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*“Broadening of scope is essential to survive” or how
Norwegian companies engage in internationalization of R&D
and Innovation*

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Abstract

Participation in global networks and increased internationalization of R&D are important ways how Multi-National Companies (MNCs) try to diversify their knowledge and use the location-specific advantages to sustain their global competitiveness. The present Master's thesis attempts to analyse how the Norwegian companies that are actively engaged in international operations and markets internationalize their R&D activities. The analysis of five large Norwegian companies shows that these companies increasingly diversify their knowledge base and seek complementary knowledge by engaging in international networks, especially with foreign universities and institutes. These companies also improve the mechanisms of knowledge sharing with foreign markets and international operations. International R&D strategies are often carried out in support of overall corporate business strategies and interests of these companies in the emerging markets, such as China, Brazil and India. Adapting to new international markets and partnerships and knowledge sharing are some of the main challenges in these companies. In line with the R&D internationalization, the Norwegian companies are adjusting their existing relationships with the scientific community in Norway and searching for the competences and knowledge that the National System of Innovation (NSI) is not able to provide. Overall, the analysis supports an argument that the current lock-in of the NSI presents several limitations and challenges for knowledge-intensive industries.

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Introduction

Globalization of business, knowledge and human relationships facilitated by ever developing sophisticated information technologies (IT) and social media are the realities of the modern world we live in. Networks, which are increasingly facilitated by the IT tools, are seen as crucial for providing new knowledge and capabilities for innovation in the companies (Powell & Grodal, 2005). The reason is that no single company can have all the necessary skills and sources of knowledge internally at the times when technology is developing and spreading very fast and the sources of knowledge are distributed widely (Ibid, p.59). Furthermore, it is argued that diversity and heterogeneity of the knowledge base is vital for the companies to sustain or to improve their competitive position (Powell & Grodal, 2005; Narula & Zanfei, 2005). To succeed in this process, the companies look for new knowledge outside their organizational and national boundaries.

Thus, in addition to various sources of innovation within one country or region there are also external international networks. Global markets and international networks facilitated by digitalization provide new opportunities and challenges for the companies. Some authors (Ernst & Kim, 2002) talk about “*major organizational innovation in global operations*”, namely, global production networks, and how this development triggers international knowledge diffusion across the national borders. The main purpose of these networks is to provide the flagship (or, in other words, the multinational company) with quick and low-cost access to resources, capabilities and knowledge that are complementary to its core competences.

In their quest for new opportunities, multinational companies (hereafter MNCs), indeed, are exploring overseas markets and establishing new partnerships with local customers, suppliers and scientists in order to improve their services, products and find new sources of innovation. The MNCs are seen by many scholars as important actors in transferring technology and other forms of knowledge between the countries (Almeida, Song, & Grant, 2002; Ernst & Kim, 2002; Narula & Zanfei, 2005). There are different mechanisms how innovation is spread across the national borders, and foreign direct investment (FDI)¹ often used by the MNCs is just one of them (Narula & Zanfei, 2005). Other forms and channels of international knowledge flow include: trade, licensing, cross-patenting, international technological and

¹ Through FDI, MNCs acquire existing assets abroad or set up new wholly or majority-owned activities in foreign markets (Narula & Zanfei, 2005, p. 318).

scientific collaborations (Ibid, p.318). The MNCs also establish joint global ventures and strategic technological partnerships in order to sustain and enhance competitiveness. This is particularly evident in high technology industries, as pointed out by Lam (1997), because in these types of industries a single company rarely has all the necessary technology and knowledge to accomplish product innovation on its own.

Internationalization of research and development (R&D) has, however, occurred at a much slower speed compared to other value-added activities, such as international sales or production (Narula & Zanfei, 2005). That is largely due to the complexity of innovation systems and because the companies tend to be embedded in their domestic environments². High costs involved, uncertainties, cultural barriers and management challenges are among the reasons why globalization of R&D is accepted by the MNCs somewhat reluctantly and with resignation (Von Zedtwitz & Gassmann, 2002; Narula & Zanfei, 2005).

Looking back historically, the MNCs relied on their home base knowledge and expertise, and used their subsidiaries abroad for adjusting their products to the local markets, as well as benefiting from the local resources and production conditions (Cantwell & Mudambi, 2005). Thus, different types of knowledge were created at home and spread worldwide in the form of new products and processes (Almeida, Song, & Grant, 2002). Typically, the MNCs from more developed and industrial countries were transferring knowledge and technologies to less developed countries and emerging markets. According to Narula & Zanfei (2005), in 2001, 90% of all outbound FDI was from industrial countries and the EU accounted for the largest share. Technology transfer or FDI may also produce a positive spillover for local environments, whereby domestic firms benefit from the presence of FDI and boost their productivity (Zhang, Li, Li, & Zhou, 2010). However, the evidence of the positive results of FDI spillovers is somewhat limited (Narula & Zanfei, 2005; Zhang, Li, Li, & Zhou, 2010).

According to the recent literature (Cantwell & Mudambi, 2005; Zanfei, 2000; Almeida, Song, & Grant, 2002; Song, Asakawa, & Chu, 2011), subsidiaries abroad and decentralized R&D units increasingly become providers of new technology and new knowledge, which have value outside the local markets and are transferred and used by the MNCs. In other words, knowledge is not transferred in just one direction from the MNC's headquarters to the entities

² Narula (2002), for example, explained how the National System of Innovation impacts internationalization incentives of the Norwegian companies. It will be discussed in more detail in Ch.1.

abroad (a foreign subsidiary or local partners), but in turn it is also acquired from the foreign locations and transmitted through the networks of the MNC.

Furthermore, geographical distribution of knowledge is reinforced by the fact that new knowledge is very often generated outside the labs and research centres. Knowledge creation and innovation embraces all functions and branches of the companies, and thus knowledge creation and development occurs in all the firm's locations (Almeida, Song, & Grant, 2002). Additionally, the companies search for the diversity of knowledge and unique, local knowledge that could provide a competitive advantage or complementary value to "global general knowledge" (Von Zedtwitz & Gassmann, 2002; Zanfei, 2000). Exploiting location-specific innovative advantages in order to compete in the ever more globalized environment is mentioned as a motive of the MNCs for internationalization of their industrial R&D (Von Zedtwitz & Gassmann, 2002, p. 569).

Following these global trends in internationalization of industrial R&D and innovation, the Master's thesis will attempt to provide answers to the question: *how Norwegian companies internationalize their R&D activities*. This question will entail three sub-questions: 1) Why the Norwegian companies seek internationalization of their R&D activities? 2) How the Norwegian companies carry out internationalization of R&D? 3) What are the challenges involved in internationalization of R&D in the Norwegian companies?

The thesis is structured according to the following road map: after the introduction, the discussion will be presented on the trends in R&D strategies, the main challenges in R&D activities outside the national borders, and the existing empirical evidence about the Norwegian companies' international R&D approaches (Ch.1). Next, as the main interest within the current research is directed towards R&D and innovation, and knowledge creation at the company's level, theoretical concepts related to knowledge management and organizational learning will be elaborated (Ch.2). This chapter will also include the empirical evidence about the factors contributing to the knowledge sourcing from the foreign locations. Ch.3 presents a summary of the theoretical discussion and explains the application of the theoretical concepts in the further analysis. It will be followed by the Methodology chapter (Ch.4). The subsequent chapter (Ch.5), will contain the information about five Norwegian companies, one by one, through discussing their business, R&D strategies and activities, and knowledge management issues. It will be followed by the comparative discussion on shared

and distinctive features in the approaches of internationalization of R&D in the five companies (Ch.6). Finally, conclusions and policy recommendations will be presented (Ch.7).

1. Trends and challenges in international R&D

1.1 Main strategies, archetypes and challenges

The two main approaches how to organize R&D activities internationally are often referred to as two types of international R&D strategies implemented by the MNCs: asset exploiting strategy and asset-augmenting strategy (Narula & Zanfei, 2005). The asset exploiting strategy means that the companies rely on their knowledge generated at home and make adjustments to their products to fit the foreign markets. The second strategy means that the companies seek to acquire complementary knowledge and to create new technological assets in foreign locations for the use not only in a specific location, but globally as well. According to Narula & Zanfei (2005, p. 327), asset augmenting perspective marks a fundamentally different approach for international business and innovation, because it *“considers local contexts more as sources of competences and of technological opportunities, and less as constraints to the action of MNC.”*

However, whether a MNC can gain valuable knowledge from the foreign locations does not depend only on the MNCs' corporate strategies or only on location factors. Cantwell & Mudambi (2005) argued that the intensity of R&D among the foreign subsidiaries within the same MNC varies, and it depends on the location-specific characteristics, as well as on the MNC characteristics on the group level and the subsidiary level. These authors used the terms competence-exploiting mandate versus competence-creating mandate when describing the R&D strategies of the foreign subsidiaries. Whether a foreign subsidiary achieved competence-creating mandate, was largely influenced by the factors such as the quality of local infrastructure and networks, the functional scope of the subsidiary's mandate, the subsidiary's role within the MNC network and how mature and strategically independent the subsidiary was.

Von Zedtwitz & Gassmann (2002), based on their empirical findings, identified two principal motives for internationalization of R&D - access to markets/customers and access to science/technology. Based on the analysis of how much the MNCs depend on their research and development at home or abroad, they suggested four archetypes for R&D internationalization: 1) National treasure R&D (research and development are done domestically), 2) Technology-driven R&D (dispersed research and domestic development), 3) Market-driven R&D (domestic research and dispersed development) and 4) global R&D (dispersed research and dispersed development). These authors (Von Zedtwitz & Gassmann,

2002) also claim that, regardless of the initial motivation, there might be other factors that continue driving internationalization of R&D further. In other words, the international R&D type is not something fixed. Rather, if a company, for example, started as a market-driven archetype organization by establishing production sites in a different location while maintaining research activities at home, it might later consider adding research support and establishing research units abroad as well. Von Zedtwitz & Gassmann (2002) also noted that the international R&D dispersion often occurs as a result of non-R&D related activities, such as mergers or acquisitions of partner companies.

Additionally, important factors in internationalization of R&D are the firms' size, type of industry and technology required and used by the firms (Narula & Zanfei, 2005). International R&D activities are usually carried out by larger firms, because they have bigger R&D budgets, prior knowledge and capacity to establish and manage international networks as well as relationships. Industry-specific factors, for example, how close is the interaction needed with the suppliers, customers and their location, or how mature is the technology that a company is using, might be the reasons to consider when deciding whether the particular company needs to internationalize its R&D activities or not.

On the other hand, regardless of their structural size, the firms need to maintain diversity of knowledge and high competences. They might therefore get involved in international networks and scientific collaborations (Narula & Zanfei, 2005). Establishment of strategic technological partnerships or international scientific collaborations can be a complementary strategy to in-house R&D or it can compensate for the absence of the internal R&D capacities. According to Narula & Zanfei (2005), the main motivation for the companies to enter international strategic partnerships is to increase their multinational experience and thereby minimize the risks related to entering into new markets, as well as the need to explore new business or technological developments by learning from their partners. Powell & Grodal (2005), for instance, have argued that collaborative networks allow the firms to learn from a wide stock of knowledge, and thereby broaden their own knowledge base.

However, along with the opportunities that the international markets and the diversity of knowledge can present, there also come challenges, such as difficulties with coordination of information flow and management of overseas subsidiaries and networks (Zanfei, 2000), managerial problems related to balancing concentration and dispersion of R&D resources (Narula & Zanfei, 2005), geographical (physical) distance as an obstacle for transfer of

knowledge (Morgan, 2004), high costs involved in organizing knowledge transfer, developing and maintaining networks in host locations (Narula & Zanfei, 2005).

Zanfei (2000, p.516) has, for instance, argued that “*external networks have become key assets in the competitive arena, as a means to gain privileged and timely access to user experience and skills, and to extract economic value from the growing generic knowledge basis*”. However, managing double networks: internal (between the different units of a MNC) and external networks (between the subsidiaries and their local partners), is a serious challenge for the MNCs. It becomes difficult to find procedures and mechanism to sustain the balance between the centripetal and centrifugal forces in these networks. Zanfei (Ibid.) concludes that it is more informal relationships and networks than formal centralized mechanisms that would ensure the functioning of networks and internal cohesion of the MNC. In order to enhance the ability of decentralized MNC units to innovate, according to this author, the companies have to considerably invest in resources, competences and cultural backgrounds (Zanfei, 2000, p. 538).

It is quite evident that with the dispersed R&D units, management of R&D organization is becoming more complex. It is largely due to the special role of R&D units in facilitating knowledge and technology transfer, and due to the challenges presented by cultural, linguistic and behavioural diversity (Von Zedtwitz & Gassmann, 2002). Thus, not surprisingly, several empirical studies have confirmed that there is a certain resignation from practitioners towards internationalization of R&D (Von Zedtwitz & Gassmann, 2002; Gulbrandsen & Godoe, 2007).

A particular type of concern is related to knowledge transfer within a MNC and its international partners. The distance among different units of a MNC, including the home based headquarter and overseas labs/subsidiaries impact frequency, quality and costs of communication (Von Zedtwitz & Gassmann, 2002). Furthermore, physical and geographical proximity is much more complex than spatial distance. It also involves factors such as common culture, shared language and trust, which are important for relationship building between companies (Morgan, 2004; Maskell & Malmberg, 1999). Despite modern digital communications, the role of trust and face-to-face communication in creation and transfer of tacit knowledge³ is presented as one of the major dilemmas in internationalization of R&D

³ Tacit (implicit), sometimes referred to as uncodified, knowledge is personal, experiential, context-specific and hard to imitate. Explicit (sometimes referred to as codified) knowledge: can be codified, is expressed in

(Von Krogh, Ichijo, & Nonaka, 2000; Morgan, 2004; Von Zedtwitz & Gassmann, 2002). Thus, there is often scepticism towards the benefits of international R&D and regarding the possibility of finding solutions how to overcome the existing barriers in transferring knowledge from distant and culturally diverse places.

On the other hand, there is a growing interest in these questions and research that looks into knowledge building in the MNCs, knowledge transfer from their foreign subsidiaries and labs, especially in such huge developing markets as China. This bulk of research is covering, for example, questions like the MNCs' superiority to strategic alliances and markets in knowledge transfer across borders (Almeida, Song, & Grant, 2002), factors influencing foreign subsidiaries' performance (Cantwell & Mudambi, 2005; Un, 2011), factors impacting the ability to gain local knowledge by foreign subsidiaries and overseas labs (Li, Poppo, & Zhou, 2010; Song, Asakawa, & Chu, 2011; Andersson, Forsgren, & Holm, 2001). Some of these articles will be elaborated later in the Ch.2, by discussing the factors that contribute to gaining knowledge from external environment and foreign locations.

1.2 Internationalization trends of industrial R&D in Norway

After discussing the general trends in internationalization of R&D, I will turn to the evidence about the Norwegian companies and trends in their international R&D strategies and approaches. A limited interest of the Norwegian firms to relocate their R&D activities abroad was discussed by Narula (Narula, 2002). He argued that a firm's innovative activities are a part of the domestic network and System of Innovation (SI), which means that companies are embedded in their local environments and are dependent on other actors in SI. In the Norwegian case, he argues, SI is built around traditional, state subsidized, raw materials-based industries. Most of the R&D personnel in these industries are educated in the Norwegian University of Science and Technology (NTNU). Consequently, most of the recruitment and research contacts, as well as projects are facilitated through close personal networks formed between NTNU and SINTEF (SINTEF-NTNU axis).

SINTEF was established as the main technological research centre in Norway and has since been the main partner of the Norwegian government and industries in technological collaborations. This has led to self-enforcing systemic lock-in, according to Narula (2002), both on organizational and technological levels, and this is a less desirable situation for the

numerical, textual or graphical terms, and therefore is more easily communicated, for example, a design or a product (Tidd & Bessant, 2009, p. 543).

new high technology and knowledge- based industries. These new-type industries try to apply the “exit” strategy and are more eager to internationalize their R&D, because they need a larger variety of technologies and knowledge. The exit strategy, however, has high costs related to the establishing and maintaining new relations in host locations abroad. This is what small and medium size companies cannot always afford. The danger of this systemic lock-in is in the aspect that no single country, especially a small one, can provide world class competence in all technologies and in all industries, therefore the cross-border flow of ideas is seen as crucial in the time of global competition (Narula, 2002; Narula & Zanfei, 2005).

