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Knowledge sharing in a maritime cluster

How companies share knowledge through
an open innovation process

- Master thesis -

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Abstract

How is knowledge shared through the process of open innovation in a cluster?

Purpose – The objective of the thesis was to look into how knowledge is shared through the process of open innovation in a cluster. The term open innovation process refers to the process in which companies acquires and exploit knowledge sources outside of their organisational boundaries. The framework of the thesis is within the notion of the theoretical concepts of "open innovation" and "communities and networks of practice".

Approach – The thesis research this topic through a qualitative study. The empirical data that form the basis of the study was collected through interviews with people working within the cluster. It has also taken use of second hand data in the form of published research and reports of the cluster in order to ensure the validity of the data. Towards the end of the thesis these empirical data is discussed in the context of the theoretical framework in order to provide a nuance insight and understanding.

Findings – The thesis found that knowledge is shared through the openness on the vertical axis where the ship owners play an integral role. The process is not a managed process as called for by the definition by Chesbrough but rather a naturally developed process within the cluster that stems from the regional culture. It also found that links towards academia plays an important role both in terms of terms of acquiring and developing new knowledge and in transcending the organisational boundaries of the companies in order for knowledge to flow.

Importance/ Value – The findings of the thesis can be used in order to better understand the complex process of knowledge sharing within a cluster. It also exposes a potential risk of disrupting the knowledge flow if integral actors, such as the ship owners relocate out of the cluster. It also shows that knowledge flow follows the openness of organisational boundaries.

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1. Introduction

The maritime cluster in the region of Møre on the west coast of Norway has a long tradition of fishing and shipbuilding. And in the recent decades as the oil industry has grown in Norway the cluster has taken the position as world leading within advanced maritime operations. The cluster has a unique constellation of maritime companies coupled together with specialized research and education institutes. The thesis will look into how knowledge is shared through the process of open innovation in the maritime cluster. With the term open innovation process it refers to the process where knowledge and information is shared within the cluster through openness of the companies organisational boundaries. The research question the thesis sets out to answer is "How is knowledge shared through the process of open innovation in a cluster?" and through four sub-research questions the research will be limited to within the theoretical concept of "open innovation" and "communities and network of practice". However the thesis will also look into the cultural aspect of the region that seemingly plays an important role in the cluster. From a theoretical point of view it is interesting to look into this process since there are little research conducted into open innovation within clusters. Also the concepts of communities and networks of practice seem to be based on the same innovative mechanism of sharing knowledge across organisation boundaries as the concept of open innovation. It is therefor interesting to look into how these interplay and what role they have in the knowledge sharing in a cluster.

An important part of the cluster is Campus Ålesund that consist of: Norwegian University of Science and Technology (NTNU), Norwegian Maritime Competence Centre (NMK), Ålesund Knowledge Park (ÅKP), Ålesund Technical School, Sunnmøre District Museum, SINTEF, Møreforskning (Møre research). There are also several small and large companies such as Rolls-Royce Marine, Aker Solution and Offshore Simulation Centre. In total there are about 3000 students and 1500 employees on the campus (Legasea 2015 review). For the cluster as a whole it consists of 13 design companies, 14 shipyards, 20 ship-owner companies, 169 equipment suppliers and 22´500 employees. Collectively the cluster control 40% of the world's modern fleet and with combined revenue of 55 billion NOK. To put this in perspective Norway only accounts for 0,1% of the worlds population but still controls over 5% of the

worlds merchant fleet and has the second largest offshore fleet in the world, after USA. (GCE Blue Maritime) One important aspect for the thesis will be the cluster project GCE Blue Maritime which is facilitated by Ålesund Knowledge Park. Their key alliance partner Innovation Norway sponsor the cluster project and the cluster has received the status as Global Centre of Expertise (GCE). Innovation Norway is a state owned company and national development bank and their objective is to promote nationwide industry development and innovations. The cluster project GCE Blue Maritime is part of a nation vide effort to strengthen the largest and most futuristic sustainable industry clusters in Norway.

The motivation behind the thesis and subsequently the research question is two folded. Firstly, the theoretical aspect has intrigued me through out my studies of organisational innovation and entrepreneurship. The concept of innovating through openness and sharing is for me a highly interesting concept and especially how this could apply in a cluster. This also brings me over to the second aspect, which is the cluster it self. I am from the region and grew up in Ålesund where fishery and shipbuilding always have play a key role and this caught my interest early one. Previous of my studies I work at Rolls-Royce Marine located at NMK (Norwegian Maritime Competence centre) in Ålesund. And how the cluster and its companies are able to sustain a high rate of innovation and how they collaborate and share knowledge and information with each other developed into a key interest of mine. This combined with my studies have led to the research this thesis is conducting into the cluster.

The thesis will first look into the theoretical background for the research and then proceed into the empirical data collected before this culminates into a discussion between theory and phenomenon observed in the empirical data. The data have been collected through several interviews with persons from different organisational level within the cluster in order to provide a broader insight. Further the thesis is structured into analysis of four main topics within the empirical data that each highlights important concepts and point of views. The thesis will result in a broader understanding into how knowledge is shared through the process of open innovation within a cluster.

2. Theoretical background

This chapter will form a theoretical background for the thesis by looking into previously conducted research and literature within relevant topics. It also formed the basis of which the theoretical framework for the thesis has been developed. Note that the term open innovation process is used in the thesis to describe the process in which knowledge and information is shared through openness of the company's organisational boundaries.

2.1 Previously conducted research

The first part will look through previously conducted research that might provide a better insight and understanding of what have been researched before as well as provide relevant information for this study. To start is the article by Benito at el. (2003) with the name "A cluster analysis of the maritime sector in Norway" that sets out to analyses the maritime sector in Norway from a cluster perspective. The first obvious limitation for relying on data from this article is the year it was published, 2003. In todays world of constant innovations and technological progress thirteen years is a very long time and it would be safe to assume that large part of the findings in this article have now been obsolete. But it can still provide an insight into how the cluster operated a decade ago and can give an interesting perspective on how the maritime cluster has evolved. In this sense the article provides two interesting findings about the cluster. The first is that the article found that the companies within the cluster had not yet fully realized and acknowledged the value of cooperation and openness between companies. The second is that the maritime cluster had a low rate of innovation for some time in contrast with todays cluster that largely is defined by its high rate of innovation.

An article that provides a better insight and description of the maritime cluster in Møre is the article "The dynamism of clustering: Interweaving material and discursive processes" written by Fløysand, Jakobsen and Bjarnar in 2012. The main objective of the article is to gain a better understanding of the material and discursive dynamic of cluster constructions and looks into the maritime cluster in Møre as one of their cases. In the article it represent a cluster data with a material construction, which they define as "*the use of the cluster concept is encouraged by the observed preceding practice and networking of co-located firms*" (Fløysand, Jakobsen

and Bjarnar 2012, p. 948). The article proceeds and characterise the cluster as one with a high level of network, knowledge sharing and collective learning. One key feature with the cluster is its relations and interactions between local collaboration and competition. It is the formal and informal links between the cluster members that gives the cluster its dynamics. The article also acknowledges that some innovations and development have been a result from a top-down vertical relationship. But it also clearly states that the most important have been the horizontal networks and flow of knowledge with regional scaled networks, which the cluster participants also highly value. This is in great contrast to the article mention before by Benito at el. that describe quite a different reality for the cluster in terms of collaboration and the rate of innovation back in 2003. The article by Fløysand, Jakobsen and Bjarnar (2012) also places importance on the local network and co-operation that have formed over time in the cluster as a regional entity. Towards the end it also expresses some of the cluster participants concern that the increasing number of foreign actors in the cluster and the spatial recalling of the network composition might be a threat towards the cluster as a genuine regional cluster.

