR assemblies, both Berget and Devotek can expand their knowledge of other companies and people working within the sector, PartnerPlast is learning about the capabilities of employees at KDS, and Eidel enhances their knowledge of KDS as a customer. In some way or another, all suppliers are learning more about KDS and the defense sector through their work with the JSM project. Therefore, the participation in JSM project results in increased relationship and contacts with KDS and other companies.

All four suppliers expressed the importance of the JSM contract for future work, either within the Kongsberg-system or beyond. Having JSM and KDS as a reference could be valuable to each of the suppliers, both because of the quality assurance this represents, in addition to the promise of future contacts and possibilities.

4.5.2 Differences

Although there are many similarities between the companies, the differences between them are also present. This indicates that collaboration with a customer can have different results for different suppliers, dependent on different matters.

Finding a solution through collaboration

Collaboration between the companies is a central part of the JSM project. With the four companies having different starting points in regards to previous collaboration with KDS, their experience varied thereafter.

Berget was, as a frequent supplier for KDS, experienced and accustomed to work methods and ways of collaboration with the company. This was not the case for Devotek, a company accustomed to working with other Kongsberg, but not with the KDS division. However, Devotek employees said that communication and collaboration were easy to establish because of their frequent work involving with Kongsberg, even though many things were different with KDS.

This was not the case for Eidel and PartnerPlast. They both had to get to know the customer, demanding a startup phase for their work together. As a known actor in the defense industry, Eidel had an advantage here, already familiar to KDS as a company. Yet both PartnerPlast and Eidel had to experience KDS as a customer, through work and communication methods, in the beginning of the process. Because the companies work closely together throughout the process, it is important for KDS that all suppliers are aware of the possibilities and restrictions. Both Eidel and PartnerPlast expressed having a positive experience with the initial contact with KDS. They felt that KDS was clear as to what was expected and how they would collaborate. Therefore, even though they were new suppliers as regards KDS, they quickly established a relationship and work methods towards the company.

Working with KDS can be a challenge if the company has no previous experience within the defense sector. PartnerPlast employees found that working with products for this business required a variety of different things, including routines within security and corporate social responsibility (CSR). In order to collaborate with KDS, PartnerPlast had to meet these requirements and learn a great deal about what it takes to produce for the defense sector. This differed from Eidel and Devotek, which both were accustomed to working within the defense sector. These companies already had the formal requirements and routines in place, giving them the advantage of having a strong understanding of the requirements related to the development of the product for JSM. Berget, known for its previous work with KDS, also had a strong understanding of this.

Knowledge involved

KDS is a large company with high technological knowledge in many different fields. This knowledge can be used to contribute to the work done by a supplier because of the way customer and suppliers collaborate. Nevertheless, the amount of inputs offered by KDS can vary.

Berget, Eidel and Devotek, all companies accustomed to working within the defense sector, have received information and input related to the product itself from KDS. Yet PartnerPlast, a company previously unknown in the industry, has not received inputs related to the product. The information relevant for PartnerPlast is related to methods and requirements towards delivering products to the defense industry, valuable knowledge for a company wanting to work in this sector in the future, but not for the product itself. Note that this is not

automatically due to PartnerPlast not being familiar with the defense sector. KDS itself is not necessarily highly knowledgeable in all product areas - rotation of plastic, for instance.

Even though Devotek employees received input related to product development from KDS, it was pointed out that this knowledge was not necessarily relevant for future work, Devotek having knowledge within many of the same areas as KDS. Yet, some knowledge was important. Even though Devotek is an often chosen supplier for Kongsberg, this does not include the whole business. Kongsberg Defense Systems (KDS), the producer of JSM, is a division in Kongsberg that Devotek had little experience with. As the latter aims to become an often used supplier for KDS, relevant knowledge includes learning who does and knows what in KDS. Knowledge related to work towards KDS in general is also important, achieving knowledge usable in future projects towards this division in Kongsberg. In this case, it is also relevant that KDS has knowledge of Devotek, for them to be considered for future projects. Devotek is dependent on KDS knowing the skills and capabilities of its business for them to be an often chosen collaborator.

For Berget, obtaining a close relationship with KDS and Kongsberg is important for the company to retain its position in the market, continuing its knowledge enhancement through experience and work. As this is a company with frequent collaboration and interaction with Kongsberg and KDS, Berget employees pointed out the difference between the effects stemming from the JSM projects itself, and the company's relationship with KDS and the other divisions in Kongsberg in general. It was not the JSM project in isolation strengthening the company but the overall collaboration with Kongsberg. This was also the case for Devotek, being an often chosen collaborator with several divisions in Kongsberg. Berget and Devotek have been given opportunities to enhance knowledge in different settings involving Kongsberg, an example being their participation in the Corporate Social Responsibility (CSR) project. Even though the opportunity of knowledge enhancement through the JSM project is present, much of the strengths within this area have come forward as a result of frequent collaboration with the company.

4.6 Summary: Different companies - same way of collaboration - different relevant knowledge

This chapter has examined all four cases in the thesis, their work with JSM and relationship with KDS, to answer the research questions*: "Based on an open innovation approach, how does collaboration take place. Further, what type of knowledge is involved?"* This was done by first presenting the suppliers, case by case, before a comparison was made. The findings presented in this chapter will contribute to the discussion on the possibility of an added dimension to the open innovation model.

The suppliers deliver different parts for the JSM project. These parts are all important for the completion of the missile and the suppliers have different starting points for working with products for JSM. However, KDS collaborates more or less equally with all four. Frequent communication, an open and honest relationship, and inputs related to clarification and requirements are present in all cases. KDS collaborates through the same methods independently of the supplier. This way of collaboration results in KDS providing the suppliers with experience and relevant knowledge along the way.

It is obvious that there is a lot of knowledge circulating through developing products for JSM. Because of the method of collaboration between supplier and customer, knowledge can be diffused in the process of development. All four suppliers are experiencing knowledge enhancements within different areas through the project. Yet, even if the suppliers are experiencing a knowledge enhancement, the need for it varies.