There are several authors that support an argument that organizational learning and innovation at a firm’s level is closely linked to a wider national institutional framework (Lam, 2000; Wicken, 2009; Whitley, 2002). A conceptual framework of Systems of Innovation⁴ is often applied to this kind of analysis. In the present Master’s thesis these frameworks are not applied for analysis, because the research interest lies in the firms’ strategies and processes for knowledge creation rather than the influence of the Norwegian institutional factors on the innovation and knowledge creation processes in the firms. At the same time, it is important to acknowledge that the Norwegian companies are largely embedded in NSI or, in other words, they have traditionally been very dependent on the national innovation infrastructure, local scientific knowledge and networks.

Furthermore, Wicken (2009) has concluded that the Norwegian industries belong to their specific path dependant historical “layer” in the NSI, which is still present nowadays. Each of these layers has its own specific “innovation infrastructure” and relies on a separate knowledge base. These layers, according to Wicken (2009), are: 1) Small-scale decentralized path industries (in agriculture, fishing sector); companies in these industries do not perform their own R&D, but instead rely on public knowledge of technology; 2) Large-scale centralized path industries (in electricity, mining, oil and gas sector), which have their own knowledge base and R&D activities; 3) R&D intensive network-based path, which is typical for enabling industries (electronics, computers, automation technology).

In some of the recent publications on this topic, Gulbrandsen & Godoe (2007) analysed the motivation of the Norwegian companies to carry out international R&D and their different strategies for R&D internationalization. They found a rather sceptical attitude among the

(National) System of Innovation⁴ - “all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovations”, (Edquist, 2005, p. 182).

Norwegian companies regarding internationalization of R&D. The Norwegian companies would rather like to depend on the national R&D infrastructure. Additionally, they found that the national identity factor plays an important role in business thinking within Norway and consequently in the R&D strategies of the MNCs. By applying a typology developed by Von Zedtwitz and Gassmann (2002) discussed previously in Ch.1, Gulbrandsen & Godoe (2007) suggested that among the eight of the largest Norwegian international companies, three companies were following the strategy of National treasure R&D, one company - Technology-driven R&D, two companies - Market driven R&D and two companies were applying the Global R&D strategies. It is interesting to note that National treasure companies (conducting R&D at home) are oil and ICT companies, while global R&D companies are in pharmaceutical and chemical business.

Nevertheless, the internationalization of industrial R&D is an acknowledged tendency among the Norwegian companies, but it is carried out somewhat reluctantly (Gulbrandsen, 2008). The companies, which are more involved in international R&D, as a rule are large, international companies with subsidiaries abroad and more common in the industries like chemicals and pharmaceuticals. Most of the international R&D collaborations are concentrated in the European Union. There was no evidence found in the research of Gulbrandsen (2008), that the Norwegian companies would strive for internationalization of R&D as a result of the mismatch between the companies' needs and lock-in of the national R&D infrastructure, but rather seeking complementary knowledge to the already existing knowledge within national NSI. According to Gulbrandsen's findings (Ibid.), the Norwegian companies become involved in the international operations following their specific business rationales and business strategies.

2. Theoretical frameworks on knowledge creation and organizational learning

In order to answer the research questions, the chapter will provide discussion of knowledge management and creation process at the firm's level by looking at the approaches how companies develop abilities and the establishment of mechanisms for acquiring knowledge from foreign locations. A theoretical assumption is that for successful operation in global markets, the companies need an established knowledge base and absorptive capacity, as well as mechanisms and procedures in place for acquiring, transferring and utilizing knowledge gained from partners, clients and suppliers in the countries of interest. Thus, the concepts of absorptive capacity, knowledge management and knowledge creation will be elaborated further, along with the empirical evidence about the factors contributing to knowledge acquisition from foreign locations.

2.1 Knowledge management issues

Knowledge management is a broad term often used by both theoreticians and practitioners in describing processes related to identifying, translating, sharing and exploiting the knowledge within an organization (Tidd & Bessant, 2009)⁵. The choice of terminology often depends on the perspective or approach taken: is it a perspective of management or of organizational learning, or cognitive perspective, as argued by Lam, 2005; Tidd & Bessant, 2009. The scholars in their writings are precise and consistent about what approach they follow and what terminology they use in exploring their research questions.

In the current thesis, however, the knowledge management-related terminology, especially in presentation and analysis of cases, will vary more and it will be less consistent due to several reasons. First of all, the interviewed persons used different terminology, as seen in their quotations. Based on the empirical data, it is very difficult to draw a very strict methodological line, for example, between the process of *transferring, sharing, exchange of know-how and learning* in these companies. Or to distinguish between whether the different meanings were assigned to the choice of words: *information, knowledge, competence or experience*. In my opinion, it should not present a serious concern, because the research

⁵ Some of these terms can be seen in a sequential order or as tasks in knowledge management (Tidd & Bessant, 2009, p. 541): 1) acquiring new knowledge, 2) identifying and codifying existing knowledge, 3) storing and retrieving knowledge, 4) sharing and distributing knowledge across the organization, and 5) exploiting and embedding knowledge in processes, products and services.

question and interest is not focused on the specific aspects of knowledge management. Instead, the interest is concentrated on the processes and tendencies that contribute to knowledge creation or organizational learning in the companies, which eventually help them to become more innovative and to withstand the global competition. However, for the conceptual clarity and highlighting some of the different approaches in knowledge-related inquiries, the following ideas are discussed below.

First of all, there is a conceptual difference between information and knowledge, but in daily life these words are often used interchangeably. Tidd & Bessant (2009, p.543) suggested a differentiation between the following concepts: 1) data, 2) information and 3) knowledge, and pointed out that knowledge is context-dependent and much deeper and richer than information. According to Von Krogh, Ichijo, & Nonaka (2000, p. 27),

It [knowledge] encompasses the beliefs of groups or individuals, and it is intimately tied to action. Beliefs, commitments, and actions cannot be captured and represented in the same manner as information. Nor is knowledge always detectable; it is created spontaneously, often unpredictably.

This quotation very precisely describes some challenges related to identifying, transferring and using knowledge within organizations.

Secondly, knowledge management processes are complex enough within the companies that have a single location in their home countries. The interest of the present analysis is directed to big multiunit companies with complex structures and with numerous international offices, subsidiaries and operations abroad. Thus, knowledge transfer and sharing, and, even more importantly, knowledge building and creation in these companies take place under much more complex circumstances, because knowledge is created and spread in the various locations. Therefore the reader of this thesis is encouraged to imagine a complex web or a form of multilayer traffic in order to picture how knowledge is being spread and transferred within the units of the MNCs and their international cooperation partners.

Thirdly, it is vital to establish how one thinks about knowledge and how it is used in organizations, or speaking more strategically, whether knowledge is seen as something valuable for the organization to increase its competitiveness. As Tidd & Bessant (2009) pointed out, much of the management literature treat knowledge transfer and knowledge sharing as an end in itself. While discussing knowledge transfer and sharing in the thesis, this analysis will be provided in the context of how these factors contribute towards knowledge

creation and learning in organizations, which is aimed at increasing innovativeness and competitiveness in the companies.

Lastly, an additional complexity in dealing with knowledge creation is that not all types of knowledge, as it was mentioned earlier, are available in a shape of a document or file that can be read, analysed or shared. Tacit knowledge cannot be captured in documents, not even videos, according to Von Krogh, Ichijo, & Nonaka (2000). It is much easier to manage codified or explicit knowledge, because it is formal and systematic, thereby it is easy to share and communicate (e.g. product specifications, scientific formulae or computer programs), while tacit knowledge is highly personal, it is hard to communicate and to formalize (Nonaka, 1994).

At the same time, most of the authors see tacit knowledge as an important factor for developing competitive advantages for firms in the global markets due to its “exchange-inability” (Maskell & Malmberg, 1999). In the global markets, where codified information and technologies are spreading so easily, the companies relying on the use of tacit knowledge have advantages, because it is more difficult to imitate and transfer it over big geographical distances. Additionally, Von Krogh, Ichijo, & Nonaka (2000, p.77) make a very interesting point that not the content of knowledge, but what a company does with it and how it is applied makes the whole difference: *“The ability to transfer general public knowledge and to use it in various areas of business may play key role in company’s success”*. Not the content of knowledge, but the process itself can be unique, hard to imitate, for example, a unique communication culture in an organization.

2.2 Absorptive capacity

The value of external learning and importance of locating valuable source of innovation outside the company are well-established concepts. The concept of absorptive capacity, developed by Cohen and Levinthal (Cohen & Levinthal, 1990) is widely applied in analysing a firm’s ability to learn from external environment. They argued that the ability of a firm to identify, assimilate and exploit external knowledge for commercial ends is crucial for innovative capabilities of a firm. This ability, however, largely depends on a prior related knowledge and diversity of backgrounds in a firm. Based on the premise of cumulative learning, there are more chances that the firm can identify new useful information if this firm can relate it to its already existing knowledge. As the firm’s absorptive capacity is developed

from absorptive capacities of the individual members in the organization, internal communication and knowledge transfer across sub-units are just as important as the communication between the firm and external environment.

However, a prior knowledge does not refer only to technological knowledge, but also includes *“awareness of where useful complementary expertise resides within and outside organization”* (Cohen & Levinthal, 1990, p. 133). In other words, knowledge about who knows what and where to seek help for problem solving is important as well. That is why establishment of different external networks is quite crucial. Cohen & Levinthal suggest that firms have to invest early enough into their absorptive capacity; otherwise they might fail to identify new emerging technological opportunities. R&D departments and R&D intensity or spending contribute to building the absorptive capacity within a firm. Additionally, Cohen & Levinthal also discuss cross-functional absorptive capacity developed through relationships and close interaction between the different organizational functions: R&D, manufacturing, design and marketing.

A different look at absorptive capacity concept is presented by Lane and Lubatkin (Lane & Lubatkin, 1998). Instead of focusing on a firm's ability to identify, assimilate and utilize new knowledge, they discuss interactive learning between two firms (student-teacher pair), by arguing that interactive learning depends on relative characteristics of both firms, especially with regard to the firms' knowledge processing systems. They have discovered that one firm's ability to learn from another firm depends on the similarity of the firms' knowledge bases, organizational structures and compensation policies, and the dominant logic of the firms. Thus, Lane and Lubatkin (1998) claim that instead of developing absolute firm's absorptive capacity, where a prior technological knowledge is paramount and R&D spending is seen as an essential criterion for developing this capacity, the firms increasingly rely on the knowledge acquired from other firms to develop their own capabilities. They also suggested that this concept could be generalized to different forms of collaboration involving knowledge transfer: inter-organizational alliances, university-corporate partnerships, acquisitions and joint ventures (Lane & Lubatkin, 1998, p. 474).

When the external learning and knowledge creation in the MNCs with subsidiaries abroad are analysed, one has to bear in mind that there are several locations where absorptive capacity may be developed and applied for identification of new opportunities. Not only the absorptive capacity of the MNC's headquarters and its home base R&D department, but also the

absorptive capacity and interactive learning of its subsidiaries abroad are important. Andersson, Forsgren, & Holm (2001, p.1014) argued that transfer of knowledge between the subsidiaries, as well as from the MNC's home base to its foreign subsidiaries depend on the ability of the individual subsidiary to assimilate and commercialize new knowledge. Consequently, the subsidiaries are not merely passive receivers of knowledge, but should be seen as active participants in knowledge development.

Similarly, when discussing knowledge transfer between the MNCs and local environments in foreign locations, the absorptive capacity of a local supplier or a firm is an important factor. Several authors (Ernst & Kim, 2002; Zhang, Li, Li, & Zhou, 2010) have confirmed that effectiveness of knowledge transfer or FDI spillovers in emerging markets do not depend only on the quality or diversity of knowledge transferred by the MNCs, but by the absorptive capacity of local suppliers, namely, their ability to absorb new technologies and to learn.

2.3 Knowledge creation and organizational learning

Organizational learning and creation of new innovative ideas, however, requires much more than identification and transfer of new knowledge. As Haas & Hansen (2007) rightly pointed out, *"knowledge sharing is no guarantee of improved performance"*. They looked beyond the knowledge facilitators or barriers for knowledge sharing and analysed how the shared knowledge is actually utilized in the firms and contributes to their performance. Another way of approaching this issue is to look at the "cognitive"⁶ perspective at the group or organization level and organizational learning (Lam, 2005). Von Krogh, Ichijo, & Nonaka (2000), for example, stressed that knowledge creation is a dynamic, social process; it happens between the people and is the result of relationships. The question is how to translate individual insight and knowledge into collective knowledge⁷ and organizational capability (Lam, 2005, p. 124).

A continuing interaction of tacit (un-codified) and explicit (codified) knowledge is at the heart of organizational *knowledge creation* according to Nonaka (1994), where organizational knowledge development heavily relies on accumulating individual knowledge. *"Organizational knowledge creation, therefore, should be understood in terms of a process*

⁶ The term "cognitive" (Lam, 2005, p. 123) refer to the idea that individuals develop mental models, belief systems, and knowledge structures that they use to perceive, construct and make sense of their worlds and to make decisions about what actions to take.

⁷ Collective knowledge is the accumulated knowledge of the organization stored in its rules, procedures, routines and shared norms which guide the problem-solving activities and patterns of interaction among its members, (Lam, 2005, p. 124)

that “organizationally” amplifies the knowledge created by individuals, and crystallizes it as a part of the knowledge network of organization”, (Nonaka, 1994, p. 17). Within this concept, self-organizing teams play an important role because they trigger organizational knowledge creation through the trust between the team members and enable the team members to share their experiences and create a continuous dialogue. Managers in such knowledge-creating companies work as catalysts of the knowledge creation process and provide the necessary framework, where particularly the top management should articulate the company’s vision, concepts and sense of direction.

Nonaka further expanded his concept in (Von Krogh, Ichijo, & Nonaka, 2000), where the authors talk about *knowledge enabling* to support knowledge creation. By *knowledge enabling* they mean “the overall set of organizational activities that positively affect knowledge creation” (Von Krogh, Ichijo, & Nonaka, 2000, p. 4). The important part of this enabling context is developing relationships, trust and caring in organizations, because only in these conditions will people be willing to share their tacit knowledge, suggest new ideas and be ready to experiment. The task of the companies’ leaders and managers is to overcome barriers for knowledge creation and to focus on “enablers”: 1) instil a knowledge vision; 2) manage conversation; 3) mobilize knowledge activists; 4) create the right context; and 5) globalize local knowledge (Ibid, p.5).

Von Krogh, Ichijo, & Nonaka (2000) criticized the dominating “knowledge management” approach (which implies the control over the processes) and the emphasis on the use of Internet technologies in knowledge creation processes. According to them, some of the barriers for knowledge creation in the companies are reinforced by lack of distinction between information and knowledge, relying on standardized and quantifying information management tools, leaving out the creative aspects of knowledge. A similar point is made by Tidd & Bessant (2009) - large organizations often do not know what they know. The companies rely on their data bases and programs for storing and retrieving information, but often miss the opportunity to identify the potential value of synergetic information. Thus, “organizational learning occurs when more of an organization’s components obtain new knowledge and recognize it as of potential value” (Tidd & Bessant, 2009, p. 458). According to Von Krogh, Ichijo, & Nonaka (2000), the companies have to invest in the training that emphasizes emotional knowledge and social interaction.

Nonaka's approach and theory regarding knowledge creation in organizations has largely been influenced by the studies of Japanese companies. Thus, there could be a reasonable doubt about application of this framework to different cultural environments. However, there were several positive examples presented from international companies (*Skandia, Siemens, Chevron, Nokia, Gemini* and others), which, by following the principles of knowledge creation, have achieved success (Von Krogh, Ichijo, & Nonaka, 2000). Accordingly, knowledge creation and knowledge enabling concepts will be used in this research.

2.4 Knowledge transfer and creation issues in international context

Increased internationalization of R&D has created a growing interest among the scholars and practitioners to investigate the factors and mechanisms that contribute to acquiring, utilizing and transferring knowledge from foreign locations and management of these complex processes. The embeddedness concept, for instance, is used by several scholars in explanation how multinational companies are gaining valuable information from international external environments (Andersson, Forsgren, & Holm, 2001; Song, Asakawa, & Chu, 2011). Embeddedness is defined as closeness in a relationship that reflects the intensity of information exchange and the extent to which the resources between the parties in the dyad are adapted (Uzzi, 1996).

The importance of being embedded in the local scientific and engineering communities was examined by Song, Asakawa, & Chu (2011). They argued that it was not sufficient for a MNC to locate a source of knowledge and absorb it. Instead, the companies need to develop social relationships to really benefit from a knowledge flow and locally specific knowledge. Only by relying on social relationships the MNC could overcome barriers related to their "foreignness" and gain access to tacit knowledge that resides within regional interpersonal networks (Song, Asakawa, & Chu, 2011, p. 383). In their research, they used two types of embeddedness - internal (in corporation networks) and external (in host location environment), similar to Zanfei's (Zanfei, 2000) internal and external networks.