In the period 2010-2014 the Business School BI, Molde City College and Møreforskning conducted in collaboration with some key companies within the cluster a research project named MarCo. The aim of the project was to look into new modes of collaboration in the maritime industry in Norway and the project looked into collaboration models and tools for working processes both externally and internally in companies and the cluster. The project did not look directly look into the concepts of open innovation or communities and networks of practice, but it did provide some relevant data. Perhaps the most relevant is an article about the smartness of sharing knowledge (van Oorschot, Solli-Sæther and Karlsen. 2014), but then towards Chines partners. This article points out that knowledge sharing and partnering always is based on thrust, but both sides want to gain from it. Norwegian companies wants access into Chines market, and the Chines wants to learn and gain access into Norwegian knowledge. They developed a simulation model in order to determine whether the Norwegian companies should share their knowledge or try to protect it as best as possible. By protecting their knowledge the imitation and stealing from the chines side is much lower. But so is also the feedback and inspiration about what the Chinese market need in terms of new technology and product that the Norwegian side gains in return. However, if they share the knowledge the imitation and stealing of knowledge from the Chinese side will

increase, but so will the rate of innovation increase at the Norwegian side. The conclusion they reached was "to share!" as this would benefit both sides in the long run.

It proved difficult to find relevant research previously conducted into the notion of Open Innovation within a cluster. This is underscored by the article "Surfing the new wave of open innovation research" by Vanhaverbeke, Chesbrough and West (2014) that suggest further analysis into the role of local clusters should be done in order to determine the effectiveness of open innovation. Vanhaverbeke, Chesbrough and West (2014, p. 289) also remarked in the article that *"...the benefits of open innovation may be better realized in regional clusters, which provide an improved environment for information exchange, and because collaboration among firms (and research organisations) in a cluster is a major factor in the success of the cluster*."

2.2 Communities and network of practice

Lave and Wenger (1991, p. 98) defines a community of practice as "*a set of relations among persons, activity and world, over time and in relation with other tangential and overlapping communities of practice."* These relations are an inherent condition for the very existence of knowledge and it is what gives the interpretive support needed for us to understand our heritage. So the knowledge that exists within the participation in the cultural practice is an epistemological principle of learning. Further they (Lave and Wenger 1991, p. 98) stated that *"the social structure of this practice, its power relations, and its conditions for legitimacy define possibilities for learning."*

"At whatever level or task, small groups working closely together, sharing insights and judgment, both develop and circulate knowledge inevitably as part of their practice." (Brown and Duguid 2000, p. 25) For these knowledge groups the shared practice that circulates knowledge and makes them strong is also what limits them, as the group will be limited by its boundaries. The knowledge will be stuck within the group and new knowledge will not be circulated outside the shared practice. And the knowledge dynamics for groups can be explained, regardless if they are predominantly practical or theoretical with communities of practice (Brown and Duguid 2000).

Situated learning is a theory that learning does not just come from the direct transaction of knowledge but also from the social context and process it takes place in (Lave and Wenger 1991). It is in many way similar and based on the same principle of learning in and of your social surroundings as the notion of social and cultural capital developed by Pierre Bourdieu (1986). Lave and Wenger (1991) state that situated learning in the communities of practice transforms into legitimate peripheral participation. In basics what they mean is that in the communities of practice you still learn from your surroundings and by being in the situation, like situated learning, but also when you are not a full participant. It is enough to just be a part of the community, even though passive or peripheral, to learn from it.

"Knowing is inherent in the growth and transformation of identities and it is located in relations among practitioners, their practice, the artefacts of that practice, and the social organization and political economy of communities of practice." (Lave and Wenger, p. 122)

A key characteristic of a cluster is that there is undoubtedly a high level of knowledge inside the firms, but also a high level about the firms. In other words people outside the firms still know what they are developing and information that normally would be seen as sensitive for a company is widely known within the cluster. *"Ambient awareness of what its close competitors are up to drives a firm to innovate to stay ahead."* (Brown and Duguid 2000, p. 21) This is due both formal and informal interactions. Formal in the sense where companies them self announce what they are up to. Informal where the employees due to localization meet and interact with employees of other companies and share information and knowledge, as well as people changing jobs between the companies.

Brown and Duguid (2000, p. 28) defines network of practice as: *"Networks that are made up of people that engage in the same or very similar practice, but unlike in a community of practice, these people do not necessarily work together*." The mechanism of the knowledge sharing is the same but it is between the different communities of practice and therefor often not as strong as the knowledge sharing within one community. Generally speaking we can also say that when networks grows larger only certain very general ideas will be able to spread through the networks. One reason for this is that the links across the network may be fairly distant and they are not as strong as the links within a community. But within clusters the network of

practice is typically quite strong and it will have many of the same advantages as the community of practice, but between firms within the cluster instead of internally. This comes as a result of the cluster participants close proximity to each other and in many cases shared social networks both in work situation but also outside work. In some cases the links can become so close that they form new intercompany communities of practice. These interpersonal relations accelerate the knowledge sharing between the different organisations within the cluster. *"Innovative firms succeed by bringing together different communities and coordinating their different practices and belief systems."* (Brown and Duguid 2000, p. 27) A firm's strength, in the perspective of knowledge dissemination, lies in its willingness to take on the high initial cost of starting the knowledge flow between communities with minimal shared practice.

2.3 Open innovation

Open innovation is defined as "*a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organisations business model."* (Chesbrough and Bogers 2014, p. 17) The main defining characteristic of open innovation is the exploitation of knowledge, both inside and outside the company, in order to be innovative. In other words, open innovation is quite literately to look outside the box that is the company. Open innovation transcends the company's organisational boundaries and enables the knowledge used in the innovation, as well as the knowledge resulting from it, to permeate both inside and outside of the company's organisational boundaries (Chesbrough, Vanhaverbeke and West 2014).

The flow of knowledge across the organisational boundaries can be divided into three types of open innovation, outside-in, inside-out and coupled. (Chesbrough and Bogers 2014) These different types of open innovation are best illustrated in the figure on the following page.

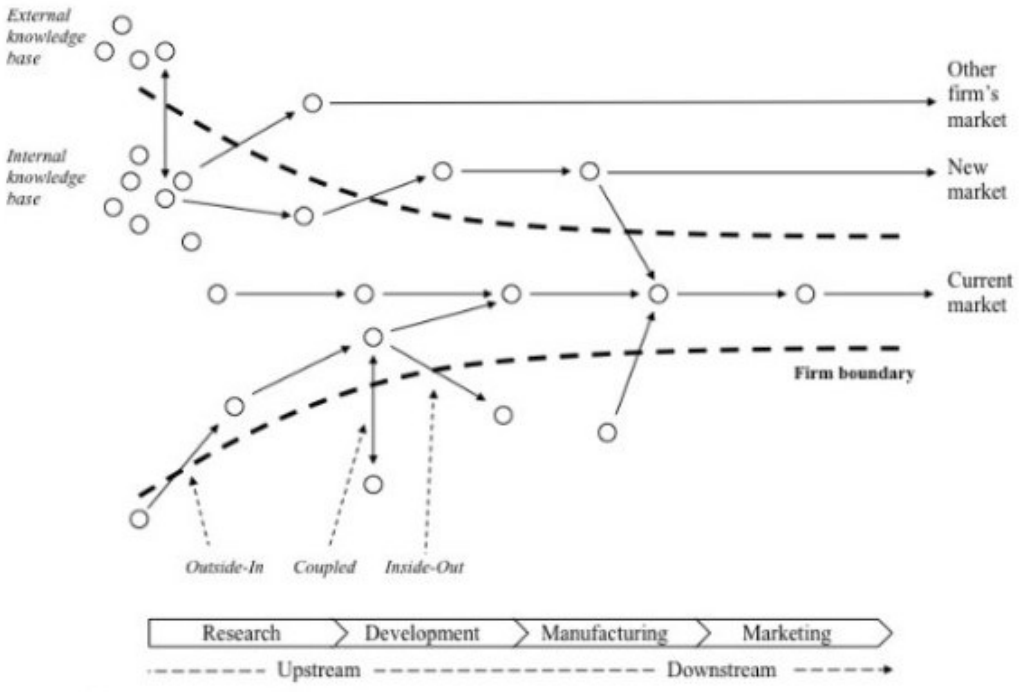


Figure 1 – Illustration of open innovation (Chesbrough and Bogers 2014, p. 18)