For Eidel, it seems that the relevant knowledge is that related to entering the field of encryption, an ambition the company has.

For Berget it is important to retain KDS as a customer, and the knowledge related to collaboration with KDS and Kongsberg in general is in focus. By maintaining a close relationship with KDS, Berget can continue as a frequent supplier and recieve relevant knowledge through these projects.

Devotek needs knowledge for developing a close relationship with KDS and in this case, is dependent on KDS also developing knowledge of Devotek. This is important for Devotek to ensure close collaboration with the company on future projects.

PartnerPlast acquires knowledge relevant to developing products for the defense sector in the future, in addition to that transferrable to the offshore section of the company. Through the JSM project PartnerPlast is learning what it takes to deliver projects to customers in the defense sector, a challenging field in which to work. The requirements and working methods from this sector can be relevant in different fields, and PartnerPlast also wishes to take relevant knowledge and transfer that to their work in offshore. In that way, the JSM project can strengthen PartnerPlast's deliveries for other customers through knowledge from the project.

Therefore, although knowledge enhancement can be obtained through working with KDS, the knowledge obtained will not necessarily be usable for the suppliers in the future, beyond work on the JSM project. But it seems that all four suppliers achieve a knowledge enhancement relevant for future use, dependent on the goals and needs of the company itself.

5 Discussion

This chapter looks at what has emerged from the empirical findings, discussing this with regard to the research questions and the theory framework presented in chapter 2, in order to explore the possibility of a new dimension in the open innovation model. As stated in chapter 1, I am hoping see additional positive outcomes from using the open innovation approach to innovation.

I discuss the cases studied in this thesis, in addition to drawing the lines towards a general level, viewing if the similarities or differences can indicate that the findings may be applicable in other cases as well.

The theory chapter covered the concept of open innovation. It reviewed how companies can work through this approach, including how small and medium-sized enterprises (SMEs), in this case the suppliers, can be used as a source of innovation for a company through external technology insourcing. Thereafter, I reviewed how companies can collaborate with others, placing focus on using SMEs as collaborative partners due to the unique qualities they possess. This theory will be reviewed in relation to the empirical data to answer the first research question: *"Based on an open innovation approach, how does collaboration take place?"*

In the theory chapter, I then presented the concepts of knowledge and learning, focusing on the four types of knowledge: know-what, know-who, know-how, and know-why. This theory will be reviewed in relation to my empirical data to answer the second research question: *"What relevant knowledge is involved?"* to consider whether the suppliers can achieve knowledge enhancement through the collaboration.

Together, this can provide an answer to whether we may speak of an added dimension of the open innovation model.

5.1 Finding a solution through collaboration - open innovation in the production of JSM

Open innovation as a theory encompasses the ability to open up and allow for external resources contributing to new innovations (Chesbrough, 2003a). By using external sources as

key players, companies working through this approach can gain access to technology and ideas outside the borders of the firm for the completion of new products or processes (Lindegaard, 2010).

This is being done at Kongsberg Defense Systems (KDS) for the development of Joint Strike Missile (JSM). JSM is a highly complex product, developed to become the first of its kind in the market with advanced technical components and systems. KDS works through an open innovation approach, using various suppliers delivering different parts to the missile. These suppliers contribute to JSM through external technology insourcing (Chesbrough, 2005; Van de Vrande, 2009; Von Hippel, 1988). By using small and medium-sized enterprises (SMEs) to accomplish the production, KDS gains access to external knowledge in different areas of the development process. In this way, people working outside the borders of the company can come up with solutions for innovating.

According to the theory presented in chapter 2: "many SMEs withhold specialized technical knowledge in one area, making them highly skilled in certain fields" (Chesbrough et al., 2006). This is the case regarding the suppliers delivering parts for JSM. All four suppliers examined in this thesis possess expert knowledge in their area of work, making them able to contribute complex technological solutions to the parts they make for JSM: Eidel in telemetry, Berget in machining, Devotek in engineering, and ParterPlast in rotation of plastic. The solutions developed by these companies would have been difficult or impossible for KDS to develop on its own considering the complex nature of this project. By seeking help from external sources, KDS can gain access to the latest technology and use external insights and ideas. This is one of the key principles in the theory of open innovation (Chesbrough et al., 2006).

Collaborative agreements between suppliers and customers are common in Norway (Wilhelmsen, 2011), and KDS as a customer collaborates closely with the suppliers involved in the JSM project. In the process of collaboration, communication has been noted as a crucial factor, one which is essential to successful innovation (Dollinger, 2002; Johannessen & Olaisen, 1995). This is in focus for the production of JSM. Through close communication with each supplier KDS has the possibility of making sure that the desired requirements and qualities are present in each product. The characteristics of JSM, given the environment in which it will be operating, means that different demands must be heeded - which KDS has to

ensure the suppliers do. Therefore, close collaboration and communication is necessary to complete production.

All four suppliers differ in their previous relationship with KDS. Some having experience with KDS as a customer, some do not. PartnerPlast, for example, had not yet worked in the defense sector prior to the project. Nevertheless, the method of collaboration with KDS is more or less similar for all suppliers examined in this thesis, despite the differences between the suppliers.

Because the collaboration between supplier and customer is similar in all four cases, it is reasonable to assume that the way of collaborating is transferrable to other supplier-customer relationships. It seems the open innovation approach can be accomplished in other settings, independent of the supplier's previous collaboration with the customer. Via close communication, supplier and customer can collaborate to innovate in high-tech industries by including SMEs as external technology providers for the development. Hence, the customer can gain access to expert solutions for development, enabling them to find solutions to complex development problems. With the complex demands involved in defense products, it seems appropriate to seek to SMEs with specialized knowledge to gain access to the newest technology solutions. This expert knowledge can facilitate innovation in knowledge-intensive, high-tech industries, such as the defense industry.