Based on the studies of the subsidiaries of the Swedish multinational corporations, Andersson, Forsgren and Holm (2001) explored how the external technical embeddedness of the subsidiaries affected their market performance and, additionally, contributed towards competence development at the corporate level. According to these authors, embeddedness in a form of close business relationship with local suppliers and customers, is essential for the

ability to assimilate new knowledge from external environment. Technical embeddedness is related to one specific area of product development and processes where the organizations are interdependent in their activities related to technical development (Andersson, Forsgren, & Holm, 2001, p.1017). These authors discussed interactive learning and the role of relationships and networks, instead of relying on prior related knowledge and experience. They emphasized the role of relationships with both external and the corporate counterparts in assimilation and commercialization of new knowledge.

Looking at the empirical evidence about important factors and mechanisms for transferring knowledge in multinational companies, most of the scholars agree that both formal and informal or relational mechanisms can be useful in knowledge transfer and knowledge building (Almeida, Song, & Grant, 2002; Li, Poppo, & Zhou, 2010; Haas & Hansen, 2007). That means that the organizations should design differentiated approaches for choosing a knowledge transfer mechanism and for maintaining their relationships and networks. Formal mechanisms are contracts, documents or digitalized information. Informal mechanisms involve relational aspects and impacts from personal relations.

Almeida, Song, & Grant (2002) disclosed that multinational firms were superior to strategic alliances and market forces in cross-border knowledge building due to their flexibility and variety of mechanisms for knowledge building. One of the advantages of the MNCs was international transfer of personnel, which allowed to internationalize the firms' culture, and thereby to overcome some cultural and language barriers. Almeida, Song, & Grant (2002) warned about overemphasis on IT systems as a solution of knowledge management problems in the global businesses. They were pointing towards the need to look at the design of organizational structures, systems and culture that enable knowledge building.

Based on the study of 168 foreign subsidiaries in China, Li, Poppo, & Zhou (2010) explored the impact of relational (network ties, shared goals and trust) and contractual mechanisms on acquisition of tacit and explicit knowledge by foreign subsidiaries from the local suppliers. They concluded that goals shared by the foreign subsidiaries and the local suppliers impacted acquisition of both tacit and explicit knowledge, while the trust between these two cooperation partners was necessary for acquisition of tacit knowledge particularly. They also found that formal contracts play a supplementary role in knowledge transfer between the foreign subsidiaries and the local suppliers because "*contracts as a stock of related*

knowledge reduce cognitive barriers and enable brokered access to be more effective conduit for acquiring new knowledge” (Li, Poppo, & Zhou, 2010, p. 355).

These authors used a term and concept of “brokered access” - defined as the supplier’s network scope, which facilitates the foreign subsidiaries’ access to local knowledge. They found that brokered access particularly contributed to acquisition of explicit, but not tacit knowledge. Without this brokered access, however, the foreign subsidiaries lack legitimacy and knowledge in new markets, especially in the developing countries. In their managerial implications, Li, Poppo, & Zhou (2010), encourage the managers of international subsidiaries to understand the importance of these relational mechanisms for acquiring local knowledge and to use them in differentiated ways.

The degree of tacitness of knowledge between the partner firms in collaborative projects and the way this knowledge is created, utilized and structured is found to be an important factor in explaining difficulties in knowledge transfer within global technological collaborations (Lam, 1997). This author used the data from a British-Japanese technological partnership, and argued that difficulties with managing global cooperative ventures could not be solved just by appropriate governing or managerial structures. A reason is that the nature of knowledge and expertise, how it is organized and utilized in firms, is deeply rooted in their “*societal models of skills formation, labour markets and career systems*” (Lam, 1997, p. 975).

Based on these different approaches, for example, one partner of this collaborative project was used to rely on document-based sharing, while the other - on sharing through human-network basis. These and other differences among the British and Japanese experts had led not only to misunderstandings and conflicts, but also had jeopardized the whole project. This argument provides direct managerial tips for the MNCs conducting or starting international collaborations on how important is to understand the collaboration partner’s knowledge systems and their institutional context, and need to prepare for challenges it may create.

To summarize this theoretical discussion, it can be concluded that the MNCs increasingly rely on their networks and interactive learning for acquisition of new knowledge. An ability to build networks and learn from external environment requires much more diverse skills and different type of absorptive capacity than the technological competence within their respective R&D departments. Several authors put emphasis on the development of social and network building skills and the need to increase cultural awareness. Additionally, subsidiaries seem to

be benefitting from being embedded in their local networks and from developing relationships with the local counterparts.

From the discussion about knowledge creation and knowledge sharing, it becomes evident that relational aspects and enabling context are important for organizational learning. It is also interesting that, contrary to the common belief about a decisive role of IT instruments, several authors actually warn against overemphasizing the IT role and see it as an obstacle for knowledge creation. On the other hand, an important managerial implication for dealing with complexity of knowledge sharing and transfer, is the acknowledgment that different types of knowledge needed in a company may require different approaches and flexibility in the use of mechanisms for knowledge transfer and sharing.

3. Summary of theoretical foundation: complementary concepts

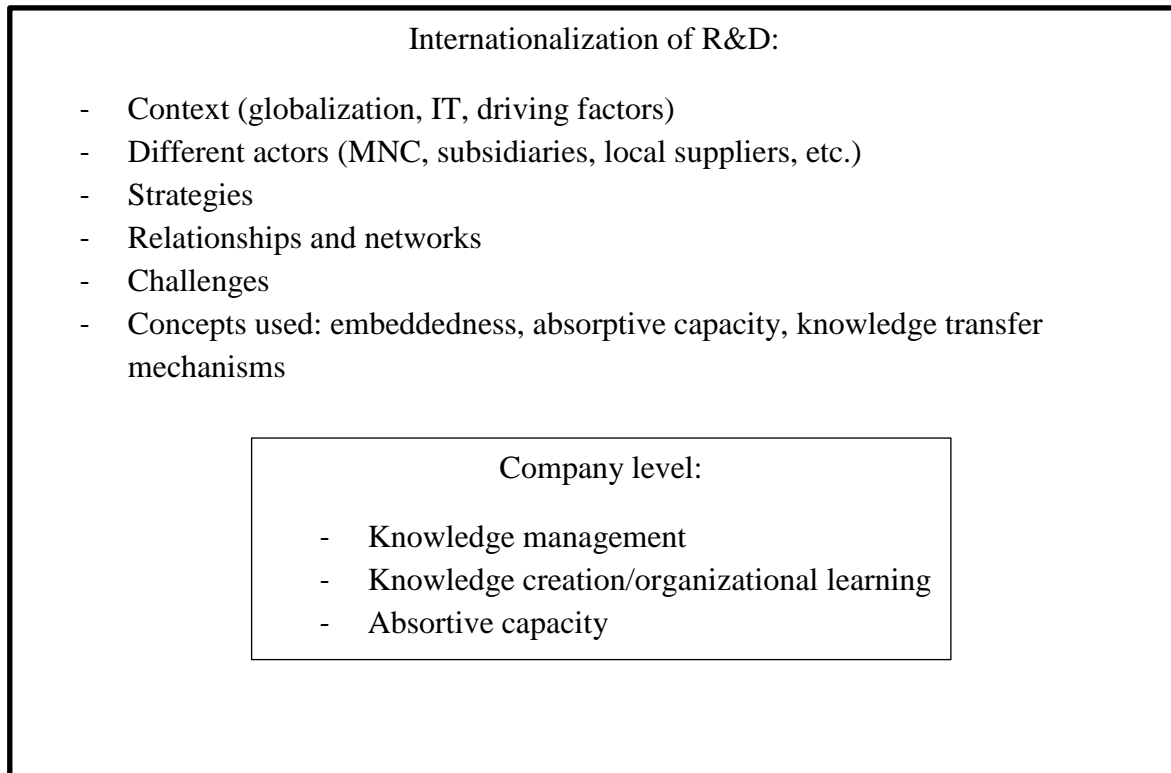
In the Chapters 1 and 2, two inter-linked theoretical frameworks were discussed. One of them regarding internationalization of R&D strategies and related challenges, showed the motivating and driving factors for internationalization of R&D activities, but also the complexity and many challenges related to the internationalization of R&D and innovation. For example, the various networks and relationships that the companies have to establish and maintain, complex managerial issues that need to be addressed, and the skills and abilities, that the international companies have to develop in order to be able to benefit from different foreign locations.

This inevitably links the aforementioned framework to the second type of framework that looks at knowledge management and knowledge creation issues at the company level. This framework, in turn, provides concepts and tools for analysing how companies actually deal with those challenges and how they design and implement the necessary R&D strategies and mechanisms for knowledge transfer and knowledge creation. Furthermore, several studies on R&D internationalization apply the concepts of absorptive capacity, knowledge transfer mechanisms, or tacit and codified knowledge in their frameworks and analysis, as it was demonstrated previously in Chapters 1 and 2.

Thus, it can be concluded that internationalization of R&D concepts provides a broader context, looks at the questions that are outside the MNC and national borders, and often has different focus in their inquiries, e.g. looking at networks and embeddedness in the local environments. However, international R&D inquiries also tend to include a company or

subsidiary level analysis, knowledge management or creation aspects. Therefore, it must be emphasized that both these types of frameworks were useful for answering the research questions and that they logically complement each other (see Figure 1).

Figure 1: Complementary Concepts



The challenge lies, however, in operationalization of these concepts and using them directly in the interviews and analysis. For instance, the concept of absorptive capacity, which is highly relevant in the analysis of the companies' skills to identify sources of innovation outside their organizational borders, is not easily applied in conducting interviews. The same is true of the concepts of knowledge creation and knowledge enablers for organizational learning, which include many subjective and hard-to-identify questions, e.g. feeling of trust among the people within a company. Thus, these concepts will be adapted and presented in the different types of questions.

To conclude, the discussion of the two aforementioned theoretical frameworks provides a set of questions and factors to be analysed further and to be included in the Interview guide. These are: 1) Innovation and R&D strategies; 2) Motivation for internationalization of R&D; 3) Challenges in the R&D internationalization (cultural diversity, geographical distances,

knowledge transfer); 4) Factors contributing to acquiring knowledge from outside networks and foreign locations; 5) Networks and relationships for identifying of new knowledge and sources of innovation; 6) Different mechanism for knowledge transfer and sharing; 7) Role of subsidiaries in knowledge creation; 8) Human factor and relational factors in knowledge creation; 9) Diversity of backgrounds and knowledge in the companies.

4. Methodology

4.1 Method and data collection

This Master's thesis is an explorative multi-case study about internationalization of R&D in the Norwegian companies. The overall research strategy was to carry out a qualitative research to look for commonalities and differences in a number of cases and to analyse some tendencies within the scope of the research question.

The case study method was suitable for implementing the current analysis due to the type of research question, due to the absence of control over the processes being studied, and through having the focus on contemporary events. These are the main criteria for choosing the case study as a research method according to Yin (2009). The case study is also the way to organize the data and to keep a holistic approach by studying the phenomena in a bounded system, and by using multiple data collection methods (Punch, 2005, pp. 144-145). Each Norwegian company and their networks are relatively bounded systems, and it allows to study the knowledge creation processes in the real context and time.

A combination of data collection methods were used in order to achieve greater accuracy and to present a full context of the cases: in-depth interviews, analysis of the companies' websites, booklets and other publications, as well as review of articles about these companies in the media. However, the main data gathering method for the thesis was a qualitative semi-structured in-depth interview conducted with the companies' representatives. An interview guide was developed based on the literature review and an initial analysis of the relevant information on the companies' websites (see Annex 1, Interview guide). The conducted interviews provided both some factual data about historical developments within the companies and R&D structures, but also, more importantly, the answers to "why and how questions" with regard to their R&D internationalization strategies. Information analysis of the companies' websites and additional publications was used to build background information about the companies' international operations, R&D and innovation strategies.

The interview guide was slightly adjusted from one interview to another due to several following reasons. Initial adjustments were made after the first interviews by reconsidering an overall research design and research questions. Additional adjustments were made for shortening the list of questions and for grouping the most important ones, after realizing that the initial set of questions was too broad and too long. And finally, the adjustments were

made by tailoring the questions to the expertise area of the interviewees and to the specifics of each company. Thus, for example, the set of questions addressed to a person with international project management experience was slightly different from the questions discussed with the head of a R&D or Innovation Department. Overall, the interviews took place in a form of a conversation rather than systematically following the pre-planned list of questions.

The interviews were conducted in English and most of them took place at the companies' locations. In a couple of cases the interviews were conducted over the telephone and one interview over *Skype*. The average length of an interview was one hour. All interviews were taped, but in one case the interview was conducted without a recorder, based on the interviewee's preference.

4.2 Sampling

In this Master's thesis, five Norwegian companies were chosen for case studies because they could provide interesting and diverse data for studying the tendencies in internationalization of R&D and knowledge creation, and not because of an interest in the particular companies or their uniqueness. There were no specific industries and types of companies that would be selection factors. Information that determined the selection of companies was related to their identity, international business activities and an assumption that the companies might have developed international networks or internationalized their R&D.

This approach was following a common belief that large companies with experienced R&D personnel and bigger R&D budgets more likely would get engaged in the internationalization of R&D. That was one the main considerations. Another criterion for selection was the origin of the companies. The selected companies were established and/or based in Norway or owned by Norwegians. Regardless of their international expansion and even, in some cases, a change in their ownership, all of the selected companies have been built as Norwegian companies with headquarters in Norway and, in most cases, relying on the Norwegian national System of Innovation (NSI).

However, the level of embeddedness of these companies in NSI and their relationships in Norway vary. This fact and the diversity of the industries that these companies represent, were additional factors for selecting these companies, because the aim was to analyse Norwegian companies of certain diversity (see Table 1 below). It is also important to mention

that each of these companies is a leader in its respective industry in Norway and to some extent internationally as well, considering their scale of business and markets, competence and reputation. This might allow to reveal some tendencies more effectively, as well as to make some generalizations with regard to internationalization of R&D of the Norwegian companies.

Table 1 Information about five cases

Company	Industry type	Size	Embeddedness in NSI ⁸	International markets, production sites etc.
<i>Alfa</i>	Chemicals	Large	Less strong and has international R&D, but has historical attachment	Globally, new markets in Russia, Brazil, China, India
<i>Beta</i>	Energy supply	Large	Strong in terms of current relationships and R&D	Europe, developing countries in South America, Asia; some countries in Africa and Central America
<i>Delta</i>	Telecommunications	Large	Less strong, but has historical ties	Scandinavia, Eastern Europe, Asian countries, including India and Pakistan
<i>Omega</i>	Materials, metals	Large	Less strong	Globally, particular interest in Brazil, China
<i>Lima</i>	Oil, gas	Large	Strong in terms of historical development and ties, recently started expanding international R&D.	Globally, particular interest in Canada, Gulf of Mexico and Brazil

Selection of the interviewees followed the same logic of strategic sampling: it was determined who could be the most competent people to discuss internationalization strategies of R&D and knowledge sharing in these companies. Thus, an initial approach was to have interviews with the directors of R&D and Innovation departments and other representatives of their respective departments, and additionally with internationally experienced project managers. The main idea was to collect more contextually rich data, to have more than one interview per company

⁸ The assessment of the embeddedness in NSI is done based on the findings of Narula (2002), Wicken (2009), Gulbrandsen (2008) and information about particular companies.

for greater variety of data and including different perspectives. That approach, however, materialized only partly. The total number of interviews is eight: *Alfa* - two interviews, *Beta* - one interview, *Delta* - one interview, *Omega* - one interview, and *Lima* - three interviews.

One group of the interviewees are directors of the R&D centres, Innovation departments and vice presidents for innovation. They presented more strategic views and broader outlook about the R&D processes and innovation in their respective companies. Another group of the interviewees was the experienced R&D personnel, where some of the representatives were working in specific R&D programs or R&D centres of their companies' business segments, and thereby they provided the data more related to their R&D programs. Additionally, two experienced project managers were interviewed. The data from the last group was not directly used in the analysis of the cases, but they helped to build an understanding of their respective companies and provided a broader context of the cases.