2.3.1 Outside-in open innovation

Outside-in or inbound open innovation is the inflow of knowledge into the organisation. In this situation the organisation is working to exploit external knowledge sources through internal processes. It requires the organisation to open up its innovation process towards many kinds of external sources and inputs. Which external sources and inputs that will be taken forward into the market will largely depend on the organisations business model. There are many mechanisms in outside-in open innovation that can help an organisation to manage the purposive inflow of knowledge, such as: Scouting, suppliers and customers, university research programs, funding start-ups, competitions and tournaments, in-licensing IP, etc. (Chesbrough and Bogers 2014). This model combines using externally and the organisations internally developed knowledge and innovations in order to create an offering that then will be commercialised by the organisation. The steps in the process are first to find external knowledge and innovation, then select the once that are suitable and then it have to be integrated in the organisations R&D in order to create either a product or a service. It is important for the organisations using outside-in open innovation to carefully consider the knowledge flow brought into the company, which they will combine with their internal knowledge capabilities. This since they will have to finance the final development, production

and marketing of the product by themselves. External knowledge sources often have economical motives behind their offering. And it is not unusual that the company absorbing the knowledge flow as an input for their internal innovation process does so in exchange for a monetary compensation. (Piller and West 2014)

2.3.2 Inside-out open innovation

Inside-out or outbound open innovation is the outflow of knowledge from the organisation to an external knowledge base. It is the opposite of an outside-in type of open innovation, where instead of exploiting external knowledge the organisation is leveraging internal knowledge through external commercialization processes. This kind open innovation requires the organisation to release and let unused or under-utilized ideas and assets go outside the organisations boundaries for others to use. Also here there are several mechanisms to help the organisation manage the purposive outflow of knowledge, such as: donating IP and technology, joint ventures corporate incubators, alliances, spinouts, etc. (Chesbrough and Bogers 2014)

A classical inside-out open innovation is venturing, when a company create a new start up in order to exploit a latent potential in the mother company. There are typically two main rations behind it. The first is financial in order to create new revenue and maximize financial return. In such a case the management will be better off leaving the new start-up with more autonomy and self-governance. The second ration is a strategic one to take advantage of a potential for additional growth within the company. In this case on the other hand, the management should be more involved and intervene in the new start-up to avoid conflicts with the mother company. A well known problem for venture capitalists is the “founders death grip”, which is when a founder is not able to let go of the control over or change the direction the start-up is going despite overwhelming market feedback indicating that it would be the right thing to do. Spin-outs on the other hand do not seem to suffer from the same problem. (Chesbrough and Winter 2014)

Complex spin-out ventures are spin-outs that are built up of parts from multiple sources or organisations. Typically it could be a spin-out with access to a powerful technology that needs parts from outside the organisation in order to create a complete customer proposition. Such

complex spin-out can be used as a tool to gain new, otherwise unachievable, business opportunities for the company. (Chesbrough and Winter 2014)

It is important for the management to change its view on how to govern innovations while dealing with inside-out open innovation. It must not be seen as something controllable from the inside, but rather as an ecosystem that can evolve. A final important aspect of inside-out innovation is its potential to make a culture or process within an organisation more innovative, as stated by Chesbrough and Winter (2014, p. 220) *"…inside-out innovation has the potential to change the culture and processes internally to support more innovative environment and make the organization more open to new ideas from both inside and outside the main operating culture."*

2.3.3 Coupled open innovation

The coupled type of open innovation is a combination of the two previously mentioned open innovation types. The organisation is combining the external knowledge sources with the commercialization activities. This type of open innovation means that the organisation has to combine both the purposive inflows and outflows of knowledge in order to develop and/or commercialize an innovation. It involves two or more partners that also purposively manage their mutual knowledge flows across their organisational boundaries through commercialization activities and joint innovations. In order to manage the purposively knowledge flow the organisations can use mechanisms such as: networks, joint ventures, ecosystems and platforms, consortia, strategic alliances, etc. They may also in principle implement any combination of the respective mechanisms mentioned for both outside-in and inside-out type of open innovation. (Chesbrough and Bogers 2014) The broad conception of coupled open innovation processes can be extended and specified by through the four dimensions shown in the figure on the following page.

Dimension	Alternatives
External Actor	• Firms; customer, supplier, complementor, rival • Other organizations: university, research lab, government, other non profit • Individual: customer, user, inventor, citizen
Coupling topology	• Dyadic: single partner • Network: multiple partner • Community: a new interorganisational entity
Impetus for collaboration	• Top-down: initiated by upper management • Bottom-up: developed through employee or customer collaborations
Locus of innovation	• Bidirectional: innovation created within each organisation • Interactive: innovation jointly created outside the organisations

Figure 2 – Dimensions of coupled open innovation (Piller and West 2014, p. 38)

An important dimension is the locus of innovation where there are two distinct approaches towards coupled open innovation, which are bidirectional and interactive. This dimension differentiates between two kinds of knowledge flows. In the bidirectional approach the organisation continues their separate innovative efforts but utilizing each other's knowledge. While in the interactive approach the innovative effort takes place outside both organisations boundaries as an interactive collaborative process of joint value creation. This differentiation is illustrated by the figure below.

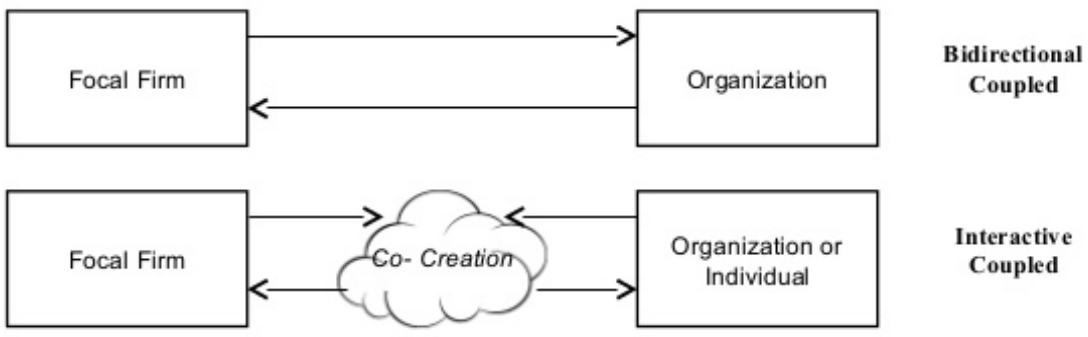


Figure 3 – Illustration of coupled open innovation (Piller and West 2014, p. 39)

The concept behind the bidirectional coupled open innovation process is cooperation between two or more organisations where they share information both ways. This knowledge flow will help the organisations to become more innovative and create better knowledge together then they can achieve separately. What sets this bidirectional open innovation process apart from a classic cooperation between two organisations are that the classic cooperation is a simple exchange of product or a specific IP with the aim create a specific product or service. While with a bidirectional open innovation process it is the knowledge and ideas behind that are shared through a knowledge flow with the objective to create new knowledge or innovate new products or services. It still resembles closely a typical cooperation between the organisations if somewhat more open and less restricted in terms of the knowledge flow then a more classical cooperation. According to Piller and West (2014) an interactive coupled open innovation process usually entails a four-step process, as show in the figure below.

Process stage	Key activities
Defining	• Problem formulation • Institutions and rules: including contract terms, IP • Resource allocation and strategic commitment
Finding participants	• Identifying participants with right characteristics • Motivating and retaining a critical mass of collaborators • Selecting the right participants
Collaborating	• Governance of the collaboration process: organising, monitoring, policing • Interaction platform and other tools • Openness of firm attitudes, structure and processes
Leveraging	• Integrating external knowledge • Commercializing the knowledge through products and services

Figure 4 – Interactive coupled open innovation process (Piller and West 2014, p. 40)

2.3.4 Enablers and Barriers

The most widely know enabler and barrier for implementation of open innovation is culture, but there have been very little research done into this subject. It is believed that culture most often act as a barrier towards the implementation of open innovation. The most cited barrier of open innovation is however the "not-invented here" syndrome, which in short is the organisations distrust and scepticism towards external knowledge. In order to ease the implementation of open innovation it is important to motivate the employees and build a trust linkage between the organisation and the external knowledge source. In some cases the geographic location can act as en enabler for open innovation as it eases and promote communication across organisation boundaries (Mortara and Minshall 2014).