As mentioned in the theory chapter, the open innovation approach has been considered less relevant to the defense sector due to the demands of protection and secrecy of the products in question. Because of the special qualities of the defense sector, it has been stated that this sector is better suited to work with a closed model of innovation. However, all of the suppliers in this thesis described their way of working in the defense sector as similar to work in other sectors. They must consider the rights and restrictions related to what solutions can be used in future products, but this is also the case with other customers and products not in the defense sector, making the open innovation approach as appropriate here as in other fields. Further, being a high-tech industry, the technology intensity in the defense sector can require rapid development of new technology, difficult to conduct in isolation, making it necessary to open up the innovation processes to accomplish this.

5.2 Knowledge involved

Collaboration can be advantageous for the suppliers involved for many reasons. The reference itself has been pointed out as a good outcome of participation in projects, the knowledge involved is another.

The theory chapter revealed that through collaboration, various resources can be provided to smaller firms. The advantage SMEs possess by having specialized knowledge in one area can affect their resources in others, making them dependent on attaining these resources from other sources, collaboration being a way to do this. Through collaboration, SMEs main attain knowledge relevant in future work.

However, the open innovation approach claims that the knowledge provided through collaboration is that provided *from* the external sources *to* the company in charge of the innovation (Chesbrough et al., 2006; Van de Vrande, 2009): in this case – from the suppliers to the customer. The open innovation approach places the emphasis on mutual knowledge enhancement and sharing in networks or alliances, but not through the use of external knowledge for technology insourcing (Chesbrough et al., 2006), as is the case in this thesis.

The literature has further noted that knowledge spillovers make take place the other way round, even if not an intended goal of the collaboration (Chesbrough et al., 2006). However, as stated in chapter 2, in the Norwegian defense sector there is a focus on collaborating to achieve positive outcomes for all parties involved. The occurrence of an enhancement of knowledge by collaborating is a desired outcome, contradicting the statement that knowledge spillovers is unintentional. If the knowledge diffused from customer to supplier is a wanted result from collaboration, the statement of knowledge diffusion as an intended effect from collaboration is strengthened, supporting the added dimension to the open innovation model.

In this case, all four suppliers experienced different forms of knowledge enhancement through their collaboration with KDS, where this knowledge was given away intentionally. It was transferred either directly from KDS or as a consequence of the supplier's relationship with the company or work with JSM. The enhancement of knowledge for the suppliers involved has been a desired outcome of the collaboration for all parties involved.

Still, for the new dimension to be relevant, it is necessary that the suppliers achieve knowledge relevant beyond the JSM project. If the four types of knowledge presented in the

theory chapter are obtained and usable in future areas of work, the new dimension of the open innovation model may be accurate.

5.2.1 Know-what

As pointed out in chapter 2, know-what is a codified form of knowledge, represented as facts or information (Lundvall, 1996). Through the JSM project, know-what was provided by KDS to all suppliers in some way. Necessary know-what was provided in regards of the demands and necessities of the product itself, through information about JSM and the environment in which it will be operating. This was passed on to all four suppliers. In addition Eidel, Berget, and Devotek all received information regarding the development of the part for the missile itself, due to KDS contributing their knowledge on the subject. These companies also received know-what from other sources, one example being the information Eidel received from the Norwegian National Security Authority. The know-what was provided in order to enable a solution in developing the parts for JSM.

Further, the suppliers could also use relevant know-what in future work. An example includes know-what PartnerPlast received for their new IT system and work with corporate social responsibility (CSR). This was knowledge gained from the company's participation in the JSM project, but is transferable in other settings. Eidel, Devotek, and Berget also received know-what transferable to future work.

It seems likely that a larger customer will be able to contribute know-what for development on a general basis. If the customer possesses knowledge on the subject, the company is also able to assist in finding solutions for development with the supplier. The similarities in the cases presented in this thesis support this assumption. With the customer possessing knowledge relevant for development, this knowledge can be transferred to the suppliers. The diffusion of know-what from KDS to all suppliers indicate this as a probable outcome of collaboration, if they work together to achieve product development. Know-what can be achieved directly from a customer through collaboration; indeed, this will probably occur in similar cases where supplier and customer work closely together.

Note that know-what, being a codified type of knowledge, can be achieved through other channels and is easily transferable (Lundvall, 1996). Therefore, it should be clear that know-what obtained as a result of the collaboration with KDS could have been achieved by different

sources, either through other projects or R&D. However, as stated by the suppliers and the literature in this thesis, SMEs have a limited amount of resources and fewer assets to distribute. Although know-what, being an explicit and easily codified type of knowledge, can be acquired without KDS as a customer, the SMEs might not have been able to obtain this information on their own. Therefore it can be an advantage to obtain know-what through a larger customer.

5.2.2 Know-why

Obtaining know-why through a larger customer can also be an advantage for smaller suppliers. This codified type of knowledge involves achieving an understanding of the principles underlying a phenomenon as well as a comprehension of why things work the way they do (Garud, 1997). By working with larger customers on complex projects, know-why can be achieved.

Devotek is an example of a company with a strong focus on obtaining know-why. Through know-why achieved, employees wish to transfer acquired knowledge across different sectors to strengthen their deliveries to customers. Since all four suppliers work in various sectors, achieving know-why can be a great strength, enabling them to cross knowledge from different technological fields to create new knowledge in new sectors (Garud, 1997).

Since JSM is a high-tech product, the technology applied is extremely complex. Several of the suppliers pointed out that much of the technology was universal, and therefore also transferable to future projects with the same or less complexity. Had the suppliers delivered less demanding products, the knowledge gained may not have been of the quality acquired for the JSM project, and know-why might not have been achieved. The similarity between the four cases indicates the occurrence of know-why being a likely outcome for various suppliers, when delivering products to demanding customers. If the project demands complex solutions, the occurrence of know-why is probable and the solutions may be applied by the suppliers in future developments.