4.3 Data analysis

After conducting the interviews and completing of interview transcripts, the transcripts were reviewed and analysed against the number of categories in order to see whether the data was sufficient to analyse the questions of interest. After this first satisfactory assessment of the available data, the analysis of the transcripts was done more thoroughly and the statements of interviewees were checked against the same categories again: R&D and innovation strategies, internationalization of R&D, knowledge sharing mechanisms, existing relationships and networks, learning from foreign locations, backgrounds and expertise of people, and challenges within the companies. After completion of this stage of analysis it became evident that there were reoccurring topics and factors discussed by all companies. That is how the Table 2 and Table 3 in Chapter 6 were put together, and the data analysed accordingly. Information from other publications and the companies' websites was used in parallel to the search for the necessary data and cross-checking the information. After the analysis and conclusions about the five cases were completed, one more review of the empirical data was conducted in order to identify if any substantial evidence was overlooked and whether the conclusions about the five cases were substantiated.

4.4 Validity and reliability

Agreeing with the view that a case study as a strategy "rests on both the researcher's and the participants' world views" (Marshall & Rossman, 2011), the researcher's reflexivity over

potential biases and thinking of the possible ethical dilemmas, becomes part of a research process and data analysis.

In conducting my research, I tried to be aware of my personal world views and biases. For example, I might be used to slightly different communication and management styles, organizational culture and leadership principles. Altogether, that might have made impact on how I see and analyse the processes in the Norwegian companies. Clearly, being an “outsider” in several ways in relation to these companies, worked as my strength and sometimes as weakness, too. Naturally, the people whom I was interviewing also were influenced by their backgrounds, positions and agendas. Some of the interviewees occupy very high positions in their organizations, and that might have influenced how they represented and portrayed the processes in their organizations. Some interviewees seemed to be more cautious about the information they were sharing and more careful than others when describing problems in their organizations.

In order to ensure credibility of my research, I tried to be as transparent and clear as possible in explanation of how the data was acquired and analysed, and how the conclusions were reached. That is why it was decided, first of all, to present a description of each case in Chapter 5 and to demonstrate the diversity of these companies. Therefore the quotations from the interviews are used quite extensively, before starting the comparative discussion part and conducting the analysis in Chapter 6. My approach was to enable the reader to create his or her own mental picture about these companies and to see trends in their innovation approaches.

Referring to external validity of the findings of the current research, and particularly the extent to which these findings can be generalized, I would like to argue that it is possible to make some analytical generalization from these case studies, as it was discussed by Yin (2009, p.43). First of all, the analysis is not limited to one case. Five cases are considered, initially presented separately and, afterwards analysed and compared alongside according to certain categories and questions. The companies in these cases are quite diverse, but at the same time similar in their motivation for innovation and R&D, international outlook and interest in international markets, their challenges and main concerns, as it will be demonstrated in the Chapters 5 and 6.

Secondly, these companies serve as interesting examples because most of them have quite a distinctive position in Norway and within their respective industries. However, most

importantly, the aim of the current Master's thesis was not to argue that the processes discussed here were very typical and that these cases were representative in a general sampling sense. The analysis of these cases allows to draw cautious conclusions regarding the tendencies in internationalization of R&D and innovation in the Norwegian companies, and to relate them to the frameworks and theories that are discussed in the literature.

4.5 Ethical considerations and challenges

There were some challenges in gaining access to the companies and people whom I was planning to interview. It took a lot of time, patience and persistence to get in touch with the companies' representatives that could help set up the interviews. It was not because people were not willing to help or to have interviews or were extremely busy, but rather because the emails that were sent to numerous big companies were sometimes lost in the labyrinths of different structures and contact points. In many cases, the contact details of R&D and innovation personnel were not listed or they were not easily reached. However, once the relevant people were contacted, they were forthcoming, helpful and quite open in discussing the questions related to research topic, regardless their status or position. In some cases, though, after having good interviews with the R&D and Innovation directors, they were somewhat reluctant to the idea of having further interviews in their respective organizations.

Control over the interviews and the ability to ask the necessary questions was an additional challenge, as often suggested by scholars in discussing interviewing of elites (Marshall & Rossman, 2011). It turned out to be a bigger issue than anticipated partly due to a very limited experience in interviewing, and partly due to the specifics of the companies' businesses and the research and technology related terminology, which was used during the interviews. Nevertheless, a lot of useful information was obtained also from the "lecturing type" of interviews.

In most cases, it seems that the necessary trust was established, and a positive and professional atmosphere facilitated the interview process and conversations. As it was said earlier, in most cases, the interviews took place in the companies' meeting rooms. There were more problematic situations, however, with regard to mutual trust and an overall quality of interviews where the interviews were conducted over the telephone and *Skype*. In some cases, bad quality of sound and the lack of personal contact added to obscurity and confusion during these interviews. However, from these interviews, too, very interesting data were obtained,

but extreme concentration during the interviews was required as well as much more patience and time for writing the transcripts.

This thesis follows the anonymity principle regarding the companies' and participants' identification. Thus, the names of the companies are altered to *Alfa*, *Beta*, *Delta*, *Omega* and *Lima*. It was a particular aim to present these companies as generally and abstractly as possible, but certain details or descriptions of the companies could not be omitted because they were regarded as important for the understanding and analysis of the cases.

5. Description and discussion of five cases

Company *Alfa*

General description and innovation in company *Alfa*

Company *Alfa* is a large, Norwegian-based chemical company, which for many decades has been involved in international businesses and operations in the Middle East, North and Central-America, Eastern and Western Europe, South East Asia and several countries on the African continent. It has presence in the hundreds of places outside Norway nowadays, including joint ventures, production sites and international sales offices. Additionally, it has two research centres outside Norway - in Germany and the Netherlands, which it has inherited during historical development of the company. One of its research centres is located in Norway.

As in any large innovative company, research and development (R&D) in *Alfa* is both supporting on-going operations and trying to find more cost-effective solutions within existing markets and products, and exploring new business opportunities and looking into creating new markets and new products. The lateral type of R&D activities is aimed at the need to change and innovation. However, there is no structural separation between the researchers working specifically in support of the existing markets/products and those who are dealing only with innovation and exploring the new possibilities. Instead, researchers with mixed backgrounds and experiences are contributing to the both types of R&D. Everyone in the company, according to an interviewee, can come up with a new idea or to comment on any new idea.

Tasks, organization and manning of the three research centres correspond to the main business segments in the company: upstream, downstream and industrials. From the total of approximately 85 researchers working in R&D, about 60 people are dealing with product quality, processes and market application within upstream segment. It is quite obvious that *Alfa* puts more effort into market-orientated research, and also is doing a lot of work with the customers in foreign locations and markets. Referring to the technology development side and production, the opinions were expressed that technology used by company *Alfa* is very mature, “100 years old”, and that there has not been any significant or major improvements since.

Discussing innovation strategy and its management in *Alfa*, it was emphasized that it is a very structured, centralized and step-wise process which starts with creating and discussing a new idea. The process entails various types of analysis, including market possibilities, and passing through several stages of decision making and reviewing by the Innovation Team and by the Innovation Board. The Innovation team meets regularly and it consists of the directors of the above mentioned research centres and some other experts. The Innovation Board is at the top management level and consists of the representatives from all business segments. Therefore all new ideas concerning the creation of new brands or entering into new markets are addressed by both decision making structures before the new idea goes into implementation phase. The centralized innovation process in company *Alfa* works in this manner, because the company does not have a shared innovation centre at the corporation level.

Overall, it seems that *Alfa* has been investing a special effort into innovation for the last couple of years with the arrival of new leadership in the company. Part of this process was employment of a new Chief Technology Officer whose task is to look at the innovation processes outside the gates of the business segments and try to promote innovation in the company. No plans were mentioned about concentrating R&D and innovation in one place, but rather that the existing research centres *“together with external contacts, external companies and external universities will be a hub for driving innovation”*.

It was also mentioned several times that the company has to look into how to improve the exchange of know-how's, competence and experience among the different locations, and thereby to improve its market understanding and benefit from the variety of knowledge. Information sharing and spreading of competence is one of the biggest problems they have in the company. One approach how the competence sharing is facilitated within the company *Alfa*, is by placing people with different backgrounds and transferring knowledge with people to various locations:

You try to take good, experienced people with good background and put them into different environments, both to broaden their experience, but not least, might utilize their experience and their contacts to improve different sites. That is sort of structured way to do it from the top.

Additionally, competence sharing between the different locations and sites is facilitated by the Technology Process Owners who oversee, follow up and report on the particular technology or processes across the different locations and production sites.

Historical dependency vs. need for diversity

In a case of company *Alfa*, it is interesting to note that the word *history* was repeatedly mentioned in explaining the R&D organization and the R&D activities in this company: “*To understand Alfa, you have to understand the history of Alfa*”. For instance, there is a historical explanation for inheriting and retaining two research centres outside Norway and one in Norway. The invested money and competences developed in the two research centres outside Norway are among the factors that would make a consideration of moving all the researchers to one place very difficult. In case of centralization of R&D, the company might be losing the key competences if the researchers would refuse to move to a new place. Company *Alfa* also has maintained historically developed links with universities in Germany, France, the Netherlands and Norway throughout the years. In Norway, it has retained a long lasting cooperation with *Sintef* and NTNU:

So, we had a huge contact base with NTNU and Sintef. We still have contacts with them, we still work with them, but at the same time, you also tend to look at, when you go for innovation and... what type of products are we developing, what kind of markets we are developing, and then try to figure out what university, research corporation, what type of external contacts would have a better understanding of that market.

At the same time, as it can be observed from the quotations, there is a strong acknowledgement about the need to engage much more actively in establishment of external contacts and benefitting from the variety of external networks: “*We try to be open and to be more effective in broadening the contacts with foreign universities*”. One way how it is achieved is by hiring people with different backgrounds and nationalities. There are British, Polish, Dutch, Swedish, Vietnamese scientists working together with the Norwegians at the research centre in Norway. By doing that, *Alfa* is not only benefiting from the diversity of the R&D personnel’s knowledge, but also exploits the contacts and networks that these researchers bring along. One of the latest examples is that by hiring a Korean scientist, who has worked for several years in the United Kingdom, *Alfa* now established contacts with both, the Imperial College in the UK and the University in Seoul, South Korea.

Company *Alfa* seems to be a motivated to look for the variety of external contacts and the best competence instead of just relying on established contacts and relationships, especially in Norway. They need the best partners and competences that would help to find innovative solutions and to understand new emerging markets:

... To me much better is to ask my researchers: who out there beside the usual suspects have competence who we can work with? Because, that would give us, in my opinion, broader networks and, probably, will also give us a lot of new ideas on already existing projects.

This approach, however, is challenging the traditional ties with *Sintef* and NTNU and a general assumption that these institutes would always provide the best competence that is needed. This dilemma is even more apparent in the context of global competition and entering into international markets, especially in culturally very diverse places:

...Because the world is a lot bigger than Norway and Europe. If you want to succeed in the emerging markets, new markets, you need to understand that market and those market needs. And, the only way to do that is to hook- up with people who know that.

Understanding of emerging markets vs. Norwegian dogmas

Company *Alfa* has been involved in international operations and businesses around the world for many decades and, according to one interviewee, it has developed a good understanding of the markets in the South-East Asia, Northern Africa, North America and Europe. But now, as many other companies, it is looking for new business opportunities in big emerging markets such as Brazil, India, China and Russia. Thus, company *Alfa* needs to develop markets' and cultural understanding in these countries. This is quite a challenging, but necessary task. Clearly, *Alfa* realizes that it can be done alone or just by using experts from Norway or Europe. One way how to do it is to hire local people and to develop local networks in order to build upon their knowledge: *"When it comes to understanding a market in Brazil, you definitely need the Brazilian people to tell you about it. We definitely need the locals with competences and understanding of the cultural."*

The doubts were expressed, however, as to what extent one can ever achieve an understanding of these markets. It has to do also with the mentality, perceptions and culture that Norwegians, just like any other nationalities, bring along to foreign places and through what type of glasses they are looking at the other countries and their cultures. On the one hand, the opinions have been expressed that the Norwegian mentality and the Norwegian way of doing international business - without having double agenda and with open attitude towards different cultures and nationalities, is helping in international endeavours and facilitates establishing trust with the locals. However, there were also reflections about Norwegians being too naive believing that things will work out according to their expectations:

Because, there is a tendency, I don't know whether because Norwegians are being extremely naïve, or just because of the fact that we are rich, we tend to think that everything that works here must be applicable to the rest of the world. And there is a huge difference in the way how Russian market operates, how Brazilian market operates and how they do it in Europe, especially in Norway.

Some problems and challenges that company *Alfa* has encountered in the foreign locations were related to their partnerships and limited presence and limited control over the business processes there. One of the reasons for entering into those local partnerships or joint ventures was to minimize political risks related to going into foreign markets, into unknown environments. These risks were to be minimized by relying on the partner's knowledge and developed networks. However, it seems that the company has learned that it has to be more present in the foreign locations instead of just owning part of the shares in a common project or joint venture and relying completely on its partners. Thus, these processes were referred to as a new learning situation or a new learning curve in *Alfa*, where it has to reconsider how to manage its external relationships and partnerships in international locations.

Company *Beta*

General description and innovation in company *Beta*

Company *Beta* is a large energy production company which has, in addition to its place in Norway, strong positions in Sweden, Germany and the United Kingdom. It has grown internationally quite considerably during the last couple of years by entering into joint ventures and building energy supplying facilities in Brazil, Turkey, India, South Asian countries, Chile and other Latin American countries. It has a separate company that is working particularly in the developing countries and developing markets, and whose ambition is to be a leader in those countries within the particular competence area of the company.

The company's R&D activities are divided into three major programs corresponding to the main strategic development areas. However, according to the interviewee, there is only one international R&D program among them: that is a program run together with the UK relying on the British expertise. Most of the R&D activities seem to be tailored to the business activities within Norway and *Beta* relies significantly on the relationships established with the Norwegian scientific community. It was mentioned, however, that they are working on including more R&D activities in their work in the developing countries and in their international operations generally. Until now, it seems that cooperation with the local

scientists in some developing countries has been on case by case basis. Company *Beta* would like to change this practice and to have a more systematic approach, for example, by establishing separate R&D budgets and R&D coordinators in the foreign locations: “*We are working on getting our international operations to be better about R&D. It is not so well-established in that part of organization as it is here in Norway*”.

Like in many other companies, there seems to be a tension between the short term goals in the R&D programs and the projects addressing the long-term needs and emerging technological possibilities. One of the reoccurring challenges seems to be related with the difficulties to spread and appreciate information from the projects addressing the long term needs: “*...the closer it is to the future, it is easier, if it is something you need tomorrow. But, when it is something you need in 5-10 years, it is harder to make sure that you spend time to understand.*”

One of the features that probably differentiate the company *Beta* from many other R&D intensive companies is the absence of the in-house researchers. Instead, company *Beta* relies on external expertise, mainly from *Sintef* and NTNU. Research projects are supervised by the project managers from the R&D department, and these project managers have technical competences and backgrounds. However, quite contrary to what might be a common assumption about the difficulties related to knowledge transfer in this kind of partnership, the weakest link is not between the company *Beta* (or its R&D department) and the research institutes on another side. The problem seems to be within the company *Beta* itself - how the information is spread inside the organization or, more precisely, how the personnel responsible for the R&D projects are delivering results of the research projects to those who need them within the company *Beta*. Within the current system, it is the responsibility of project managers to transfer knowledge within the organization. As the company’s representative said: “*We try to be very concerned, very specific that project managers do have the responsibility to transfer knowledge*”. The Innovation department in this regard has assumed some kind of control and facilitation function in taking initiative to improve processes related to knowledge transfer.

Routines and mechanisms vs. human factor

Challenges related to the implementation of R&D projects and transferring information within the company *Beta* seems to be a serious concern and it has been addressed by the Innovation department. One way, how this issue is dealt with, is by introducing routines and procedures.

For instance, they have designated project managers for each project and introduced project implementation cards that help to control the implementation of the planned activities, including the information how the project results are spread: publications, seminars or meetings. The Innovation department helps in organizing those meetings and seminars where all R&D project managers and also external scientists are invited to share information.

In addition, each R&D program has a steering committee, and one particular committee addresses issues related to activities in developing countries and also includes personnel working in those countries. Organizing meetings and getting people to talk and share their information was mentioned as very important: “...*I am not sure I actually believe so much in searching for information. It is much more important that people go and talk to each other, talk to those who been involved. And this is something we are working on.*” Nevertheless, it seems that the problems exist in relation to the project managers’ effort in sharing information and building the competence inside the organization:

The problem is us, our project managers not prioritizing time to follow up the projects tightly enough. Tightly, not in a form of watching them or controlling them, but to get the information and understand what researchers actually are finding out.

So, it seemed that part of the problem was that the project managers didn’t understand the importance of sharing the research results that they received from the research institutes. The impression was given that project managers were not always fulfilling responsibilities to read research reports and understand the application of the results and therefore were not able to contribute to in-house competence building.