2.3.5 Innovation intermediaries

In the different stages of the external knowledge searching organisations can take advantage of innovation intermediaries, so called innomediaries, to improve their chances of success. Two different kinds of innomediaries with their respectively subtypes can be distinguished, as shown below. (Roijakkers, Zynga and Bishop 2014)

1. Innomediaries that offers their service based on the interaction between their staff and the clients they are surveying, thus heavily rely on experienced personnel.
    a. Innomediaries that help with the external knowledge and technical solution searching.
    b. Innomediaries that help companies make use of their unused IP.
    c. Innomediaries providing staff to help the client solve open innovation problems

2. Innomediaries that offers their service based on the interaction between innovation companies and technology and thus heavily rely on software programs and search engines.
    a. Platform providers that offer platforms for innovation companies to post their technological needs and offerings.
    b. Software companies that create platforms for ideation/searches.
    c. Crowd sourcing companies that provide access to consumers.

(Roijakkers, Zynga and Bishop 2014, p. 243)

The figure below shows how innomediaries can potentially add value in the different stages of the external knowledge searches, value-adding actions by innovation companies and key success factors related to each phase.

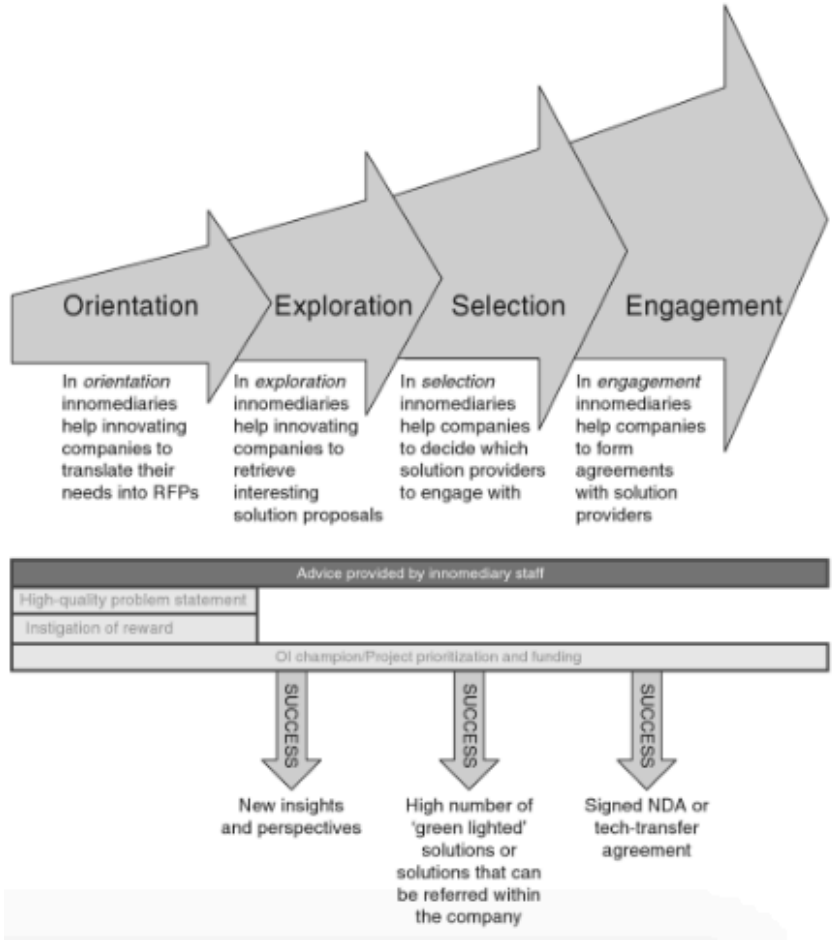


Figure 5 – Added value by innomediaries (Roijakkers, Zynga and Bishop 2014, p. 245)

2.4 Clusters as ecosystems

A concentration of competing, complementary, interdependent firms and industries that create wealth in a region through exporting to other regions are defined as industry clusters by Henton (2000, p. 48). He further state that the proximity within the cluster helps to reduce the transaction costs, which is of great importance for fast-moving companies. A cluster can be looked at as an ecosystem with many different species and a complex interaction system. Also, in many cases someone´s loss can be someone´s gain. In the example where proprietary knowledge leaks from a company, this could be a significant loss for the company but a gain for the cluster as a whole. It might be tempting for the company that sustains such a loss to

close down, but as with all ecosystem they also feed of it and trying to isolate themselves from it will most likely make a bad situation even worse and spell disaster for the company (Brown and Duguid 2000). In order for the information and ideas to circulate through the network and be understood in a correct manner it is important the all participant of the network have the same baseline of knowledge on the subject.

In order to give us a more complex and enriched understanding of the business environment then the classical industry concepts there have been defined two types of ecosystems, business ecosystems and innovation ecosystems. Viewing the business environment as ecosystems underscores the relationship between the innovation of the firm and the firm's environment. It also implies that proactive firms can contribute to shape their business environment, instead of them being shaped by it. (Christiansen 2014)

Business ecosystems are defined as *"…the community of organisations, institutions, and individuals that impact the enterprise and the enterprises customers and suppliers."* (Teece 2007, p. 1325)

Innovation ecosystems are defined as *"…the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution."* (Adner 2006, p. 96)

Christensen (2014) also uses the concept of ecosystems to address the collaborative context for product markets and industry, as illustrated in the figure below.

<table>
<tr><td rowspan="2"></td><td rowspan="2"></td><td colspan="2">Nature of business context</td></tr>
<tr><td>Emerging</td><td>Mature</td></tr>
<tr><td rowspan="2">Nature of inter-firm business relations</td><td>Competition</td><td>Product market</td><td>Industry</td></tr>
<tr><td>Collaboration</td><td colspan="2">Eco-system</td></tr>
</table>

Figure 6 – Concept of business ecosystems (Christensen 2014, p. 103)

The most well-known and classical example of a cluster today is Silicon Valley. And a key defining feature of Silicon Valley is described by Lee et al. (2000, p. 10): *"Although companies in Silicon Valley fiercely compete, there is also an attitude that all can gain from sharing knowledge that is not company-secret."* From this attitude towards knowledge sharing the open standard and environment came to life. Lee at al. (2000) describes that within this open standard or environment there is individuals open to win-win exchange of knowledge.

In an industry or technology cluster the close geographic locality towards the other organisations within the cluster can influence the mobility of the human resources. Typically the inter-organisational mobility of the workforce is higher in a cluster. This high mobility rate leads to an increased knowledge spill over and it will also be a promoter of open innovation. The network a person that change job at his or hers former employer can serve as a collaboration linkage for open innovation. (Asakawa, Song and Kim 2014) The location towards well-qualified workforce is also a very important factor as stated by Lee et al. (2000, p. 10) *"Research institutions and universities are such rich sources of advanced research, and of well-trained and often experienced scientists and engineers, that locating near them is now widely recognized as a powerful advantage for high-tech companies".* In the case of the Silicon Valley cluster the local government also contributed to the continuous growth of the cluster by reducing the transaction cost for businesses through streamlining of permit processes, building code etc. (Henton 2000)

As the world is moving towards a knowledge society where the intangible goods within a firm become increasingly important. This also increases their valuation of qualified labor and the measures of R&D and patents exponentially. And according to Cooke (2005) this has spatial expression in regional innovation systems and clusters. The increasingly demand and used of networks with the research industry such as research institutions and university centres of excellence. They also note that clusters become more characterized by both knowledge specialization and diversification. And the rise of regional knowledge capabilities is partly due to the potential for disruptive innovation as well as the scarce knowledge capabilities that may be found in or near universities. They theorize that in the early stages of a new technology there will be few institutions, be it university or firms that can exploit it and there will be a "pipeline" transaction. Further when new firms that starts up into the newly

developed cluster they will keep the close affiliation with their home university and therefor "open channels". This "open science" thus creates a knowledge spill over that creates highly innovative environments. But the real knowledge production will first start when diversification within the cluster begins. And the final step is when they go back towards "pipeline" transaction and exploit the technology and knowledge create. The figure below describes the process and stages that characterize knowledge clusters.