However, for this transfer to be possible, they have to gain an understanding of know-why, of the constructions of components and solutions. This is necessary for the solutions to be applicable in other contexts. For instance by achieving know-why, Eidel can take technical solutions and transfer them to encryption work. This is an advantage since the know-why

developed through work with JSM would enable them to make advances in the development of new technology at a faster rate.

This type of knowledge is achieved internally, in this case through the work done for developing the different parts for JSM. However, it occurs due to the supplier's participation on the JSM project, so the knowledge is obtained as a result of the collaboration, though not directly from KDS. This is most likely generalizable to other cases too, where suppliers are developing new parts for a customer. Because development of new parts may require new solutions and developments, it is likely that know-why can be gained internally, as a result of collaboration with a larger customer on a general basis. Through the work done internally, suppliers will enhance know-why, perhaps strengthening the company for future work.

Note that in this case, since the suppliers are still working on development for JSM, they have not yet transferred all relevant knowledge to other projects. Therefore, it is difficult to see the effects of obtained know-why. In addition, intellectual property rights (IPR) can affect what can be re-applied in future projects: suppliers cannot deliver products with the same technical solutions to competitors of KDS. Still, according to a business manager at Devotek: "The experience and mindset are always reusable", indicating possibilities for future use of the knowledge gained.

5.2.3 Know-how

The reference to the achievement of "experience" points to know-how obtained. As it is a tacit form of knowledge, know-how must be achieved through active participation. It requires learning by doing and interaction with others in the same domain, which makes transference between companies difficult (Lundvall, 1996; Nonaka et al., 2000).

By developing parts for JSM, all four suppliers achieved know-how and enhanced their ability to do things on a practical level. An example includes PartnerPlast employees trying different solutions with the material for the fuel tank, modifying these along the way, and obtaining know-how via this work and experience.

Know-how was obtained by all four suppliers. Like PartnerPlast, Berget, Eidel, and Devotek all worked with the development themselves, trying to find new solutions. Therefore, know-how was achieved in isolation from KDS, through the independent work done by the companies. Through learning by doing and trial and error, employees at the four companies

enhanced their skills and capabilities, strengthening internal know-how. The similarities between the cases indicate know-how being a type of knowledge likely to be achieved through collaboration with demanding customers. It is plausible for this to occur in other cases too, anticipating know-how to be gained internally. Suppliers can expect to experience an enhancement of skills and capabilities through working on developing new technical solutions for a customer, through the work performed within company borders, strengthening the suppliers towards new projects. If the suppliers are smaller companies, this type of knowledge may be difficult to obtain on their own, as it is expensive and time-consuming to develop competencies in isolation. By delivering to larger customers the SMEs as suppliers get paid for the work done and can obtain know-how in the process. This will save the SMEs from spending money and resources on developing this knowledge in isolation.

Although the transfer of know-how is characterized as one of the most important reasons for participation in collaborative relationships, the know-how obtained by the suppliers in this case was not transferred directly from KDS. The literature focuses on the enhancement of know-how being shared between companies (Lundvall, 1996), but this has not been the case for the JSM project. Know-what, in the form of information or input from KDS, has been used to enhance know-how within the suppliers, but the know-how itself is obtained internally. It was obtained as a result of work done in the companies, without participation from KDS.

It is therefore reasonable to assume that this will be the case in other supplier-customer relationships, where the suppliers work to achieve developments independently. If the customer is not involved in the practical work accomplished, the know-how is not transferred directly from the customer, but is developed internally, as a consequence of the collaboration between supplier and customer.

5.2.4 Know-who

Since know-who is a type of knowledge requiring the creation of social relationships and knowledge of people expertise (Clarke, 2001; Lundvall, 1996), collaboration between supplier and customer can create an arena for strengthening this, due to interaction and contact between different company employees.

In part due to different starting points with KDS, know-who obtained varied between the four suppliers examined in this thesis. Berget, as a frequently used supplier, has know-who from previous projects with KDS; it is familiar with the employees, their way of work, and capabilities. This is different from PartnerPlast and Eidel, where employees learned about capabilities, contacts and skills of KDS employees through the JSM project. Eidel had previous knowledge of KDS, though not as a customer. Therefore, Eidel employees can still expand know-who by working with JSM, possibly enhancing their knowledge of who knows what in KDS. Through this, they might create access to information and know-how for future possibilities, like the other suppliers.

Know-who is especially important for Devotek, with the goal of becoming a frequently used supplier for KDS. With most know-who towards other divisions in Kongsberg, primarily towards Kongsberg Protech Systems (KPS), Devotek uses the JSM project as an arena for establishing contact with KDS, trying to obtain know-who in the process. For Devotek it is equally important that KDS obtains know-who of their company. Having the ambition of being an often chosen supplier, Devotek needs KDS to have knowledge of their skills, resources, and areas of expertise, to be considered when projects emerge.

The differences between the four suppliers studied in this thesis indicate that the amount of know-who possessed and achieved through collaborating with a client may vary from one supplier to another. Yet, it seems this type of knowledge can be achieved through various supplier-customer relationships. It is increasingly important having knowledge of where the expertise lies, as well as having access to this expertise, and by collaboration this can be provided to suppliers. Through working together, know-who will be obtained, but there may be distinctions between suppliers based on previous collaboration with the customer, as the cases in this thesis have shown. If the supplier and customer collaborate frequently, much know-who may have been achieved in the initial collaboration. On the other hand, if supplier and customer have no previous relationship, the amount of know-who obtained is most likely high.

Since know-who requires more than information about employees and capabilities, working on a project such as the JSM project is a good way to establish this type of knowledge. Through the collaboration, employees create a social network relationship, necessary for establishing know-who (Lundvall, 1996). By establishing this relationship, employees gain an

understanding of and access to knowledge in different areas. This knowledge is both usable in the JSM project and future areas of work.