Relying on outsourcing of the R&D and risking with not developing in-house competence was mentioned in the following words, when talking about inviting external scientists to meetings for sharing research results:

But, actually, I rather prefer to have project managers to be responsible, because, you know, it is too easy for them just to outsource the all thing. It is better that our own employees are actually more into the results from the research that is done. And then, again, for project manager to make sure that the rest of the organization that needs to know about this actually gets it.

There seems to be high expectations that project managers should be more competent about the knowledge gained from R&D activities, take some kind of ownership of the R&D results and to be more proactive in knowledge sharing within organization.

Existing Norwegian relationships vs. getting more international

Company *Beta*, as it was mentioned earlier, relies on the Norwegian scientific community and existing relationships in Norway, particularly *Sintef* and NTNU. Established relationships, contacts and knowing people personally are important factors:” *We tend to rely on the Norwegian universities. Especially in Trondheim, that we know the people and the people know us...*” Another factor explaining why, probably also in the future, company *Beta* will maintain a lot of research cooperation and relationships in Norway was expressed as follows: “*It is kind of expected of us as a Norwegian energy company owned by the state.*” Thus, the type of ownership, importance of the links with the Norwegian scientific community and, maybe even much broader view - what role this company plays in the national energy and economy policies, are influencing how and where company *Beta* is looking for its cooperation partners for R&D and innovation activities.

Additional factor that might be playing role in choosing to do R&D activities mainly in Norway and with the Norwegian partners is funding. For example, the funding it receives through the Norwegian Research Council. Obtaining money from the EU for carrying out R&D projects does not seem to be a very common approach due to the amount of the bureaucracy and time it requires in relation to uncertainties about getting money. While in Norway, it is much easier for company *Beta* get the Norwegian funding for its R&D activities.

However, at the same time it was not expressed in any way that being a state owned company would be an obstacle to be more international. The company has earlier had a cooperation with the universities in Sweden, Denmark and now it has established a big R&D program with the United Kingdom. Additionally, the Innovation department is currently working on mapping of the relevant universities outside Norway in order to expand international linkages and to have more international research. So, the need to be more international was expressed in several ways - to have more cooperation with the external universities and research institutes, to make international operations to do more R&D, trying to improve feedback from the foreign locations, subsidiaries and trying to increase the use of local competences, scientists in the projects within developing markets.

Another type of company’s international R&D activities is a technological collaboration. One particular example is an international collaboration carried out by *Beta* in cooperation with an Asian country for development and testing of one specific technological asset. This

technological collaboration, however, has created many challenges related to differences in language, culture and, particularly, with regard to information sharing:

...working with [name of the nationality omitted] is a challenge. Here comes language, culture, obviously also distance and time difference. Especially language and they got completely different style when it comes to...They don't want to share as much as we. They are not used to share knowledge the same way.

Company *Beta* had tried to prepare itself upfront and had consultations before they started this international technological cooperation, but they were quite surprised by this challenge: *"But, I still think that we were little bit surprised how big that issue is..."*.

Since this collaboration started, company *Beta* is trying to learn from the difficulties with information sharing. The company is taking these conclusions into consideration for improved planning and preparation for meetings together. Frequent mutual visits and spending time at each other's sites is also helpful in proceeding with the project. It was mentioned that there are always two sides at the table in such technological collaborations and both sides are responsible to fulfil the obligations. Nevertheless, a sort of disappointment or judgement was expressed about the Asian colleagues not doing things the way Norwegian counterpart expected them to with regard to information sharing and conducting the meetings together. There were no reflections or thoughts about the need to improve company's *Beta* understanding about cultural differences and the way information sharing takes place in different countries.

Company *Delta*

General description of company and its innovation strategy

Company *Delta* has a very strong position in telecommunications business in the Nordic countries and has also established strong footprint in Central and Eastern Europe and Asia. The company's innovation and research supports its strategic challenges and addresses the needs of strengthening and expansion of existing core business, development of new business models and looking into creation of future businesses and services. Many of the current business and innovation challenges are related to new, huge and diverse markets, for example, in India. India presents challenges related to the size and diversity of the country, and in terms of culture and understanding of the local market needs: *"We can't do always the same thing in India as in Norway. So, we need to know the market, our customer, the culture, how they*

are thinking.” Company *Delta* provides very different types of products and services in the countries, based on the market needs and the overall development level in the technologies and societies at large. Subsequently, the services it provides in the Nordic countries are not necessarily the same as those which they offer in the Asian market.

Open innovation⁹ system and customer centric approach seems to be the overarching innovation philosophy and strategy. It is also pretty evident that innovation is understood much wider than conducting formal research or searching for technological solutions. For example, *Delta* is looking for innovative solutions in the business models and pricing. To rephrase it in the company’s words: *“But innovation is not only in the form of new services. We can innovate through new and improved production processes, business models and customer experiences.”* Thus, innovation is understood very broadly by looking at the new market opportunities and customers’ experiences. Furthermore, it is also acknowledged that innovation takes place everywhere and people from different branches of the company contribute to it: *“So, innovation could happen anywhere. Really, it is not only deep inside in the research project. So, to organize it, we do it in different ways and ...clearly, dissemination is important.”* In this context, it was emphasized how important it is to share with the ideas inside the organization and disseminate the information.

The same principles apply also in the international context:

...research and innovation part, it takes place not only here in headquarters in Oslo. Yes, we are in charge of it, but we have good innovative people all over our company. So, it is important to get these included in our total activity....

It was mentioned that innovation comes from different international places where company *Delta* has foreign subsidiaries, owns shares in the foreign telecommunication companies and has other types of international offices. Coordination of this information exchange and sharing is important. According to the interviewee, company *Delta* has established a governance structure and procedures that enable this information and experience exchange between the different foreign locations.

⁹ In the literature dedicated to innovation, the term *open innovation* is connected with the name of H. Chesbrough, who has published several books on open innovation, recently focusing on open innovation in services. The main idea of the open innovation principle is that “not all the smart people work for you” and that company should be open to the external sources of innovation (Tidd& Bessant, p.295, 2009).

Open innovation: partners in Norway and internationally

Open innovation, as it was mentioned earlier, is stated as one of the core principles how to organize innovation activities and it is defined as an overarching innovation strategy in company *Delta*. The company emphasizes that it has changed its approach to innovation. Now, it is carried out in close cooperation with partners and customers. It is expressed, as follows:

...That's why we say that open innovation is important, it is not only a buzzword. We really mean it. What does open innovation mean exactly? For us, it is definitely important to have partners. Then, I mean partners of all categories, more or less, all those categories which are needed.

A quite recent example of open innovation by involving multiple partners is the establishment of a big program at one of the Norwegian business schools. This program focuses on improving service innovation together with the partners from the Norwegian institutes and universities, and industries. Different industries, especially the various types of technology suppliers, providers of IT solutions and pricing models are mentioned as important partners of *Delta*. Cooperation with the suppliers also includes common research projects relevant to particular topics.

The company *Delta* cooperates with all the main universities in Norway, including NTNU in Trondheim, University of Oslo, the Norwegian Business School in Oslo, the Norwegian School of Economics in Bergen, the Oslo School for Architecture and Design. Outside Norway, cooperation partners include the London School of Economics, the Massachusetts Institute for Technology, USA, and several universities in the Nordic countries. In addition, *Delta* has also established cooperation with the foreign universities and research projects in the countries where it has a footprint (as expressed by the interviewee), for example, in Malaysia.

The words “*the best*” or “*good partners*” was often used in describing how company *Delta* is searching for its partners. It may seem to be a very broad and open approach, yet it is very focused and selective: “*but we are quite open in real sense of the word, but clearly focus on to choose the good partners - those giving us something, sharing knowledge. And, it also has to be mutually beneficial for us*”. Besides gaining access to technological and business of knowledge, another reason for having external partnerships is receiving help in understanding the local culture and local market in the countries of interest:

But clearly what we need to know is the needs of our customers. We can't sit up here and understand them down there and wherever. So, we need to know them: culturally, what are their needs. It could be quite different from ordinary Norwegian.

That is why they have launched several projects with the scientists and universities in the Asian market, for example, in Malaysia. However, it was mentioned that suppliers from different industries are the main partners in the new emerging markets. In addition to its old partners among the suppliers from the Western Europe, company *Delta* has launched cooperation, for example, with the Chinese suppliers which have competence within the Asian market.

It is also interesting to note that company *Delta* seems to be very aware that it needs to develop its own competence and knowledge about the foreign markets, foreign cultures instead of just relying on the partners' and suppliers' competences. It has to be in control of the processes. It was expressed as follows:

But, those partners..., also for us it is important to collaborate in a manner that we are in control what we order from them. You can't say always: ok, you know this country, give us what we need. No, we have to build up our own knowledge about the needs in that country, we have to influence our supplier and to deliver what's needed to fulfil the needs of our local customer.

Influencing vs. listening to the customers

As it was discussed previously, company *Delta* is interested in expanding its business and offer their products and services to customers in the new big emerging markets in the Asian countries. But, in order to do that, it has to understand the customers' needs. The importance of *listening* to their customers and understanding their needs are among the main ideas throughout the company's statements about innovation and business in the new markets. However, it is more complex than that. It seemed that this is linked, first of all, to a broader understanding that in order to operate in these countries and to engage people there, one really has to develop the knowledge of the local culture, to be informed about the overall development level in the country and its technological advancement, as well as the people's needs and concerns.

It is also linked to the way how company *Delta* communicates the company's corporate strategy and values to its local offices, to local people that company *Delta* is hiring and trying to engage in open innovation system. According to the interviewee, it is done through the dialogue and again - by listening:

Well, it is a huge challenge. But, it is not only one way that we are coming from headquarters tell them what to do. We have to listen. We have to have their interpretation of values. It is important how they really understand the values and....And it, is not that we are pushing Norwegian culture here at all. We try to understand more their culture, their way of life, needs.

Furthermore, listening to the customers in the emerging markets is closely linked to the *Delta's* innovation strategy: to create new business opportunities by listening to the customers' experience and by understanding market opportunities and needs: *"Our future depends on taking new positions in the market and using these opportunities to offer better products and services to our customer."* There seems to be a rather positive self-assessment of the current level of understanding the foreign cultures. However, at the same time, it is acknowledging the need to keep improving, gaining more knowledge and understanding. Company *Delta* also conducts thorough studies and analysis of the new markets and countries before they launch business activities there.

Getting feedback on their products and services and sharing different experiences from the foreign locations is a part of the approach which emphasizes listening to the customers' experiences and learning from various markets. It seems that this is regarded as valuable information, because *Delta* has established structured processes and an organizational model that enables a regular information sharing. Technically it is done by using videoconferences, organizing meetings and seminars. The information sharing takes place on different levels, for example, there are regular meetings of the experts or branches representing similar functions from all locations, i.e., marketing, operations' or technology experts. At the same time, it seems that these processes are not necessarily centralized, but rather function like networks. Subsequently, the information is shared directly among the parties of interest, not necessarily through the main departments in the headquarters in Oslo.

Company *Omega*

General description and innovation in company *Omega*

Omega is a large company producing environmentally friendly materials for different industries worldwide. Its business activities are organized in quite distinct segments, and consequently, technologies used in them are also very specifically tailored to production of different products and their application areas. Therefore, information about *Omega*, its international operations and R&D activities are often presented within those business

segments. The data in this chapter will be referring to *Omega* generally and to its one business segment *Omega-S*, particularly. *Omega-S* is producing and delivering metallurgical products worldwide for the chemical, electronic and aluminium industries. *Omega-S* has network of sales offices in the European market, Americas and Asia. Its technological research centre, test facilities and productions sites are located in Norway. However, based on the specific needs and applications areas, it is using testing facilities also outside Norway.

The *Omega-S* research centre employs about 25 people and its main two tasks are the development of new products and providing of technical service within the particular technology application areas. Additionally, it has technological hubs in the Middle East and Far East, including China, which are responsible for quality assurance and quality control of the products. It was mentioned, however, that the hubs in China have recently started getting engaged in the research activities under the supervision of the technology centre in Norway.

Overall, the company *Omega* has four research centres within each division and one corporate research centre, which has a more long-term outlook. *Omega's* other divisions have established production plants also outside Norway. It seems that company *Omega* is undergoing some serious organizational changes due to the shift of focus in some business areas and, consequently, the need to reallocate resources and adjust the organizational structure. Some developments might be also related to some major changes in the company's ownership. These might be some of the reasons why there is lack of a common R&D strategy or innovation system, which is something *Omega* is working on and has recently established a corporate research centre.

Meanwhile, since 2009 *Omega-S* has introduced its own system of innovation. It is called the "stage gate system", and involves passing the several buffers or stages of analysis and decision making, starting from an idea until a viable solution. This process involves many experts, including marketing and research people, and every stage requires more money and human resources. This system is facilitated by the database and intranet, but it was emphasized that an overall organizational culture and personal engagement matters:

Of course, this process is a tool, but cultural issues is another aspect, I would say. I can't force people to come up with new ideas if the cultural situation is not appropriate, if you don't have dynamic in the organization....So, people in my department, we are encouraged to come up with new ideas, they are encouraged to use at least 10% of their time to come up with new ideas. So, we have an organization which is capturing these ideas, original ideas through our intranet system.

At the same time, it was mentioned that new ideas come from different places, also outside the organization: from research institutes, conference attendance or external partners. It was acknowledged that *Omega-S* could be even more active in involving external sources and seeking partnerships, especially with suppliers.

Additionally, a very substantial approach how *Omega-S* tries to retain the competitive edge is to follow constantly the developments in the industries that use their products. In order to accomplish that, their strategy is to hire people from these industries, because that provides the possibility to benefit from the customers' knowledge that these people bring along:

You need to speak the same language, the customer's language. And [...]you cannot earn this competence, knowledge just by reading, visiting time to time. You need to have people, knowledgeable people coming from the industries.

It was mentioned that despite the Intellectual property rights restrictions (IP), which sometimes hamper open dialogue with the customers, most of the new application areas in *Omega-S* have been developed because of the cooperation with the best customers.

In- house competence vs. worldwide partnerships and operations

Sintef in Oslo and Trondheim are the main cooperation partners for *Omega-S* in Norway. However, it was mentioned several times that within all application areas of their products, there was no extensive competence in Norway. Therefore *Omega-S* has established contacts and cooperation with the external institutes around the world in the countries where the best expertise within the areas of their required competence exist - for example, with the research institutes in the Netherlands, Germany, UK and France. Various projects and cooperation are established with China. One of the projects with the Chinese entails inviting a Chinese student every year to come to Norway to conduct a research on a relevant subject.

The interest of *Omega-S* in China is connected to the growing business opportunities there, and that is why they have established cooperation with the test and research institutes there:

In order to develop business in Asia we need to have good cooperation in Asia. So, therefore we are more and more active in order to promote our product in Asia. And to do that, you need to have some research activities, you need to have some cooperation with the local agents and distributors. You need to have cooperation with some customers.

Additionally, there are two labs, located in Beijing and Shanghai that ensure presence of the company *Omega-S* in the region and ensure the quality and services of their products. Another big market, where the company is expanding their business, is Brazil.

It was mentioned repeatedly during the interview that *Omega-S* has many cooperation partners and is looking for the opportunities around the world. As it was discussed earlier, it has established, technological hubs in the Middle East and Far East. Based on the business opportunities and the required competence, *Omega-S* establishes its partnerships abroad: *“..and depending on what kind of demand and requirement we might have we establish cooperation either with the customer society or with the institute....And, it is not specific China, it is everywhere.”* For example, they use the testing institutes in Brazil and Texas, U.S, because these institutes have high competence and the necessary equipment for the conducting tests within the specific technologies.

At the same time, it the opinion was clearly expressed that there will be increased international cooperation in research, rather than moving competences over to the foreign places:

...but the competence has been developed in Norway. So, it takes time. It is not like you can pass the competence over the night to some others. I think we can utilize more our competence that has been developed in Norway for so many years in order to cooperate better with those places, where we see the market is moving to.

It seems that so far the strategy is to keep building the in-house competence, however, broadening the international networks and establishing new external partnerships at the same time. It is also interesting to note that comparing the intensity of the cooperation with the Norwegian institutes and the foreign ones, it has been acknowledged that in some application areas most of the competence will be outside Norway in the future.

Good information sharing in *Omega-S* vs. problems with sharing in *Omega*

As it was discussed earlier, *Omega* does not have a common R&D or innovation strategy. The same seems to be a case with the information sharing and competence building in *Omega*. There are several reasons why information sharing within *Omega* is not functioning so well. Intellectual property rights' restrictions were mentioned as one of them. This has created challenges for the development of an open dialogue with their customers, suppliers and, most likely, also has affected the overall culture for information sharing in the company: *“It is a lot IP restriction here. So, I don't think it has been open way of communication and knowledge*

here. But the only way to have knowledge across the divisions here is to have a project in common.”