	Specialization	***Diversification***
Pipeline	1. Embryonic	4. High success
Open science	2. Innovative	3. High potential

Figure 7 – The stages of knowledge clusters (Cooke 2005, p. 93)

2.5 Theoretical framework

In the early 2000´s the maritime cluster and the companies within it had not yet fully realized and acknowledge the value of cooperation and openness between companies and it also had a rather low rate of innovation according to some previous research. Since then much has changed and today one of the key characteristic of the cluster is their high rate of innovation and having a high level of network, knowledge sharing and collective learning. This fits neatly together with the emerging of Henry Chesbrough concept of "Open Innovation". He also stated that open innovation might be better utilized in a regional cluster since the level of collaboration between the companies is an important part of any cluster. The cluster has by previous research been characterized as one with a high level of network, knowledge sharing and collective learning. Clusters are a complex composition of companies that can be seen as an ecosystem of competing, complementary and interdependent firms and industry within a limited geographic area. The knowledge sharing could therefor potentially be caused by and explained by several mechanisms and theoretical concepts. However for the purpose of this thesis the knowledge sharing and learning in the cluster will be seen through the notion of an open innovation process.

Open innovation is an innovation process in where companies aim to exploit both internal and external knowledge sources across organisational boundaries. These knowledge sources

could be anything from other companies to customers and academia. And there are several concepts of open innovation, as outline earlier in the theoretical background, which can be utilized in order to gain access to these knowledge sources. But at the core of these concepts is Henry Chesbrough definition of open innovation that the process must be a purposively managed flow of knowledge. This is of importance sine the notion of communities and networks of practice are based on the same innovation mechanism of sharing knowledge across organisational boundaries. But in this concept it occurs as a naturally forming process amongst peers. It is important to also take into consideration the workforce mobility as the workforce could potentially be a part in both distributing an inherent knowledge for a organisation as well as open up new links for open innovation.

What has been show through the theoretical background are several concepts that can distribute knowledge through a cluster. A key aspect for a cluster is the heighten knowledge and competence level within the region, and this thesis will look into how an open innovation process contributes towards this. With the meaning open innovation process in this thesis it will not exclusively focus on the processes that are "purposively managed knowledge flow" as in the definition by Chesbrough. But rather focus on the process in where knowledge and information is shared through the openness of the company's organisational boundaries. This will open up to the notion of communities and networks of practice. Based on the theoretical framework four sub-research questions have emerged. Answering these will provide a deeper insight and understanding of the study case and thus help answering the research question "How is knowledge shared through the process of open innovation within a cluster?" As a cluster is a complex composition of companies the sub-research questions also provide a limitation of the scope and further focus the topic of the thesis. The scope of the thesis will be limited to within the theoretical context of "communities and networks of practice" and "open innovation" as these are the most relevant and interesting theoretical topics for the research.

How is information and knowledge distributed within the cluster?

In order to understand how the knowledge sharing and knowledge learning within the cluster can be seen through the process of open innovation the information and knowledge flows must first be identified.

What role does communities and network of practice play?

The theory of communities and network of practice share many similarities in their innovation mechanisms with open innovation. It is therefor interesting to identify and see what role communities and network of practice plays within the cluster in order to distinguish it from open innovation.

Can the use of Open Innovation, as defined by Chesbrough, be identified in the cluster?

To understand how knowledge is shared through open innovation we must first determine where the notion of open innovation can be identified. As defined by Chesbrough in the sense that it is a purposively managed knowledge flow across organizational boundaries.

Is the knowledge sharing process in the cluster affected by the regional culture?

During the initial interview with Frank Emblem a key topic was the importance of the regional culture in the innovation process. It is therefor an interesting topic to consider while looking into the theoretical framework of the thesis. Clusters are naturally forming out from a wide range of factors, one of which is the latent culture in the region. Also take into consideration that the process of open innovation and knowledge sharing is largely based upon social interactions. The regional culture might be a factor that affects the open innovation process in the cluster and making it unique for this region and thus an important factor to be aware of.

3. Methodology

This chapter will go through the design of the study and several important considerations and definitions that follows with it in order to be able to conduct a purposeful research. To start out with it is important to understand the meaning of "methodology" and how this applies to the thesis. Strauss and Corbin (1998) described methodology as a way of thinking about and studying social reality. This is a wide term that in essence goes into how you think about your research and in which perspective you see it. There are also many useful procedures and techniques for gathering and analysing data that can prove helpful in order gain a deeper and more accurate understanding of the research subject.

3.1 Epistemology

Epistemology can be defined as: *"The theory of knowledge, especially with regard to its methods, validity, and scope, and the distinction between justified belief and opinion."* (Oxford dictionary) And the basics is that while conducting a research into the social sciences we take with us a set of assumptions and principles. Research can be thought of as a transformative process that with the use of scientific methods can transform hunches, ideas and questions, what sometimes referred to as hypotheses, into scientifically knowledge (Neuman 2000). We can look at this as our approach towards social research and it is important to be aware of and understand it before conducting a study within the social science. Neuman (2000) divide the different approaches into three main categories: Positivist, interpretive and critical. There are several common features identified between the three approaches; they are all empirical, systematic, theoretical, public, self-reflective and open-end processes. The three different approaches are not mutually exclusive. Even though it is normal to heavily lean towards on of the approaches some researchers can adapt parts from different approaches. It is the approach of positivist social science that is closest to my way of thinking and understanding of social sciences and therefor also is the approach of the thesis. The goal of this approach is to develop an understanding of social interaction and meaningful interactions and also have practical orientation. Neuman (2000, p. 66) describes the approach as "*Positivist social science sees social science as an organized method for combining deductive logic with precise empirical*

observations of individual behaviour in order to discover and confirm a set of probabilistic casual laws that can be used to predict general patterns of human activity."

Further it is not only important to know the approach towards the study but also the purpose of the study. Studies can have several purposes or goals, but typically these can be divided into three main overall categories (Neuman 2000). A study will usually have one dominate purpose or category of purposes but it can also very well have multiple.

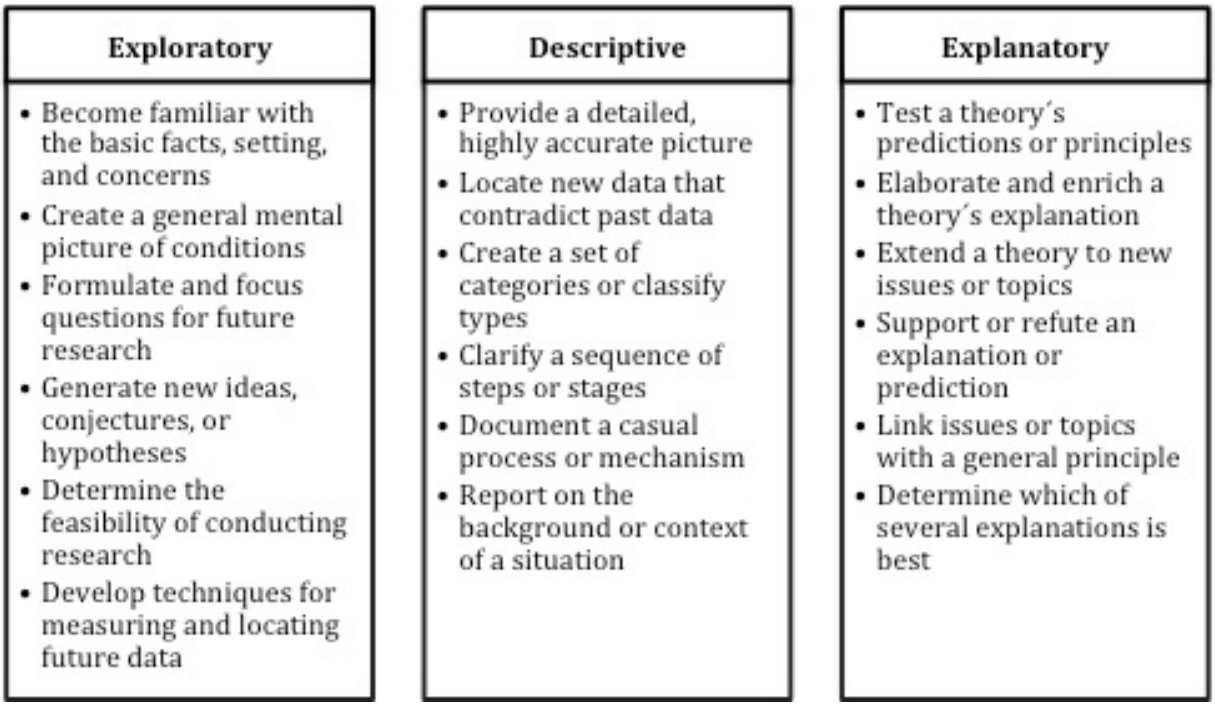


Figure 8 – Purposes behind a study (Neuman 2000, p.22)