Further, the restrictions related to the size of the companies can create a necessity of achieving know-who of larger companies through supplier-customer collaboration. The achieved know-who may create opportunities for future work through the contacts established, or through other types of knowledge gained through these contacts. Therefore, this type of knowledge may be necessary for SMEs trying to gain projects with future customers.

5.3 Four types of knowledge – different types of relevant knowledge

Knowledge is viewed as an important resource in companies, something necessary to expand the business. However, without being able to exploit gained knowledge, it can lose its effect. Companies need to be able to use the knowledge achieved for this to be an advantage (Styhre, 2002). For the new dimension of the open innovation model to be appropriate, the different types of knowledge must be relevant for the suppliers in their future work.

Eidel, Berget, Devotek, and PartnerPlast all achieved different types of knowledge through working on the JSM project. It is clear that all forms of knowledge: know-what, -how, -why, and –who, have been present throughout the development, indicating knowledge enhancement through the collaboration with KDS. It is fair to assume this will be the case in similar supplier-customer relationships, when collaborating to develop new products or processes, expecting the different types of knowledge to be obtained through collaboration.

This said, the knowledge gained is not necessarily relevant for future use. If the knowledge is useless beyond the project, it is not really relevant for the suppliers beyond collaboration with the customer. Therefore, to assume the existence of a new dimension to the open innovation model, the knowledge gained as a result of collaborating with a larger customer must be relevant beyond the JSM project.

Even though the types of knowledge have been achieved for the suppliers, it is not evident that one certain type of knowledge has been more or less present. All four types of knowledge have been gained, either from KDS or as a result from working on the JSM project. But even

though the different types of knowledge were achieved through collaborating with KDS, this knowledge is not necessarily relevant for the company beyond the work with JSM. The similarities between the cases show general knowledge enhancement for suppliers as a possibility, while the differences show that there can be distinctions of relevant knowledge for future use. It seems the type of knowledge relevant to transfer from a bigger actor is dependent on the company itself, its needs and future goals. This was apparent in the four cases examined, as illustrated below.

Eidel found the knowledge related to future use within encrypting relevant, this being a desired field of work. All four types of knowledge were relevant here, and were gained both internally and from external sources through the JSM project.

The types of knowledge present and relevant for Berget are related to having Kongsberg and KDS as a customer in general. The desired knowledge was that relevant for continued collaboration with Kongsberg. All four types of knowledge were present through the development of JSM, even though some types were more central for future use than others.

With the ambition of becoming a frequently used supplier by KDS, Devotek found it important to gain know-who of KDS, but also important that KDS gained know-who of Devotek. Even though all four types of knowledge were present here too, know-who was especially prominent and necessary for Devotek to ensure future work with KDS as a customer.

Finally, PartnerPlast had the possibility of using the different types of knowledge in their main area of work: offshore. However, the company is also able to exploit new knowledge for further work within the defense sector, a sector unknown to them prior to the work with JSM.

This shows that the knowledge relevant for the suppliers varies, dependent on the company itself. It is expected this occurring in other cases where customer and supplier collaborate, where the knowledge obtained may be relevant for future work. But it will depend on the needs and goals of the individual company. Yet, it also proves the possibility of relevant knowledge for future use, strengthening the existence of a new dimension to the open innovation model.

As stated above, the focus of the open innovation approach has been on the knowledge transferred from the external sources into the organization, from the suppliers to the customer.

Yet, the knowledge examined in this thesis has been provided to the external sources, either directly from the customer or as a consequence of the suppliers' participation on the project. Knowledge useful for future areas of work has emerged for all of the suppliers and all four types of knowledge are represented. The open innovation literature describes knowledge enhancements for the external sources as knowledge spillover, a possible side effect from using external sources in the innovation process.

In the cases studied in this thesis, knowledge was transferred intentionally, because employees at KDS wanted to ensure the quality of the parts for JSM. It was provided to reach a development and to increase the knowledge and capabilities of the suppliers. As a result, some of this knowledge could be re-applied in different projects, strengthening the suppliers for future work. This knowledge is not viewed as knowledge spillovers by KDS, but rather as a positive outcome of the collaboration. As the empirical data describes, it was both expected and desired that the suppliers experience knowledge enhancement. This argues against the statement from Chesbrough indicating that the knowledge provided is unintentional.

Intentional knowledge enhancement may be the case in various product development projects where customer and supplier collaborate closely to innovate. When the two parties work together in the process, knowledge will intentionally be shared between companies to achieve development, including the diffusion of knowledge from customer to supplier. As stated by government employees (Forsvarsdepartementet, 2007; Regjeringen, 2012a), knowledge diffusion is viewed as a positive outcome from collaboration. It is therefore desirable for suppliers to gain an enhancement of different types of knowledge from delivering developments to a larger customer, strengthening the existence of new dimension of the model.

5.4 A new dimension of the open innovation model

Providing external technology to a company through collaboration, in this case from the suppliers to KDS, can lead to knowledge diffusion for the SMEs involved. By being part of a company's open innovation approach, resources for future work can be achieved. That makes this innovation strategy positive for all parties involved, thereby making it possible to add a new dimension to the open innovation model.