Another factor that hampers information sharing is that activities of *Omega's* divisions differ significantly and, consequently, they apply different types of technologies and knowledge. Referring to the knowledge exchange among the *Omega's* research centres, it was said that not much information sharing takes place: *“We are trying to establish something in common, but we haven't come so far.”* The only way to facilitate information sharing was through the common projects, which didn't seem to happen very often. And lastly, there were no established procedures or mechanisms for information sharing among the divisional research centres: *“...we don't have any sort of arena where we meet these people regularly to exchange knowledge...”* It seems, however, that this was acknowledged as an existing problem and some work has been started to improve the current situation. Improvement in information sharing probably is related to the structural and other changes that *Omega* is undergoing. It seemed that many organizational, structural and strategic issues had to be addressed before a new system could be created for information sharing or any significant improvements made in this regard.

In contrary to the problems described above, information sharing and competence building in *Omega-S* seemed to be functioning very well. It was achieved with a help of several processes and mechanisms: a shared database and IT tools, regular meetings and allocation of the same persons to different projects and different application areas. Meetings between the people were seen as very valuable. IT tools were particularly useful in ensuring the continuity and institutional memory in cases of personnel change to ensure that projects will be carried on.

Furthermore, information sharing involves information exchange with the colleagues and partners around the world:

We have daily contact with international people around the world. So, in each of the applications we are have monthly exchange of information. And we have telephone conferences. We exchange information about customers, about markets, about the progress in our projects. That is on operational basis.

Additionally, they had quarterly meetings where research, marketing and sales people were meeting at management level. Meetings involving different experts were taking place on regular basis or project basis. Thereby, overall, the assessment was made that information

sharing system works pretty well and that *Omega-S* is receiving the necessary feedback and information from the foreign locations and markets.

Company *Lima*

General description and innovation in company *Lima*

Lima is a large Norwegian company in oil sector which was established to operate in the Norwegian continental shelves, but it has grown considerably internationally, especially during last years. Its new corporate strategy sets big ambitions with regard to its global growth even further. These ambitions directly concern also its R&D programs and activities, which are in line with the overall business corporate strategy and overarching corporate technology strategy: “...we are working along globalization strategies, of course. We are in the middle of it. We started globalization... and we will really expand during the next years.”

It was mentioned that a half of research is done internally and approximately half of these programs are carried out with external partners. *Lima*'s current R&D activities are divided in the seven big R&D programs, where some of them are directly related to solving new technological challenges in the distant locations: in Canada, the Gulf of Mexico and Brazil. Besides the research centres and test facilities in Norway, it has established a technology centre in Canada and has technological hubs in Beijing in China, Huston, USA and Rio in Brazil. With regard to internationalization of R&D, it seems that they are growing very fast and have very concrete and ambitious goals:

This is really important for us, getting more international, to get access to the best people, and getting closer to the best suppliers, because we in R&D, we would like to be..., we have an ambition to be leading R&D organization. And this is one way of getting there. Not just being based in Norway.

Lima has also established a special programme for exploring global possibilities around the world and has around 145 people working in it from the offices in Norway and Europe, but also in Moscow, Jakarta, Beijing and Dubai. Their work includes looking at new ideas and business opportunities in the locations, where the company has not yet established itself. The aim is to get new licences for acquiring oil and gas in those new areas. A part of their job is conducting assessments of the concepts that were developed for one geographical area - whether these concepts, their technological and business solutions would be applicable also in other locations.

Another approach used by company *Lima* to boost its innovative capabilities and to help its people to think differently is through establishing a special training program for their project managers. It is based on the approach that innovation happens everywhere, also outside R&D labs and one can learn a lot from other industries and companies, from combining different ideas. This training program is designed together with one of the best American Universities and takes place in several foreign locations. It includes visits to the most innovative companies in Silicon Valley and various meetings with other international companies and institutions. According to one of the interviewees, *“It helps to see differently”* and it was aimed *“to increase awareness of how people think outside”*.

Based on a positive external assessment of *Lima*'s innovation performance as well as by the comments from its employees, it appears that there are particular reasons why this company is regarded as one of the most innovative in the world. It was mentioned that there is a *“culture of making bold steps”*; meaning that one feels free to try a new idea without having a fear of bad consequences in case of a failure. On the other hand, it was mentioned that innovation and research has *“earned trust”* in the organization, and that is why it also could demand new technologies and investments:

I think we have taken some of the best technology in the past. We have really demanded new technology. We have a history of taking technology with and succeeded in doing it. So, in a kind of way, we have trust in the organization, based on that we have met expectations, we have delivered. And that has given us a kind of freedom.

R&D centre outside Norway: benefits vs. organizational challenges

R&D centre in Canada was *Lima*'s first research facility outside Norway. It was established there mainly due to the reason that the necessary competence in that particular technological domain was available only in Canada at the moment. Company *Lima* needed to build upon that competence: *“We wanted to get up to speed very fast by building upon competence that existed in this area.”* Another reason is that, based on the concept that *Lima* is truly global company, they increasingly hire people internationally: *“and we want to be there where the skilled people are. They don't want to necessarily go to Norway.”* Additionally, it was mentioned that proximity between a production site and a research facility is highly beneficial, and that is an important factor for establishing research facilities abroad, close to the on-going operations.

At the same time, when they established a research centre in Canada, *Lima* also launched an academic program with the Canadian Universities. Some of the collaborations with universities are based on the PhD pairs' model, where the students from the Norwegian and Canadian Universities work on the same topic together. This approach is facilitating a mutual experience exchange between the Norwegian and the Canadian PhD students and, eventually, it allows learning from the Canadian competence and exporting this knowledge to Norway.

It is quite important to discuss how this research centre is organized and managed. A part of this centre is in Norway and another part of it is in Canada, 60 people in total. It is organized in the traditional manner - the leaders are responsible for the team members on both sides of the Atlantic Ocean within their area responsibility. Thereby, it is not structurally or functionally divided between the Norwegian and the Canadian side. The only dividing aspect is a distance, the ocean and the difference in time zones, as they do not have overlapping office hours. This is obviously one of the challenges in this type of organization. Personnel had to learn to adapt to it by the extensive use of videoconferences and other IT technology tools. Another challenge is that regardless intensity of communication through electronic wires, face to face communication and meetings are vital, especially for the establishment of a truly functioning team. That is why the frequent travelling is involved, as well as attendance of regular seminars together in Norway.

Cultural differences and the use of the English language seems not be an issue in this R&D organization. This type of organizational setup seems to be important for avoiding the cultural and communicational barriers:

...We wanted really to have one common organization; we don't want to end up with sub-cultures. We really choose to have organizational set-up that didn't... we didn't want to put any fences or restrictions. We wanted to keep organization as we would have it if we had been located in the same location.

They have established procedures for regular information exchange between the different locations, and it seemed that this system works. Another advantage, which was mentioned several times, is that this organization was young, and established relatively recently (4-5 years ago). Thus, the personnel in this R&D centre maintained their links to the parts of the company where they worked previously. In other words, they brought along the networks and knowledge regarding whom to contact where, and thereby were facilitating the information exchange informally.

Growing globally vs. being Norwegian based

It was quite apparent that company *Lima* has ambitions to grow even more internationally and to establish more international hubs or R&D labs. Words “*globally*” were repeatedly used and acknowledged that the company is “*growing outside Norway.*” The main reason for the need to expand R&D internationally was looking for the best competence and recruiting the best people with the necessary competences, and the need to establish R&D facilities close to the production facilities, for example, in China and Brazil.

It seems that this global expansion creates quite a new learning situation and brings along many changes and new challenges in the organization:

... we are going into totally new areas, it is not like the Norwegian continental shelf. Business challenges, suppliers and everything is very different from what we are used to. So, we need more... we need competences that are unconventional. We do not have unconventional experiences in Norway....We need for production, business needs and challenges, we need to be integrated there, and we need to be close to the key competences....

It was acknowledged that *Lima* brings its experience to new places, but it also has to learn from the others. It seems that overall there is a lot of learning taking place inside *Lima*, both in terms of new technological competences and approaches how to operate globally and build presence in the foreign locations. A mutual or two-ways of learning, or two-ways of knowledge exchange was mentioned as taking place in the research centre run together with the Canadians.

In addition to establishing R&D centres or hubs outside Norway, *Lima* has various external partners and collaboration with the suppliers, service providers and cooperation with external universities. However, it was noted that despite of this global growth, *Lima* would remain Norwegian based in the years to come and also maintain its ties with the Norwegian suppliers and the Norwegian universities. Regardless this overwhelming emphasis on globalization, global expansion and moving closer to the competences that exist outside Norway, it was not suggested that *Lima* would reduce its partnerships and scientific collaboration in Norway. No changes were mentioned in relation to the three existing research centres in Norway either. Overall, the external knowledge and external competence from the foreign locations was seen as complementary to the Norwegian competence, not replacing it.

It can be noted, however, that growing globally might create some organizational and information sharing challenges. On the one hand, *Lima* has ambitions to keep growing outside Norway and building knowledge upon the competences in new foreign places. On the other hand, their plan is to maintain their base in Norway. Thus, some particular challenges might be related to receiving feedback and sharing the information among the different places around the world and the headquarters in Norway. So far, this system was acknowledged as functioning well, but it was something that had to be coordinated and it required procedures and mechanism in place:

But, we do see the experience exchange, ideas' exchange between the different hubs. But it is demanding and it doesn't happen spontaneously, we really need processes to take care of that, because otherwise they will end up like islands without connections.

Thus, the exchange of competences between the different company's locations was regarded as very important.

6. Comparative analysis on internationalization of R&D and innovation in five cases

6.1 Common tendencies and challenges

Tendencies and challenges in the Table 2 are identified from the analysis of the empirical data, largely based on interviews (see Annex 1 Interview guide). This table presents a relative assessment of the given tendency in the five companies. It serves an illustrative purpose and it will guide the discussion and analysis in this chapter. Differences and variation in these tendencies among the companies are discussed in the text that follows the table, and thus, these common features should not be interpreted as if these companies were very alike or very similar in their R&D approach.

Table 2 Common tendencies and challenges in innovation and R&D¹⁰

Tendencies and challenges	<i>Alfa</i>	<i>Beta</i>	<i>Delta</i>	<i>Omega</i>	<i>Lima</i>
Need to diversify knowledge base and broaden networks	+	+	+	+	+
Need to look for the best competence, the best partners	+	+	+	+	+
Need to understand new emerging markets	+	?	+	+	+
Need to be present in foreign locations	+	?	+	+	+
Challenges related to cultural differences in international R&D	+	+	+	+	-
Challenges related to information sharing and competence building in companies	+	+	-	+	-
Need for information and exchange of know-how from foreign locations	+	+	+	+	+

¹⁰ The question mark sign in the table means that either the data were not obtained regarding the particular question or it was impossible to make any estimate on that particular type of tendency. The plus sign means that the particular tendency is present in the given company. The minus sign means that the particular factor or tendency is not very common or is not present in the given company.

Following the structure of Table 1, common factors and tendencies in the five cases regarding the innovation activities, motivation for expanding international R&D and related challenges will be discussed. First of all, it can be noted that all five companies were stating the interest and necessity to expand their contacts and to **diversify their knowledge base**. As it was stated by one of the interviewees: “...*Because we have a lot of competence, but there is a lot of missing pieces in this puzzle, that we could get from people with different point of view or different background, different scholar that can sort of help us to rethink what we are doing*”.

Broadening of scope, attaining new ideas and diversifying knowledge base was particularly related to expansion of international contacts and entering into new international partnerships, as well as learning from new markets. No single company was relying only on their R&D centres and Innovation departments for coming up with innovative ideas or useful knowledge, and none of the companies had its R&D collaboration and activities in Norway only. However, comparing the type of knowledge the five Norwegian companies are looking for in the new markets and in foreign locations generally, there seem to be differences in this approach. Some companies appear to be more interested in obtaining knowledge that helps to understand the markets of their interest better and inspires for the new opportunities. On the contrary, other companies, especially, *Omega* and *Lima*, were looking for unique technological knowledge and the best competences in the foreign locations that would provide essential expertise for development of new products as well as launching new operations and services.

This was closely linked with a tendency that all the five companies were interested to look for ***the best competences, the best expertise*** and ***the best partners*** in order to access the necessary technological knowledge or to help these companies to build understanding of the local markets and their needs. As it was expressed by one of the company’s representatives:

...We acknowledge that we need to collaborate with good partners. I would say, with the competence that compliments ours. We can’t do all by our own. That’s why we are looking always for good partners, the skilled, good partners to perform. And it is not important where they are, really. They could be anywhere. Clearly, it is additional benefit if we have good partner where we have footprint.

Apparently, the best competence and the best partnerships were often residing outside Norway. Actually, in several cases the assumption that *Sintef* or *NTNU* are always the best cooperation partners and have the best competence, has been challenged: “...*but also the*

Norwegian research institutes are not necessary the best in all cases, in everything. So, we need to find the best.”

In some particular cases and technology areas, particularly in *Omega-S*, *Lima* and one R&D program in company *Beta*, the necessary competence did not exist in Norway at all, it was found in other countries. Overall, the need to look for new ideas, knowledge or competence and contacts outside Norway was expressed by all five companies. However, comparing already existing intensity of international partnerships among the five cases, it might be observed that company *Beta* was lesser engaged in the external international contacts compared to other companies. It might be linked to its current R&D management approach, as well as relying on the Norwegian scientific institutes and established relationships in Norway. It is also interesting to note that obtaining the necessary competence internationally does not mean just creating partnerships or hiring foreign scientists, it also involves “moving” closer to these competences and establishing research centres in the locations where the competences are residing, as in the case of the company *Lima* in Canada.

To a great extent, attaining the necessary complementary competence was directly linked with challenges in the **new markets** and the **need to develop understanding about them**. The need to develop knowledge about the new markets especially in Brazil, China and India was acknowledged by most of the companies. This tendency is very apparent in the context of the economic crises in Europa and the USA, where many businesses, including these large Norwegian companies are moving to the Asian markets and Brazil. In order to do that, the companies need to have partnerships, collaboration with the local scientists and to hire local people. The understanding of new markets entails knowing their customers’ needs and cultural aspects, identifying and applying useful competences, but also being aware of and adjusting to local regulations and political environment. The words of “*political adaption*” and its importance were mentioned by one interviewee when commenting on their activities in Brazil and Angola.

The next common feature is a growing understanding among the Norwegian companies that in order to benefit from local relationships and to develop knowledge about the foreign markets, the companies **have to be present** locally in one way or another. To be present in terms of structural presence and establishing R&D labs or entering into joint ventures, present in terms of developing new partnerships and following up the customers’ requirements, and in terms of growing an understanding about the foreign markets. The companies also have to be

present in the sense that they have control over their operations and partnerships, instead of just owning part of the foreign companies or selling the licenses to other companies. The need to be present and to understand the customers' needs, was expressed in the following way: *“So, it is important to understand, and to be able to really understand you have to be there, you have to feel what they feel, more or less, and their needs.”*

There are several reasons for that. One being that companies have learned through their own or others' mistakes that it is too risky to fully rely on partnerships in the foreign places and not be completely engaged themselves. Secondly, by selling their technical competence, licenses, and, for example, by building production sites and leaving it entirely to others, there is a risk to lose their relevance and miss the opportunities that might come from the contacts with users, customers, and diversity in the foreign locations. Thirdly, the proximity between the production/operation site and the companies' R&D units; and the proximity to the main customers/users was mentioned as an important factor. And, as the Norwegian companies are increasingly growing internationally, they perceive the necessity to establish the R&D units or partnerships in support of their operations, thereby establishing R&D presence in the foreign locations as well.

Another common challenge and important factor was related to **cultural differences** in the foreign markets and challenges related to international technological partnerships. Consequently, it requires from the Norwegian companies the need to understand these cultural factors and possibly also adjust to them. First of all, it should be observed, that this challenge was not described by the Norwegian companies as a major problem or a major obstacle, but rather as something that they need to be aware of or an area where they need to make constant improvements. It is partly due to the fact that most of these companies and their personnel have been involved in international business for decades and they also have people with international backgrounds working in the companies, including their R&D research centres and departments. Thus, the Norwegian companies are used to work in international and challenging environment. On the other hand, it is also a quite new situation.