This study has an explanatory purpose with the objective to create a best possible insight or picture if you want into the knowledge sharing process within the maritime cluster. In order to achieve this I will be best served with conducting a case study that Neuman (2000) describes as a study where the researcher typically examines, in depth, many features of one or a few cases. The cases can be individuals, groups, organizations, movements, events or geographic units. The data collected are typically very detailed, varied and extensive and it mostly involves qualitative data about a few cases. To better describe the purpose behind the study I have defined this study as an *Instrumental case.* Stake (2008) describes this as a study of a particular case in order to provide insight into an issue or redraw a generalisation.

3.2 Research question

When developing and focusing the research question it is important to know what the research question is and how its formulation can affect the research process. First we start of with the definition of a research question which Strauss and Corbin (1998, p. 35) defines as *"the specific query to be addressed by this research that sets the parameters of the project and suggests the methods to be used for data gathering and analysis".* Neuman (2000) describes focusing the research topic in a research questions is for most qualitative researcher a process that forms throughout the beginning of the research and data collection. In order to form a picture of what the researcher is really looking into, and thus the research question, it might be necessary to start the preliminary data collection and gain an understanding of the topic first. I therefor initially started out with the broader research topic of "open innovation in a cluster" and waited with developing the research question until after I conducted the preliminary interview with Frank Emblem at GCE Blue Maritime. I combined this information together with my own first hand experience from working within the cluster and with information from previously conducted research. This provided me the insight and awareness about the most important information and social mechanisms in advance. I also look into previous research and theoretical background before deciding upon the research question.

How is knowledge shared through the process of open innovation in a cluster?

Further I developed four sub-research questions that both have the function of focusing the research question and limit the scope of the research. These questions are developed out from the theoretical framework presented in the previous chapter and they are intended as steps in answering the main research question. The theoretical framework in chapter 2.5 presents a more thorough argumentation and reasoning for the development of each of the four sub-research questions and their relevance.

- *How is information and knowledge distributed within the cluster?*
- *What role does communities and network of practice play?*
- *Can the use of Open Innovation, as defined by Chesbrough, be identified in the cluster?*
- *Is the knowledge sharing process in the cluster affected by the regional culture?*

The sub-research questions also functions as a limitation on scope of the thesis to be conducted within the conceptual confines of "communities and networks of practice" and "open innovation". However they also open up for regional culture variations to be identified and investigated since the research question is generic for all clusters but is only researched in the case of one cluster. Thus leaving the possibility that the thesis findings are only valid for said cluster. The limitation of the thesis has been set within the theories of "communities and networks of practice" and "open innovation" since these are the most relevant and interesting theoretical areas for the context of the cluster. This is presented through the theoretical framework in chapter 2.5 and sets the limitation for the remainder of the thesis.

3.3 Designing the study

After deciding on the topic and defined the approach and purpose behind the research I proceeded with designing the study. Neuman (2000) describes the research process as a sequence of steps that may vary depending on the approach. But in the larger perspective they are typically as outlined in the figure to the right. It is important to note that the figure is an oversimplification of the process and its meant to give an idea of how a research progress works even though many of the steps often differ in reality. The process for the thesis was very similar to the one shown in the figure to the right. The design the in terms of which research study was used and how the study then was conducted will be presented in the following.

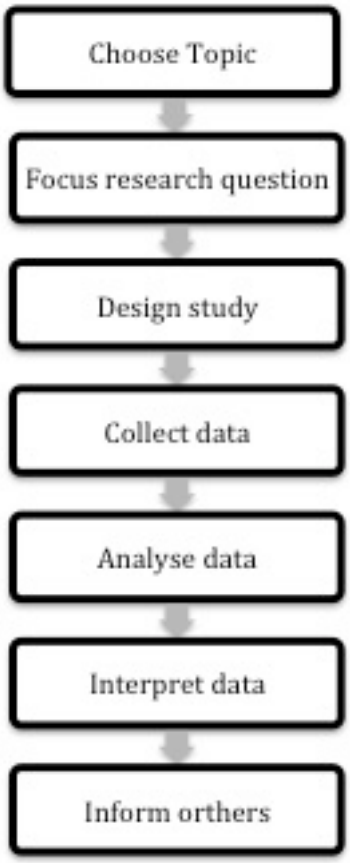


Figure 9 – Study design (Neuman 2000, p. 12)

3.3.1 Literature review

The thesis defined two types of literature. The first is a review of previously research conducted within the topic, and the second will be a review of theoretical concepts that formed the background for the analysis

of the data collected. These two kinds of literature review gave a better context in which to can understand the data collected and the outcome of the research. The two kinds of literature review can be thought of as a technical theory which Strauss and Corbin (1998, p. 35) defined as: *"Reports of research studies and theoretical or philosophical papers characteristic of professional and disciplinary writing that can serve as background materials against which one compares findings from actual data."* The necessity of literature review was underlined by Neuman (2000, p. 61) stating: *"Researchers who proceed without theory rarely conduct top-quality research and frequently find themselves in a quandary."* He also listed four goals for a literature review that can prove useful to guide the process in the right direction.

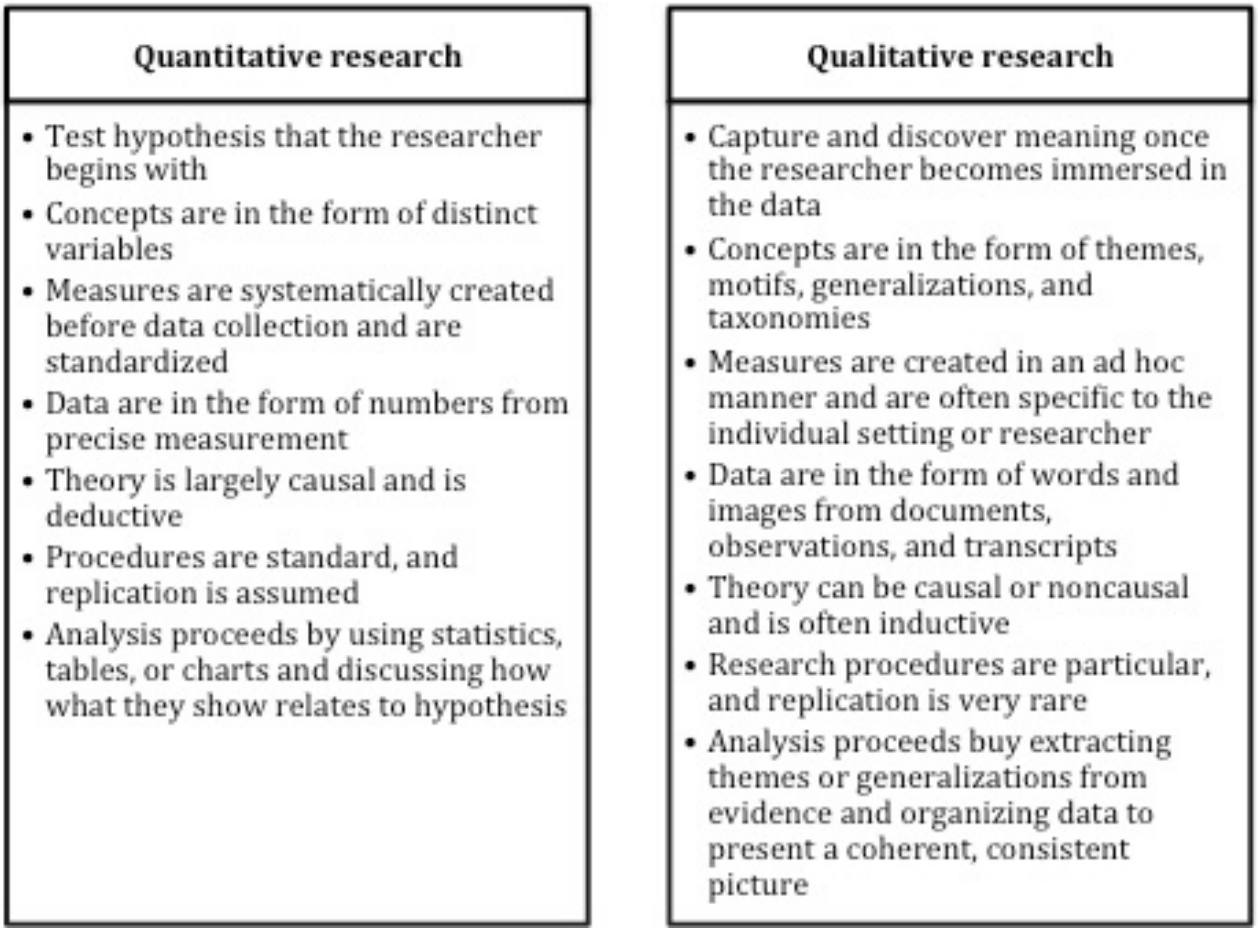
- *"Demonstrate a familiarity with a body of knowledge and establish credibility.*
- *Show that path of prior researcher and how a current project is linked to it.*
- *Integrate and summarize what is known in an area.*
- *Learn from others and stimulate new ideas."*