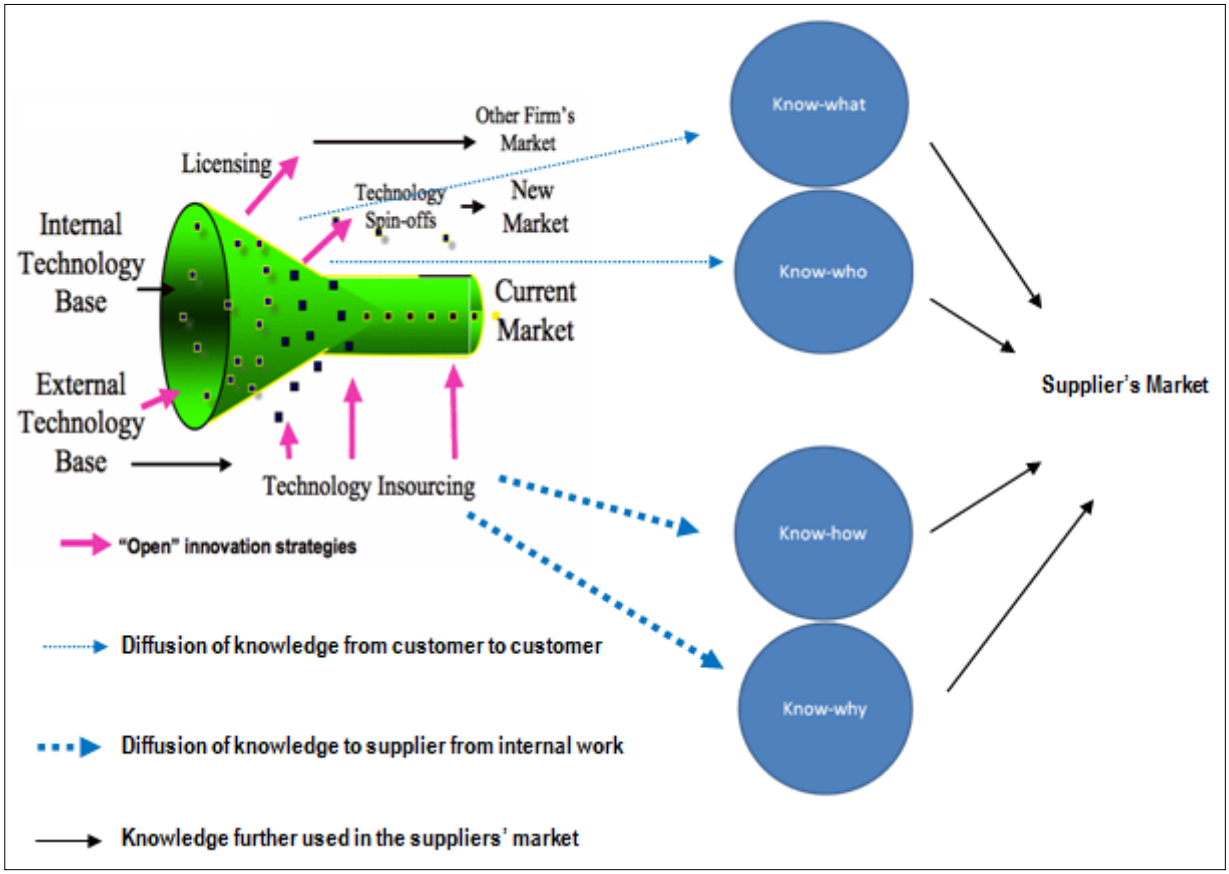

Figure 7. Open innovation with a new dimension

Figure 7 illustrates the new dimension of the open innovation approach. By collaborating with a customer as external technology providers, a diffusion of the different types of knowledge can occur. This happens as a result of the suppliers being a part of the company's open innovation approach. Yet, the knowledge is not necessarily achieved directly from the customer, as assumed in the figure presented in chapter 2. It can be diffused directly, or be achieved as a result of the collaboration, as shown in the model. This is dependent on the type of knowledge gained.

As demonstrated in the figure, know-what and know-who are types of knowledge achieved directly from the customer. Through inputs, communication, and interaction, these types of knowledge are diffused to the suppliers directly from the company innovating. This diffusion of knowledge is possible because of the way the companies are collaborating to achieve development. Since supplier and customer collaborate closely in the process, know-what and know-who is transferred.

Know-how and know-why are achieved internally by the supplier, but as a consequence of the collaboration. These types of knowledge are not obtained directly from the customer, but

from work done independently by the suppliers for the customer. It may be that these types of knowledge can be achieved from other projects or sources, but if the suppliers are SMEs, it may be expensive and time-consuming to develop know-why and know-how in isolation. From being external technology providers, suppliers are able to develop knowledge via work done for the customer.

As can be seen from the figure, the knowledge obtained as a result of being part of a company's open innovation approach can go out to the supplier's market. This refers to the suppliers using the knowledge in future projects or areas of work, beyond the collaboration with the customer. The possibility that the knowledge may be applicable in the future is a necessity for the added dimension to be considered valid. As noted, not all knowledge gained from collaborating with the customer will necessarily be used in the future: that will depend on the company itself. Only parts of the knowledge gained are re-applied, and the knowledge relevant for future use will vary from one supplier to another.

It is clear that open innovation is advantageous for a company working through this approach. However, as this thesis shows, there can be knowledge diffusion also for the external sources involved - in this case, for the suppliers involved in the JSM project. Through the new dimension of the open innovation model, this thesis has shown that open innovation can be beneficial to the providers of external technology, giving them access to know-what, know-why, know-how, and know-who.

6 Conclusions

This research project has examined how collaboration takes place and the relevant knowledge involved between supplier and customer. The aim has been to research whether knowledge enhancement can be achieved by suppliers that provide technology to a customer working through an open innovation approach, possibly enabling an added dimension of the open innovation model. I studied the collaboration between Kongsberg Defense Systems (KDS) and four of its suppliers, and the knowledge enhancement ensuing from this collaboration. As all suppliers were small or medium-sized enterprises (SMEs) delivering technology development, I wanted to explore what knowledge might be involved in their collaboration with a bigger actor.

Open innovation as a framework has focused on the external knowledge flowing into the company for innovating, not the knowledge flowing out. With the open innovation framework, we could have examined how KDS has gained external knowledge from its suppliers to enable the development of JSM, not the other way around. This is one of the main points of the open innovation theory: using external knowledge to create innovation - in this case, using suppliers through external technology insourcing to accomplish the production of JSM.

What I wanted to study was the possible outcomes for the SMEs involved as suppliers to the JSM project. Could the collaboration lead to knowledge enhancement for the suppliers that provide external technology to a larger customer? If so, perhaps a new dimension of the open innovation model could be added to the existing model.