First of all, cultural and political understanding is needed now about the places where these companies are a “new player”. They are going into markets with very different cultural backgrounds, for example, in China, India and Brazil, than those they are used to. It was expressed when discussing international activities: *“We are learning across the organization and a lot of focus on cultural experience.”* Secondly, within the international context, these

companies are getting involved in various types of operations and partnerships which differ from what they might have had before. Today, they need not only market knowledge or access to cheap natural resources, but also establishment of partnerships where they can gain useful technological knowledge and necessary competence. That requires much more sophisticated level of understanding of the partners' culture and knowledge systems, including how knowledge is created and shared within those cultures and countries. Thus, it is quite understandable that there were fewer challenges in the cases where English is a shared language and cultures are not so diverse - like in the company *Lima* research centre in Canada. This was most likely the reason why there were fewer concerns expressed by the company *Lima* with regard to cultural challenges, while in case of the company *Beta* and its technological collaboration with the Asian counterpart, obstacles were created not only by the language and the distance, but also, most likely, rooted in much deeper cultural differences and customs regarding knowledge sharing.

However, it is most important to realize that these new type of activities and partnerships, especially in the new emerging markets, require acknowledging a new learning situation in the Norwegian companies and the need to reflect upon their own way of thinking and procedures. It may also be necessary to make adjustments within the companies in order to avoid too many surprises, to be more successful in the foreign locations and collaborations or even benefit from the "clashes" of ideas and different cultures. It seems that some companies have reflected about these questions more than other companies. In some companies, they talk about *a new learning situation, need to change and to adjust, two-way learning, listening to locals, customers, learning from the industries*. This approach requires changing the overall way of doing international partnerships and challenges one's own particular way of thinking. This dilemma was very well formulated by one interviewee:

I think that broadening of scope is essential to survive. But, it is a challenge, because you need to take on new cultures, new ways of thinking. You can say that in Norway, we have developed certain dogmas on how we do things and how not to do things. And if you challenge that and go abroad, you will find exactly the same type of problems. I mean you will find dogmas in Russia, Brazil, in Europe, in France. You will find: this is how we do things in France. But I think it is sort of tension between those ideas that you can make a sort of fruitful viable cooperation, you can get ideas moving forward. Sitting just looking inside Norway is not going to put us where we want to be.

Another common concern is **information sharing**, the use of existing experience and know-how in the companies. Representatives of the three companies (*Alfa*, *Beta*, and *Omega*) told

about their existing challenges regarding information sharing, and two of them actually stated that information sharing and spreading of knowledge and know-how is one of the biggest problems in their organizations. Companies *Delta* and *Lima* were giving more positive self-assessment in this regard, however, at the same time acknowledging the crucial importance of ensuring the information sharing and spreading of competence within their organizations. Overall, the existing experience, competence and know-how are perceived as the assets or capabilities that companies can utilize in order to innovate their ideas, products and services.

There seems to be several reasons and common features why knowledge sharing is somewhat problematic in these companies. One reason is related to the human factor or human aspect and how to motivate people and engage them in knowledge sharing and knowledge creation. Most of the companies have established special routines and mechanisms for information sharing. Nevertheless, these routines and mechanisms have not always been sufficient, and, as it was expressed by one of the companies' representatives, it has to do with people's motivation and readiness to act: *"In my opinion, our responsibilities stretch further than just do job description. Because, sharing information, it is not something you can put in a job description. That is an active process."*

In most of the cases, solution for the information sharing was seen in the establishment of formal procedures and mechanisms. However, encouraging individual contribution to knowledge sharing and truly engaging people in knowledge creation might require much broader changes in the organization, possibly outside the borders of the Innovation and R&D departments and beyond the creation of formal procedures and mechanisms.

Another reason for difficulties was organizational structures which were creating barriers for information sharing in some cases. These barriers in some cases existed between the different departments, in some cases, between the research centres in the same company. Typically, the situation was caused by the fact that departments or R&D centres were involved in the specialised types of activities and were even applying different types of technologies and knowledge corresponding to their business segment. In one case, a physical location of the research centres in several countries might have been adding to these structural and mental barriers for information sharing. As a result, in some companies there were good procedures and good information sharing practice within one department and one research centre, but no procedures and none or limited sharing in the company overall or between the company's research centres.

Information sharing within companies is linked to the processes how companies utilize their existing experience and competence. These processes and challenges are stretching outside the responsibilities of the R&D and Innovation departments. All of these companies have hundreds and thousands of employees, many of whom have stayed in the same company for decades, but have also been posted to different positions and been in various international locations. Thus, these companies have a vast amount of different experiences and competences which are not always utilized to full extent:

...I believe more that people need to talk together. And we see it again and again that this is not happening. There are projects where we see: ahh, we should have done this and this, but if we actually did research up front, we could...somebody in this house knows. This is an issue, totally.

However, there is a strong realization that this in-house competence is crucial for the future innovation, especially in the companies with mature technologies, such as the company *Alfa*. In these cases, companies plan to sustain competition by utilizing their experience, recombining existing ideas and using the new market opportunities, as they do not expect very substantial breakthroughs within their technology areas. That is why the exchange of know-how from different locations is very important in the context of entering new markets and the need to understand those markets better, to become inspired by them.

It is also interesting to note that there was a general realization within all companies that problems with information sharing reside within the companies due to their personnel or due to their procedures. The problems were not related to knowledge transfer between the companies and their scientific and technological collaboration partners on the other side. Company *Beta*'s technological collaboration and related challenges is a very specific example. None of the companies' representatives did mention particular problems related to the information sharing caused by the geographical distances or due to the fact that some units of their companies are located in different countries. The companies have rather adapted to this challenge and established procedures how to deal with it on the daily basis in communication with their international partners, clients, suppliers and their R&D organizations in distant places. They have extensive use of videoconferences and internal IT systems for information sharing.

This aspect is related to the next common tendency in the context of information sharing internationally: **necessity to improve exchange of know-how** and getting **information from the companies' subsidiaries and operations abroad**. All companies either acknowledge the

need to improve it or have already established procedures how to facilitate receiving the information from their foreign subsidiaries, markets and production plants, etc. In some cases, the requirement of feedback was more related to the need to improve the understanding of different markets and trying to identify useful lessons and potential opportunities there. In other cases, it was more focused towards following up whether their products and production plants or facilities are producing satisfactory results. Thus, mechanisms were in place to gather this information from many foreign locations and ensure making the necessary adjustments or technological improvements at the home base in Norway or Europe.

In the case of company *Delta*, it was mentioned that knowledge developed for one market with some modifications were applied in different markets as well. In *Omega-S*, it was functioning like a consortium, where a development and testing of a particular technology in one country was linked to its application in another location. Overall, it seems that most of the analysed companies have established some kind of mechanisms and procedures for getting information from the foreign operations and markets. It was a more complicated and a diverse picture among the cases with regard to having exchange of knowledge, know-how and technological solutions between the different locations and including their companies' units abroad in the new knowledge creation activities.

To summarize the discussion about the common tendencies and challenges in innovation and R&D in the five cases, we can conclude that the Norwegian companies are working on expanding their international networks and engage in international R&D activities, because they seek knowledge diversity and are in need of partnerships with complementary knowledge and understanding of new markets. This tendency and R&D strategies are in a way challenging established relationships in Norway and the historical identity of several companies analysed previously. Moving into new markets, like China, India, Brazil, is creating a somewhat new learning situation in the Norwegian companies and they require a deeper understanding of diverse cultures and knowledge creating systems in those foreign countries.

Information sharing within companies is a serious matter which has already been addressed and processes are taking place to improve it. It is largely because there is a strong realization that information sharing and spreading of experience are necessary components for being innovative and sustaining global competition. Especially, in the context of growing internationally outside Norway, the challenges related to information sharing from the far

distant places and between the different locations within the same company might add a new dimension to this issue.

If we compare these tendencies from the five cases with the theoretical discussion in the beginning of the thesis, we can make the following observations. The evidence supports the argument that companies need a diversity of knowledge and broad networks to sustain their global competitiveness. The analysis of the five cases of Norwegian companies also seems to be confirming the concern that Norwegian System of Innovation does not provide the necessary variety of competences that the companies require, as it was discussed by Narula (2002). That is one of the reasons why the Norwegian companies are internationalizing their R&D activities. Another reason is the opportunities from the new markets and possibilities to explore the local knowledge and competences. This factor supports the argument that local settings in the foreign countries present many opportunities and advantages for the international companies, including the creation of new knowledge, as it was argued by Narula & Zanfei (2005).

Looking at the challenges related to knowledge sharing within these multiunit companies, there was not much evidence supporting concerns of those authors, who emphasize the difficulties related to physical distance and cultural issues that are hampering knowledge sharing processes in big multinational companies or between the companies and their partners. It was more evident that challenges with information sharing and using of in-house competence were related more to the organizational barriers, personal motivation and lack of culture for knowledge creation within the companies. This may support the argument of Von Krogh, Ichijo & Nonaka (2000) who argue that overall motivating and enabling conditions in companies are necessary for knowledge creation, and that information sharing issues cannot be solved entirely by the managerial approaches and standardized procedures. With the reference to the differentiated mechanism for knowledge sharing and the role of human and relational aspects in knowledge transfer, it was evident in all cases that the human factor, - direct interaction and meetings between people are the best ways to share information. Cultural and language differences can become a serious problem, as the evidence from some cases suggest, especially when it is linked to the wider issue of knowledge creation and sharing systems, as it was pointed by Lam (1997). However, these are specific issues that are more relevant in the context of international technological collaborations, which was not a very typical R&D activity among the Norwegian companies.

Although it was not much discussed how embeddedness in the local environments help in acquiring local knowledge, it was evident that the companies seek more presence and increased understanding of the foreign markets, and become engaged in networks and relationships that would help them both to establishing themselves in the foreign locations and to gain useful knowledge from the foreign locations.

6.2 Internationalization of R&D strategies and activities

The types of activities for internationalization of R&D in the Table 3 are selected based on the literature review and presents findings from empirical analysis. These categories are not following any specific framework, but rather provide a broad overview for the analysis of data and discussion. By following a horizontal line, we can see a relative assessment of a given activity in a particular company. By following the vertical line, we can see a given type of activity across the cases. The assessment marks inside the table are used in the same way as in the Table 2 with addition of a few characteristics. A more thorough assessment of the type of activities and their variation among the five cases is presented in the discussion part that follows, and this table has an illustrative purpose only.

Table 3 Activities for internationalization of R&D and innovation

Company	Cooperation with foreign universities, institutes	R&D centres and hubs outside Norway	Knowledge sourcing from foreign locations, role of subsidiaries	Technological collaborations	Hiring people with diverse backgrounds
<i>Alfa</i>	+ Europe mostly	+ Europe	- Limited	?	+
<i>Beta</i>	+ Europe mostly, Limited	- Expanding R&D abroad	- Limited	+	?
<i>Delta</i>	+ Globally	?	+	?	+
<i>Omega</i>	+ Globally	+ China	+	?	+
<i>Lima</i>	+ Globally	+ Canada, USA, China	+	?	+

The structure of Table 3 guides the discussion of internationalization of R&D activities in this chapter. In all five cases, the companies have established **cooperation with foreign universities** and are still working on expanding these contacts. There are different approaches to how relationships with universities are created. Sometimes, links with the European universities are maintained for historical reasons, and sometimes the contacts are expanded due to other factors, for example, by hiring R&D personnel who has maintained their links to their previous studying or working places. This approach could be characterized as having broad contacts with the foreign universities.

However, the most common approach is to cooperate with universities and institutes due to the reason that these universities or institutes have a specific competence or technological expertise that the Norwegian companies are interested to utilize. For example, company *Lima* required the knowledge of the Canadian universities in the specific technology area that was not available in Norway. In another case, it can be a specific expertise and equipment needed for testing the products, like in the case of *Omega*. They used the testing facilities in Brazil and the USA. It should be noted, that companies *Delta* and *Lima* have additional external contacts with some of the best universities in the world also outside the specific technology areas, but within the business and innovation competences.

The third, related approach is to establish a cooperation with universities in the new markets or places where the companies have a “footprint” or presence. That is also done because of several reasons. One of the reasons is that universities and their scientists function like “brokers” to facilitate the establishment of local contacts and to develop understanding of the local markets, as it was in the cases of *Delta*, *Omega*, and *Lima*. Another approach is to engage the local expertise, local scientists, engineers or geologists to address the local needs and to use technological competence that is most relevant for the local setting. For example, to use local geologists to build local production plants or to have contracts with local scientists to analyse the local society’s needs in a specific area. So, this is an approach where the most rational solution is to use the local experience and knowledge instead of employing the Norwegian experts to these foreign locations.

The most favourable is a situation when the necessary competence within universities is at the same location where the companies want to establish and expand their presence. In some cases, establishing cooperation with universities goes hand in hand with having operations in

those countries and establishing R&D unit or technology hubs there. The companies *Delta*, *Omega* and *Lima* are the examples of this approach. Additionally, a model or approach that at least two companies are using in order to benefit from the experience exchange between the foreign and the Norwegian universities, is establishing the PhD pairs' program. This model or program means that, for example, the Chinese and the Norwegian PhD students are working on the same topic that is relevant for a given company, and the students would conduct exchange of visits to their respective universities, and might be doing publications together.

Overall, the comparison of the intensity of cooperation and scope of the networks with the foreign universities reveals that companies *Alfa* and *Beta* are in the process of expanding their contacts, especially outside Europe, while the companies *Delta*, *Omega* and *Lima* have already established the cooperation with the foreign universities in a more global, extensive manner.

With regard to establishing **R&D centres** and **technology hubs** outside Norway, the situation varies considerably among the five companies. For instance, company *Alfa* for many decades has had research centres in the Netherlands and Germany, where competences have been built throughout the years. It seems that there were no particular plans to establish new research centres, especially outside Europe. Company *Beta* does not have R&D centres outside Norway and that is in line with their R&D organization - it does not have its own researchers and in-house research centres. On the other hand, it seems that *Beta* sees the potential of their operations and projects abroad to be able to contribute more to the R&D and innovation. That is the reason why company *Beta* is working on establishing R&D coordinators and R&D budgets as a part of their international operations, especially in the developing countries.

On the contrary, *Omega* and *Lima* have established technology hubs outside Norway in the areas with an extensive business potential, for example, in China and Brazil. *Omega* has established technology hubs in Shanghai and Beijing in support of their products and markets there. However, as it was mentioned earlier in the description of *Omega*, one these technology hubs had started getting engaged in the research, as well. *Lima* has established R&D offices and hubs in China, Brazil, Canada and USA, and it has a clear strategy to establish even more hubs and R&D units globally. As it was discussed previously, it runs one research centre in Canada as a part of the research organization together with the Norwegian side.

These two companies have several reasons for expanding the R&D units and technology hubs globally. One reason is the need to be close to the required competences, skilled people and

build upon these resources. Another reason is to be present and to provide support to their products and operations in large markets in the foreign locations. Thirdly, to be close to their main suppliers and customers, which are industries that use their products and technologies, and thereby, to come up with new products and solutions for them. And lastly, like in the case of company *Lima*, to have research activities in the areas where they have operations and natural resources for their productions and operations.

In case of *Alfa* and, possibly partly also *Delta*, it appears that these companies both rely on various types of mechanisms for getting feedback from their customers and markets without the need of establishing R&D units abroad. These companies are not driven by the need to move closer physically to the external competences that would be supplementing their own knowledge. Company *Beta* seems to be less dependent on the external suppliers or customers due to the nature of their activities, but it seems to be more eager to benefit from the local competences whenever that is possible and to establish R&D that would support the operations in the developing countries, for example, in Brazil.

A next type of activity is very much related to the discussion above and is the realization of the need to get useful **knowledge from their foreign markets**, and the **role of the subsidiaries** in the knowledge creation within the companies. First of all, it can be noted that there is a very limited data or evidence from these five cases that foreign subsidiaries of the Norwegian companies would be contributing to knowledge creation and delivering useful feedback about the market potentials, customer future needs, but even more importantly, about the specific technological or market opportunities or new ideas for the companies' future competitiveness. In several cases, when asking about learning from the foreign locations and markets, the first answer was negative and it was stated that this kind of information exchange does not take place within the companies. Only in one case, it was clearly stated that the company's subsidiaries and other international units contribute to innovation and knowledge creation, and that this process is functioning as a mutual information exchange and a dialogue between the headquarters and the subsidiaries.

Most of these companies have subsidiaries abroad in geographically dispersed places, but it seems that their role is not seen as important for gaining useful knowledge from the local places and participating in the knowledge building within the companies. The same explanation might be valid in the cases where companies had a project-based organizational setting abroad, for example, for building plants or production facilities. They have not been

set up to “think” that way, to contribute to the knowledge building and looking into the long term needs. Another reason might be a traditional way of thinking about organization of R&D by keeping research and other knowledge creating activities relatively centralized at home, while using the foreign locations as places for the access to natural resources, markets and for building production plants.