(Neuman 2000, p. 446)

When searching for relevant literature Neuman (2000) suggest defining a clear topic and planning before starting the search process. He also recommend to set clear parameters for the search, such as libraries used, how far back you will look and so forth. The review of literature before and during the process of the thesis was focused on literature available in the library at Copenhagen Business School, both physically and online. The main tool to find previously conducted research that might be relevant for the thesis was the online portal Libsearch where I searched for key word such as "open innovation" and "maritime cluster". The limitation of this method is that despite the large online database given access to through Libsearch there is a possibility that relevant research have been conducted at other research institutions and without being included in the search results. The textbooks used to form the theoretical foundation both in methodology and background for the as loaned at the library at Copenhagen Business School, Solbjergs Plads. This has set some limitation on the availability of the textbooks and which edition of the textbooks that have been used.

3.3.2 Qualitative research

In the world of social sciences research there are two quite different styles of research method, which are quantitative and qualitative. There are many contradictions and differences between the two research methods but they are both based on the same principle of collecting empirical data and analyse them in order to gain a better understanding of your research topic. The different techniques and methods used for the two research styles are a natural result of the different kind of data they set out to collect. Where as quantitative looks into what can be referred to as hard data the qualitative research looks into the softer data. The figure below illustrates the differences between qualitative and quantitative research.



Quantitative research	Qualitative research
• Test hypothesis that the researcher begins with • Concepts are in the form of distinct variables • Measures are systematically created before data collection and are standardized • Data are in the form of numbers from precise measurement • Theory is largely causal and is deductive • Procedures are standard, and replication is assumed • Analysis proceeds by using statistics, tables, or charts and discussing how what they show relates to hypothesis	• Capture and discover meaning once the researcher becomes immersed in the data • Concepts are in the form of themes, motifs, generalizations, and taxonomies • Measures are created in an ad hoc manner and are often specific to the individual setting or researcher • Data are in the form of words and images from documents, observations, and transcripts • Theory can be causal or noncausal and is often inductive • Research procedures are particular, and replication is very rare • Analysis proceeds buy extracting themes or generalizations from evidence and organizing data to present a coherent, consistent picture

Figure 10 – Difference between quantitative and qualitative research (Neuman 2000, p.123)

"The key features common to all qualitative methods can be seen when they are contrasted with quantitative methods. Most quantitative data techniques are data condensers. They condense data in order to see the big picture. … Qualitative methods, by contrast, are best understood as

data enhancers. When data are enhanced, it is possible to see key aspects of cases more clearly." (Ragin 1994, p.92 referred in Neuman 2000, p. 17) The objective of this study is to look into the knowledge sharing through an open innovation process within the cluster. In order to accomplish this it is necessary to gain a better understanding and insight into the dynamics of the social links and mechanisms that is formed through the openness and collaboration between the companies within the maritime cluster. It would therefor be most purposeful to adapt a style of research method that can give the best insight into these social links and mechanisms between the companies, which by definition will be qualitative. As described by Strauss and Corbin (1998) the term "qualitative research" goes to the type of research that cannot be found by using statistical procedures in a mathematical way. Qualitative methods can instead be used to research phenomena such as emotion and thought processes that cannot be quantified. There are many connections between qualitative research and case study, as Ragin (1994, p.92 referred in Neuman 2000, p. 32) stated: *"almost all qualitative research seeks to construct representations based on in-depth, detailed knowledge of cases".*

When conducting a qualitative research it is important to be aware that the data collected always will represent the view of the person it is from to some degree. This because as described by Neuman (2000, p. 148) *"a qualitative researcher interprets data by giving them meaning, translating them, or making them understandable*". It is always important to be aware of the social context for understanding the social world, as the same even or behaviour might have a different meaning in a different social context or culture (Neuman 2000). As I am from the Møre region and grew up with the culture, and have previously worked within the maritime cluster I feel confident that I will have the right understanding of the social context, as I am already familiar with it and will be able to interpret it. Qualitative data collection in it self is not a specific technique or method but rather a category of method that can be used. There are two commonly used data collection techniques that are commonly used when conducting a qualitative research. *Historical-comparative research* is a method commonly used to research areas of sociology such as e.g. social change, social movements, criminology and social stratification. The method is based on looking into two cases or social settings that took place in different times periods or geographical areas and then compare them in order to track the social changes. (Neuman 2000) The other technique *field research* on the other hand looks into the social setting in one given case or social setting in order to give the best

understanding of it. Field research can also go under the name ethnography or participant-observation research. Neumann (2000, p. 345) describes it as *"... a qualitative style in which a researcher observes and participants in small-scale social settings in the present time and in the researcher´s home culture".* For the aim of this paper it was most beneficial to use the approach of field research methods, as I was looking into a case and current situation. During the field research I had to go out in the "field" and talk directly with and observe the people in the study. Researchers have to interact directly with the people in the study in their natural setting to get inside their perspective. (Neuman 2000)

3.4 Data collection

The method of field research described above is the data collection method the thesis is taking after, except on one key aspect. Due to time and scope limitation I did not have the opportunity to go out and spend a longer period of time in the field in order to collect data. Rather I chose to perform the data collection for the thesis through interviews with selective representatives in the field. In order to ensure that it is the necessary data needed for the thesis being collected it is important to understand the art of interviewing, which Denzin and Lincoln (1998, p. 36) described as elegantly as: *"The interview is a conversation, the art of asking questions and listening."* And according to Neuman (2000, p. 196) "*the primary purpose of sampling is to collect specific cases, events, or actions that can clarify and deepen understanding."* When taking the constraint of time and scope into consideration it was not feasible to conduct research the maritime cluster as a whole. I therefore decided to collect data through interviewing some persons from organisations that are representative for the different aspects within the maritime cluster and these can be seen in appendix A.