6.1 The suppliers' side of open innovation

As explained in the theory chapter, unintentional knowledge spillovers can occur from working with an open innovation approach. Knowledge transfer from the customer (here: KDS) to the suppliers could be viewed as unintentional knowledge spillovers, as something unplanned that occurred as a consequence of the work on JSM. In this case, knowledge diffusion and enhancement for the suppliers has been a *desired* outcome. Knowledge transferred from KDS to the suppliers has been intentional, through collaboration intended to accomplish the development of parts for the JSM project. As a consequence, this

collaboration and knowledge has also strengthened the suppliers for future projects and areas of work, as seen in chapter 4. The following section presents the research questions, along with some conclusions that can be drawn from this comparative case study.

The first research question was as follows:

Based on an open innovation approach, how does collaboration take place?

According to the theory of open innovation, for a company to work through this innovation approach, external sources must act as key players in the process. This was the case for the development of JSM, where the suppliers studied here developed central parts for the missile. The suppliers were a part of KDS' open innovation strategy, as external providers of technology. Collaboration between the parties involved was essential for KDS, and through this collaboration the development of the parts for JSM was accomplished.

It was clear that KDS' method of collaboration did not vary much between the different suppliers. The companies collaborated closely, communicating frequently. By choosing this work method, KDS was able to stay updated on current status and any challenges that arose. Given the many suppliers involved and the complex nature of JSM, such frequent communication was essential. Close contact and communication were also essential because the requirements and deadlines changed throughout the process. The complexity of the missile entails an extensive amount of information and details, and through collaboration KDS was able to share what was necessary for the suppliers involved.

Because KDS works closely with the suppliers, these companies gain access to information and knowledge from KDS, which in turn is necessary for reaching a solution to development. This brings us to the second research question:

What type of knowledge is involved?

Knowledge enhancement from the project is an outcome resulting from KDS' work through an open innovation approach. However, the open innovation approach does not focus on knowledge enhancement for the providers of external technology, in this case the suppliers. This thesis has shown that positive synergy effects can intentionally stem from the use of open innovation in companies. As all four suppliers studied here were smaller companies, with limited resources available internally, achieving knowledge enhancement through working with a bigger actor could be an advantage.

I examined the different types of knowledge; know-what, -why, -how, and –who, to see whether knowledge was gained through collaboration on the JSM project. It became clear that all types of knowledge were present in the companies; moreover, some of the knowledge would be relevant for future use, strengthening the suppliers, and providing the possibility of a new dimension to the open innovation model.

6.2 Implications

This study has offered insight into the possible outcomes of being a part of a larger company's open innovation approach. The research conducted has implications for both theory and practice.

6.2.1 Theory implications

This thesis has presented a comparative case study of one specific phenomenon, in connection with the development of a specific technology: Joint Strike Missile (JSM). It has revealed in-depth information about each case, but that does not automatically mean that the same findings and conclusions would emerge from other cases. Thus, it is not possible to make generalizations based on this single comparative case study (see Yin, 2009). If however, similar outcomes are obtained by replications of the study in similar cases, it can contribute to theory development.

This study has approached open innovation in a non-traditional manner. The point of departure was the external sources involved in the process, not the company that applied the open innovation approach. In other words, I focused primarily not on Kongsberg Defense Systems (KDS), but on the suppliers that contribute technology for the development of JSM.

This approach has added a new dimension to the theory of open innovation, by turning it around and looking at the external sources in order to see how the knowledge diffused to them. This study shows that it may be possible to extend the model and identify additional positive effects of using the open innovation approach to innovation.

6.2.2 Practical implications

This study has shown that collaborating with a company working through an open innovation approach can lead to knowledge enhancements for all parties involved. The findings indicate that different types of knowledge can be achieved through this collaboration, and can then be used to the advantage of the supplier companies, in further assignments.

On the practical level, this implies that suppliers can gain enhanced knowledge by collaborating with larger customers, if the work methods and collaboration are similar to those in this case.

Companies should seek to collaborate with challenging customers, where diffusion of knowledge is necessary in order to succeed. Collaboration may be important for the company's ability to achieve knowledge enhancement and survive in a rapid changing business world - especially for smaller companies with limited resources available.

In choosing to collaborate with a larger company, it is important to consider company goals, to achieve a realistic picture of the relevant types of knowledge involved. This will depend largely on the company itself.

6.3 Limitations of this study

An obvious limitation of this study is that it has not examined the knowledge enhancement for Kongsberg Defense Systems (KDS), the company that applied an open innovation approach. The focus was solely on four supplier-companies in the JSM project, inquiring into possible outcomes for these SMEs.

It would be interesting to examine the knowledge enhancement achieved by KDS through working with its suppliers in the JSM project. Thus, it would have been relevant to explore the potential diffusion of knowledge for both supplier and customer in the process, as a way of examining the possible outcomes for both companies, not only the suppliers of external technology, as in this thesis.

I deliberately chose to focus solely on the suppliers: undertaking a Master thesis that investigated the outcomes for the suppliers and for KDS would not have been feasible, given the time and structural constraints.

6.4 Suggestions for further research

Collaboration is becoming more and more important for businesses, especially in their innovation strategies. Open innovation as an approach, with collaboration in focus, is often used and can create opportunities for innovating by including others in the process.

The literature has focused on how open innovation can create advantages through knowledge inflows from external sources. However, as this study has shown, open innovation can also lead to intended knowledge diffusion for the external sources that contribute expertise and knowledge. Open innovation emerges as a means of transferring and creating knowledge both ways. This is a result of collaborating through an open innovation approach that involves all parties, even if the intended focus may be a unidirectional knowledge transfer.