However, it seems that this approach to the organization of R&D and innovation is somewhat changing. There is a growing appreciation of the need to gain information, exchange experiences and try to identify new opportunities in the foreign markets as well as the need to become increasingly present or embedded in those locations. That is why all companies are concerned about establishment of a functioning mechanism to acquire useful knowledge and know-how from the foreign markets. In some cases, it seems that this kind of organization and procedures are already in place, while in other cases there are plans and work in progress to create these mechanisms, as it was discussed previously. In the companies *Delta*, *Omega* and *Lima*, the mechanisms are already established by linking their different foreign locations for exchange of knowledge and having collaborative projects among the different locations of the companies. That means they have functioning global networks for knowledge creation and product development that include the companies’ units abroad and their partners.

International **technological collaboration** is a quite complex undertaking, as it was discussed in the theoretical chapter. It entails two or more collaboration partners working on development of a new technology or finding a solution to a problem together within a synergy. Typically, this is motivated by the need to rely on the complementary knowledge and existing technology of the collaboration partner. Either due to the complexity related to international technological partnerships or due to the situation that the necessary knowledge is gained through other types of partnerships or relying on the in-house R&D units, technological collaborations were the least common form of international R&D activity among the five cases. Based on the available data, only company *Beta* had established a technological collaboration with one producer from an Asian country within the specific technology area, as it was discussed earlier.

A different type of technological cooperation was taking place between the several foreign locations in the case of *Omega-S*. However, it was fundamentally different in a way that it did not entail producing a complex technology together, but rather producing or testing it in one location, for instance, Brazil, and using it in China. This type of international R&D activity

Omega-S representative called a *consortium*; it has to do more with sharing and transferring knowledge from one place to another instead of creating the knowledge together.

Quite on the contrary, one of the most common approaches in expanding international contacts and widening the knowledge base within the companies was **hiring people with diverse backgrounds**, including different nationalities, and with the doctoral degrees from different universities around the world. There was a slightly different motivation, however, within the companies for hiring the personnel with diverse backgrounds. One type of approach was to facilitate different way of thinking and the establishment of wider contacts with the foreign universities. Another motivation, like in the case of *Omega*, was to employ people from the industries around the world that use their products, thereby keeping an up-to-date knowledge about those industries' needs.

A related approach was to employ people with the best competences within the specific technology areas and to move geographically closer to those areas or countries where that competence resides, like it was done in the cases of companies *Omega* and *Lima*. Additionally, the companies were hiring the locals abroad in the places where these companies had a footprint, especially to ensure the understanding of local markets, but also to benefit from the local technological knowledge.

To summarize the discussion of the different types of the R&D internationalization activities present in these five cases, it is quite apparent that the widening of international networks, especially with the foreign universities and institutes, is the most common approach. With regard to establishment of new R&D centres or technology hubs abroad, there seems to be two differentiating strategies. One strategy foresees to keep research centres in Norway or in Europe and, at the same time, to increase knowledge transfer from the new markets and improve exchange of know-how through different types of mechanisms (in the cases of *Alfa*, *Beta* and *Delta*). The other strategy was to establish research centres and technology hubs globally, especially in the new big markets in Asia, in order to be closer to the customers, suppliers and the necessary local competences. This approach is implemented by *Omega* and *Lima*.

If we try to identify the types of companies which are more active in expanding their R&D activities internationally, based on these five cases, it appears that the companies that are more dependent on the proximity to their suppliers and customers, and rely on the specific technological knowledge in the foreign locations, tend to move their R&D structures abroad.

Those companies who were interested mostly in benefiting from the new markets opportunities, where keeping their R&D in Norway or in Europe and trying to improve knowledge sharing mechanism from the foreign locations and expand their networks.

There might be other important factors influencing the choice of internationalization of R&D strategies among the five companies, which were not discussed in detail here. For example, in some cases, history and historical path dependency play more important role than in other cases. The type of industry can also be a significant factor. For example, company *Delta* was a very distinct case compared to the other analysed companies, because it provides services directly to customers and its innovation strategies are very much tailored to the service innovation and working closely with the customers. In most of the other companies, their customers were industries or public authorities, to whom these companies provide products and related technical services. Another important factor is the type of ownership in the companies and the role some of the companies have in the Norwegian economy. Clearly, being owned by the state has created more opportunities in terms of resources invested in the technological development in the companies *Beta* and *Lima*. However, on other hand, it can also create additional dilemmas related to their dependency on the Norwegian SI. All these factors, most likely, to various degrees influence the choices and decisions regarding the internationalization of R&D in the five analysed companies. However, it is unlikely, that these factors, if analysed more thoroughly, would have provided enough evidence to show radically different tendencies in these particular cases in their internationalization of R&D approaches and strategies.

Although there was very limited data regarding subsidiaries' role in contributing to the knowledge-creating in the companies, there seems to be a common acknowledgment within the companies about the importance of getting the knowledge from the foreign places and their international operations, and to improve the information exchange between the different locations. Most of the companies are working on establishment or sustaining well-functioning mechanisms for getting feedback from markets and exchange of experiences. The companies *Delta*, *Omega* and *Lima*, however, already have established such processes and organizational models, where they have linked one foreign location to another in order to transfer knowledge from one location to another. Hiring people with diverse backgrounds, competences and linkages to foreign universities and industries is also a part of the strategies how the Norwegian companies are both diversifying their knowledge basis and expanding their networks at the same time.

Comparing these tendencies in the R&D internationalization with the asset exploiting and asset augmenting strategies (Narula & Zanfei, 2005), we might see both approaches among the five analysed Norwegian companies. In several cases, it appears that the companies are more following the asset exploiting strategy where they mostly rely on home-base created knowledge and adjust their products to the market needs or transfer their knowledge for building facilities or production plants abroad. However, at the same time there is a tendency to use the local knowledge as complementary, and in some cases, as an essential asset. Most of the companies are either expressing the need for or are already implementing procedures for transferring and utilizing knowledge from one foreign location to another or to the headquarters in Norway. Thus, it can be concluded that the asset augmenting approach is a current philosophy or the way of thinking for internationalization of R&D, even though it is not always practically implemented yet.

The R&D centres and activities remain very centralized and are mostly located in Norway or in Europe, with exception of the two companies that are establishing technology hubs and research centres globally. According to Von Zedtwitz & Gassmann's (2002) typology on R&D internationalization, several of the analysed companies would correspond to the Market-Driven R&D prototype. It can be said, because they are driven by the access to new markets and their research and competences are home-based, while the development, testing and product quality assurance is taking place also in other countries. However, it can also be observed that in some cases, the companies are very much driven to the foreign locations by the need of complementary or essential competences - particular examples are the companies *Omega* and *Lima*. The places for research and knowledge development are getting more dispersed and that would correspond to Technology-driven or Global R&D type of organization. Probably, the most interesting observation based on this typology, is that none of these companies could be considered as a typical National treasure R&D type company where both research and development takes place nationally. These observations may confirm the existing evidence about growing internationalization of R&D among the largest Norwegian companies.

In the current research no data was obtained, which would support the arguments discussed by Zanfei (2000) about the challenges related to double networks that multinational companies have to manage, when they establish subsidiaries and different types of presence in the foreign locations. It might be partly due to the fact that the Norwegian subsidiaries abroad were not yet so extensively integrated into local networks that it would present a serious

concern as centripetal or decentralizing forces. Another reason might be that these managerial dilemmas were not considered relevant and related to the R&D issues, and thus were not discussed during the interviews. Nevertheless, it appears that only in some cases it is possible to speak of some kind of external networks that the foreign subsidiaries, foreign offices or the R&D units might have created locally. In few cases, some related challenges were mentioned, like the need to coordinate information exchange between the different locations of the company and the headquarters at home. In one case, though, it was stated that being spread so extensively internationally is presenting serious challenges to the company. However, only some operational aspects, e.g. long hours of travelling around geographically extensive territories, were touched upon.

In the context of the widening networks and international growth, the ability of Norwegian companies to identify the sources of innovation outside their companies is an important requirement. Thus, absorptive capacity of the company, including its ability to establish knowledge about networks and interactive learning approach is more relevant than ever. A diversity of backgrounds and expertise seems to be very important for developing absorptive capacity, as it was suggested by (Cohen& Levinthal, 1990) and also for knowledge creation within organization, as was argued by (Von Krogh, Ichijo& Nonaka, 2000).

7. Final conclusions and policy implications

Conclusions

The need for knowledge diversity, getting access to the necessary competences and the development of understanding about the emerging big markets are the main motivating factors for the Norwegian companies to expand their international R&D activities. This is achieved through widening of international networks, especially with foreign universities and institutes, as well as by establishing mechanisms for getting information and experience exchange from foreign locations. Nevertheless, the R&D structures and activities remain to a large extent centralized and located in their historical locations in Europe. Only in two cases the R&D centres and technology hubs were established in new foreign locations and companies had clear strategies and plans to continue to expand even more globally.

Increased internationalization of R&D, however, makes these companies reconsider their traditional relationships with the scientific communities in Norway, and, furthermore, also challenges their historical identity and path dependency in their innovation and R&D strategies. The evidence of these five large Norwegian companies, where part of them have historically been strongly embedded in the NSI, confirms the presence of the systemic lock-in. These companies, despite their well established relationships with the Norwegian scientific community, are currently seeking the necessary knowledge and competences abroad. According to the analysed cases, the Norwegian NSI does not provide the variety of expertise, and, in some cases, has not developed the competences that these companies need.

However, none of these companies are terminating their cooperation with the Norwegian universities and institutes. It is rather the change taking place in their approach and an overall thinking about innovation and R&D strategies. Instead of just using the existing relationships, they tend to choose the approach to look for the best partners and for the best expertise around the world in order to address a given problem or come up with a technical solution.

Another reason, why Norwegian NSI is not able to provide knowledge and competences that these companies require, is simply due to the current developments in the global economy where the new big markets, especially in China, India and Brazil present a lot of opportunities, while the importance of the European markets is decreasing. These developments require new types of competences, and a lot of them are linked to the local markets and cultural understanding. This is, obviously, something that can be obtained only

through partnerships that provide necessary competences or by moving closer to these foreign locations and starting to develop the local relationships with suppliers, customers and scientific communities.

Looking at the main challenges that these five internationally dispersed companies are dealing with, they are not necessarily directly linked to or caused by geographical distance, cultural diversities or different locations of the companies' structures, including their R&D units. Most of the companies have adjusted to the situation of having international operations and partnerships. Furthermore, the knowledge transfer between the companies and their cooperation partners, be it suppliers or universities, were not acknowledged as problematic. There seems to be a general understanding, that if a company wants to compete in global markets, cultural diversity and language difference cannot be perceived as obstacles, but rather become a part of the business environment and business realities.

However, there are two sets of challenges that are linked to internal processes and learning situation within the companies. One is related to information sharing and knowledge creation, and another to adapting to work with international partners or in international locations. Several companies admitted problems with information sharing in their organizations. It seems that the problems were partly due to the lack of overall motivation and organizational culture that supports the information sharing, while the emphasis was often put on standardized procedures and mechanisms. The officially formulated values in the companies that often included importance of knowledge sharing and creation, were not necessarily followed up and implemented throughout in the companies, but, instead, were seen as a task of designated departments, particular functions or designated people.

New international partnerships and expansion to new markets were also generating new demands in terms of organizational change and adaptation. A new learning situation was created in several companies and their respective R&D and Innovation departments. It required not only understanding of new foreign cultures, but it was also challenging the traditional way of thinking and the historical, path-dependent procedures and processes within the companies. It is quite apparent that if these companies were to gain opportunities from the new diverse markets, they were required to be open-minded in terms of new cultural experiences and the changes that might be brought along. This situation also demands to have a critical approach in managing the companies' international partnerships and to have self-awareness about one's own market and culture understanding.

Policy implications

If we try to summarize the consequences that the current development of Norwegian industrial R&D internationalization might create in the future, they might have an impact on the NSI and innovation and science policies in Norway. If the current tendencies of the R&D internationalization among the Norwegian companies continue to prevail, especially towards the global expansion, then several policies, financial instruments and the role of several important actors within NSI, e.g., technical universities and institutes, might need be reassessed and could change. In other words, the question is - what will be the consequences to the Norwegian scientific community, if the large Norwegian companies increasingly rely on the sources of innovation and knowledge outside the national borders? It would, most likely, have consequences as to what types of the research institutes, competences and scientists are required in Norway in order to support industrial R&D and innovation. Additionally, it can have general consequences for the higher education system in Norway and for political considerations about what type of competences are missing in Norway and whether they need to be developed nationally or not.

It is also worth considering, whether the current financial instruments of the innovation policies, for instance, the programs and grants managed by the Research Council of Norway, are in line with the current tendencies in the global economy, innovation and the internationalisation incentives of the large Norwegian companies. Should they be much more actively supporting the participation of the Norwegian industry and scientific institutes in the globalized networks or whether the present focus on developing competences inside Norway should be maintained? For example, it is also interesting to consider the growing interest of the Norwegian companies in the markets of Brazil, Russia, India and China in the context of the current Norwegian participation in the EU framework program and the money allocated for it, which might be reconsidered. If the importance of the EU markets is somewhat declining and the Norwegian companies are more interested in the markets and cooperation in other places outside Europe, would that also mean that the scientific collaborations with the EU should be reassessed?

Referring to education policies and the role of Norwegian highest education system, the current global economic development towards new markets in Asia, Brazil and some African countries might encourage the Norwegian universities to intensify cooperation with the educational institutions in the emerging markets in order to achieve exchange of knowledge,

ideas and cultures. Thereby the Norwegian companies and the Norwegian experts would be better prepared for the opportunities and challenges in those markets, as well as learn from the external expertise. This could have direct implications for national education, science and innovation policies in Norway.

Future research

When considering the future research topics, it would be interesting to explore in greater detail, how the subsidiaries and technology hubs of the Norwegian companies contribute to knowledge creation within companies and whether establishment of the R&D units abroad has a significant impact on the information sharing and learning in the companies. In order to carry out this type of research, it would be necessary to conduct visits and interviews with the companies' representatives in the foreign locations. Another direction of research could be aimed at exploring the role which cultural aspects and cultural diversity play in the scientific collaboration between the Norwegian companies and their partners in the countries like China, Brazil or India.

In the longer time perspective, possibly in the next three to five years' period, it would be interesting to follow whether the dispersion of the R&D globally will continue, or whether the centralized and path-dependent approach within Norwegian NSI will prevail and companies would "return" to Europe. Then it could be possible to assess whether the interest in the new markets and new places for acquiring complementary knowledge is a long-lasting tendency or it has been, in fact, largely triggered by the current economic crises in Europe and the USA. Additionally, outside the R&D internationalization framework, the studies of knowledge creation and sharing systems in the countries like China, India and Brazil might be of particular interest for both industrial R&D and for the universities in order to enable improved collaboration and communication with the local scientists and experts in those countries.

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Annex 1. Interview guide

Questions related to the Innovation Process and R&D strategies

- How would you describe Innovation and R&D strategy? What are the main sources for innovation?
- Can you describe how the Innovation Process and R&D are organized? How many research centres do you have? Where?
- Who are your main cooperation partners in Norway and outside Norway?

Questions related to international R&D activities and international operations

- How would you describe international R&D strategy? Do you have any R&D activities abroad?
- Do you gain useful knowledge from international markets, customers, industries and production plants that you can use in your R&D?
- How does your company learn from foreign markets, customers and partners?
- Do your sales offices abroad or subsidiaries report on customers and market needs?
- Who are your main cooperation partners in the foreign locations?
- Do you establish cooperation with international research centres and local research communities?
- Are there any recent changes and new developments in international operations or international R&D strategies?

Questions related to knowledge transfer/knowledge creation

- What do you think about international operations and the company's presence around the world: does that create challenges for knowledge transfer and knowledge creation for your company?
- Can you tell about knowledge transfer process to the foreign locations and back (mechanisms, challenges)?
- Is there any kind of particular mechanism how lessons are captured and knowledge shared from different locations?

- Do you think that different cultures and geographical distances are important factors for knowledge sharing?
- What do you think about “human” role in knowledge transfer?

Questions related to expertise and experience

- What are the crucial expertise areas for your company for sustaining innovation and competitiveness?
- How do you identify opportunities and potentially useful knowledge outside Norway?
- What departments and what type of people are working on these subjects?
- How would you describe your company’s knowledge about the “local” settings and local culture in the foreign locations? How do you develop this knowledge?
- Who works at the foreign offices? Are they mainly local experts or your own staff posted abroad?