Future research should include more studies of customer-supplier collaboration in high-tech industries. As yet, little research has been conducted from the perspective used in this thesis, and further exploration is needed of how knowledge gets diffused to suppliers through collaboration. Perhaps it is possible to extend the model, examining the nuances in the new dimension. Open innovation may have more dimensions than generally presented in the literature, and this should be further investigated in future research projects.

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Appendix

Appendix 1: Interview Guide (In English translation)

Introduction

1. Can you explain your position in the company and your field of competence?
2. How long have you been working here?
3. What is your job as regards JSM?

Work being done as regards JSM

4. What is your company delivering for JSM?
5. Has your company delivered products for the defense sector before? If yes, elaborate.
6. Has your company delivered products to KDS before? If yes, elaborate.
7. Has your company delivered products to KONGSBERG before? If yes, elaborate.
8. Have you faced any challenges in working with JSM?
9. If so, could you tell me about these?
10. How have these problems been solved?
11. Who (if anyone) has helped solve these?
12. What challenges may arise in working with KDS and JSM in general?
13. What challenges do you face by being a smaller company?

Collaboration with KDS

14. How do you communicate with KDS?
15. How often and through what channels?
16. What type of relationship do you have with KDS?
17. How do you collaborate through the JSM project?
18. How does KDS assist as regard your work with JSM?

Knowledge/expertise associated with JSM

19. What kind of knowledge/expertise do you possess and what needs to be gained for working with JSM?
20. What advantages do you have by being a smaller company?
21. What do you learn through working with JSM?

22. Have you made any changes in the company since you started working with JSM?
23. Does KDS provide knowledge relevant for you? If yes, in what way?

Advantages stemming from working with JSM

24. Do you feel that you have gained anything from working with KDS and JSM?
25. If yes, what?
26. If knowledge has been gained, how is this used in your company?
27. Do you gain access (both directly from KDS and externally) to resources through working on the JSM project?
28. Advantages in working on a development program?

Challenges

29. Challenges involved in working on this type of project?
30. Challenges involved in working within the defense sector?

Closing

31. Is there anything else you would like to add?

Appendix 2: List of informants[9]

Position	Company	Type	Date	Lenght
Executive Vice-President Business Development	KDS	Introduction JSM	9.17.12	30 min
Procurement Manager	KDS	Introduction JSM	9.17.12	30 min
Procurement Manager, Senior Purchaser	KDS	Introduction JSM & Berget	9.27.12	30 min
Procurement Manager, Project Engineer	KDS	Introduction JSM & Eidel	9.27.12	30 min
Procurement Manager, Project Engineer	KDS	Introduction JSM & PartnerPlast	9.27.12	30 min
Managing Director (Eidel), Procurement Manager (KDS)	Eidel	Introduction of company	10.3.12	120 min
Business Manager Defense (KD), Managing Director (KD), Procurement Manager (KDS), Program Manager Defense (KD)	Kongsberg Devotek	Introduction of company	10.4.12	120 min
General Manager (Berget), Senior Purchaser (KDS)	Berget	Introduction of company	10.4.12	120 min
Managing Director	Eidel	Interview	10.23.12	45 min
Technical Director	Eidel	Interview	10.23.12	45 min
Design Engineer	Eidel	Interview	10.23.12	30 min
Project Engineer	KDS	Interview	10.26.12	20 min
Business Manager Defense	Kongsberg Devotek	Interview	11.7.12	60 min
Engineer Materials Technology (PP), Managing Director (PP), Procurement Manager (KDS), Project Engineer (KDS), Technical Director (PP)	PartnerPlast	Introduction of company	11.9.12	90 min

[9] CSR - Corporate Social Responsibility, JSM – Joint Strike Missile, KDS – Kongsberg Defense Systems, KD - Kongsberg Devotek, PP – PartnerPlast

Engineer Materials Technology (PP), Managing Director (PP), Procurement Manager (KDS), Project Engineer (KDS), Technical Director (PP), Workshop Manager/Engineer (PP)	PartnerPlast	Observation	11.9.12	90 min
General Manager	Berget	Interview	11.19.12	45 min
Technical Director	Berget	Interview	11.19.12	30 min
Manager Prototype/Programming	Berget	Interview	11.19.12	20 min
Quality Manager	Berget	Interview	11.1.12	30 min
Managing Director	PartnerPlast	Interview	12.6.12	45 min
Engineer Materials Technology	PartnerPlast	Interview	12.6.12	30 min
Workshop Manager/Engineer	PartnerPlast	Interview	12.6.12	30 min
General Manager (Berget), Manager Prototype/Programming (Berget), Project Engineer (KDS), Project Engineer (KDS), Senior Purchaser (KDS), Senior Purchaser (KDS), Technical Director (Berget)	Berget	Observation	1.14.13	3 hours, 30 min
Contract Employee (KDS), Project Engineer (KDS), Project Engineer (KDS), Senior Project Engineer (KDS), Engineer (Eidel), Technical Director (Eidel),	Eidel	Observation	1.18.13	5 hours
Project Engineer	KDS	Interview	1.21.13	15 min
Mechanical Engineer (KD), Program Manager – Product Development (KD), Project Engineer (KDS), QA Consultant (KD), Senior Project Engineer (KDS), Senior Test Engineer (KD)	Kongsberg Devotek	Observation	1.29.13	90 min
CSR Manager Supply Chain	Kongsberg	Interview	1.29.13	60 min
Group Leader – Systems	Kongsberg Devotek	Interview	2.12.13	60 min
Program Manager – Product Development	Kongsberg Devotek	Interview	2.12.13	45 min

Managing Director	Eidel	Follow-up interview	1.27.13	45 min
Managing Director	Berget	Follow-up interview	3.1.13	30 min
Business Manager Defense	Kongsberg Devotek	Follow-up interview	3.1.13	30 min
Project Engineer	KDS	Interview	3.8.13	20 min
Senior Purchaser	KDS	Interview	3.8.13	20 min
Managing Director	PartnerPlast	Follow-up interview	3.12.13	20 min