Bauer and Gaskell (2000) define a qualitative interview as an interview to be a semi structured in-depth interview. In order to conduct a successive interview it is essential that the interviewer is well familiar with the theoretical background and key concept within the topic of the interview. They also place a great importance on having a well-developed interview guide, or topic guide as they refer to, in advance. Ideally the interview guide should not contain any specific questions but rather a set of topics that should be brought up during the interview. If any questions are needed these should be open-ended questions in order to

encourage further conversation. The objective with the interview guide is to create a comfortable framework for discussion and elaboration on the topic as well as provide a logical progression in the interview. However the interview guide is just a guide and that it is important to have a pragmatic approach and understanding of the interviews progression. The interview guide developed therefore consisted of open-ended question about the topic and a few specific questions for the intention to directly compare answers between the interviews. The interview guides can be found in appendix B. Rather then developing follow up questions on the topics in advance they were improvised during the interview in the effort to create a more natural flowing conversation instead of a script based interview with few or non elaborations. During the interviews the interview guides functioned for the most part as a guideline to cover the necessary topics. The aim was to create an open conversation so the questions may therefore have been phrased different according to the conversation. In some of the interviews conversations also changed topic several time but the interview guide then functions as a guideline in order to cover all basis within the topics. All interviews were conducted in this manner with an in person meeting with open-ended questions and transcriptions. Except for the interview with the head of project development at Farstad Shipping Børge Nakken that was conducted over the telephone but still in accordance with the interview guide. And the interview with the communication manager at GCE Blue Maritime Frank Emblem was an initial interview at the start of the thesis process as mentioned earlier. This interview was a preliminary data collection in order to gain the necessary insight before designing the study and therefor did not follow a pre-set interview guide. However the data from this interview did proved useful later in the thesis process and is included in later chapter of the empirical findings.

An important consideration before setting up the interviews was which language should they been conducted in, English or Norwegian. There are potential sources for wrong interpretation with both languages. English might be the easiest in terms of implementing the interview data and quotes into the paper. But since English is a second language for both the interviewer and interviewee it is not certain that neither is proficient enough in the language. This may cause misunderstandings and hinder a proper communication of important information. By conducting the interviews in the native language for both parts, Norwegian, this source of miscommunication is reduced to a minimum. But this give room for a new

source of misinterpretation of the date during the translated into English when presenting the empirical data in a later chapter of the paper. This in mind I decided to conduct the interviews in Norwegian despite the potential for misinterpretation during translation. Choosing the native language would best enable me to fully understand the true meaning and intention of the interviewees, thus reach the most correct understanding of the data.

In order to protect the privacy rights of the persons being interviewed they were informed of my intention to record the interviews and before starting the interviews they were asked for their permission. They were also given the opportunity to conduct a quotation check before the publication of the thesis. The interview transcriptions contain a large amount of information and are direct quotes from a longer conversation with the interviewees that are not necessarily relevant for this research. However such information can be misinterpreted and misused by others if not seen in the right context of the interview. The interview transcriptions will therefore not be published in its entirety in order to protect the privacy rights of the interviewees. Before interviewing the persons defined as "workers" in the cluster they were offered the option of being anonymous before the interview started. This for two reasons, firstly it was morally correct to offer it since they would be asked questions regarding sharing of company secrets that may have consequences for them if made public. The second reason was in order to increase the reliability of the answers received since the interviewees could respond more honestly without the concern of potential consequences if the answers were made public. An overview of interviewees can be found in appendix A. After the thesis was completed all recordings from the interviews along with the interview transcriptions was deleted.

The process of triangulation was used in order to ensure the quality and validity of the data collected, which Stake (2008, p. 133) defines as: *"Triangulation has been generally considered a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation"* The triangulation type that was most relevant for this thesis was the *triangulation of observers* (Neuman 2000) that in basic was to use several observations to confirm the same finding. In the case of this study the most apparent source was to use the written reports from GCE Blue Maritime to back up the information given in the interview with them. For other organizations it was due to time and scope constraint not

be possible to conduct many interviews within the same organisations. So in order to gain a triangulation of data I used consistent interview guides for the different organisations with overlapping questions so when the findings where consistent the thrust wordiness of the findings could be ensured.

3.5 Analysis of data

One of the key aspects of all research is the analysis of the data collected. It is in this part of the thesis it is possible to start proving or developing new concepts, and it is here it is possible to get an insight into the core of the thesis. According to Neuman (2000) the formation of concepts is a part of the data analysis and it begins already during the data collection. One ways for a qualitative researcher to make sense of and organize the data is by conceptualization. The data is analysed by the researcher and organized in categories on the basis of themes, concepts or similar features, and evidence and ideas are mutually interdependent. *"Data are empirical representations of concepts and measurement is a processes that links data to concepts. … Qualitative researchers primarily follow an inductive route. They begin with empirical data, follow with abstract ideas, follow with processes relating ideas and data, and end with a mixture of ideas and data."* (Neuman 2000, p. 158) After the interviews I had a large amount of raw data that needed to be organized and the most purposively method for achieving this was the processes of "coding the data". Neuman (2000, p. 421) describe the coding process as "two simultaneous activities: mechanical data reduction and analytical categorization of data into themes". In this process I organized the raw data into different categories and concepts that was used while analysing the data. This reduced the huge amount of raw data into a comprehensive overview that also highlighted the nuances within it. For the process of analysing the data it was most purposeful to utilize the process of open coding when organising and identifying concepts and dimensions within the data relevant for the thesis. Strauss and Corbin (1998, p. 101) define open coding as *"the analytic process through which concepts are identified and their properties and dimensions are discovered in data".* I choose to use a "conceptualizing" approach (Strauss and Corbin 1998) in the open coding process. This approach calls for labelling the different phenomenon, or in other words developing concepts, which in turn the data collected can be classified to. Since the research question is based on a theoretical background I first identified four main

concepts within the theoretical framework that the raw date later could be classified into. Further the coding was in practice done by using designate colours for each of the four main concepts identified. All interviews were transcribed and printed along with the relevant second hand documents. The next step was to allocate the designated concept colour to the data that was identified and classified to that concept.

Informal and unofficial knowledge flow and sharing This concept was identified due to the importance stated by communities and networks of practice in knowledge sharing. It regards to the knowledge shared in informal setting and that are unofficial, meaning outside the companies and managerial control.

Official collaboration and knowledge sharing This concept is the phenomenon in where knowledge is shared through official collaborations between companies and inside the confines of managerial decisions. In other words, the knowledge sharing can be reasoned to be under company control, thus separating this from the previous concept.

Open innovation This concept will be used to identify phenomenon's that can be directly linked to Henry Chesbrough usages of open innovation, hence purposively knowledge flows across organisational boundaries.

Regional culture During the initial interview of the thesis process it was expressed that the regional culture plays an important role in the clusters innovation system. And while conducting the remainder of the interviews I identified a pattern where phenomenon of knowledge sharing was attributed to other factors, such as the cultural aspect. This seemed to affect the core notions of openness and knowledge sharing and on what basis they occur. It was therefor a relevant concept to include in the coding process in order to gain the most accurate view and understanding of the knowledge sharing process in the cluster.

After the coding process of allocating the relevant data observed towards the different concepts the next step was to congregate this towards a presentation of said concepts within the data. This was done through gathering the data together in one coherent text where the most relevant data is presented as my interpretation and understanding of it with the use of

some examples and quotes where it was found to be the best representation of the data. To ensure that all relevant phenomenon was identified and properly allocated within the text I printed both the text and transcriptions and labelled them with the different topics and theories using a more primitive post-it note system. In order to be able to conclude over the research questions the thesis set out to research I needed to see the data in the context of the theoretical framework developed. I therefore adapted an *Illustrative method* that Neuman (2000, p. 427) describe as *"a researcher applies theory to a concrete historical situation or social setting, or organizes data on the basis of prior theory".* In other words I looked at the empirical data and analysed it in the context of theory in order to better interpret and elaborate on the collected data. This was done by compering the concepts and patterns I found to those of the theories the research is based upon. This can be seen in the sections "findings 4.x.5" in the analysis of each of the four dimensions in the later chapter 4 "Empirical findings". In these sections of the analysis a clear link between theories and empiric and my understanding and interpretation of these links are presented.

The thesis also used written data collected in the process for triangulation described earlier. But this also imposed some challenges that I had to be aware of, as described by Hodder (1998, p. 127): "*Material culture, including written texts, poses a challenge for interpretive approaches that often stress the importance of dialogue with and spoken comment from participants."* Hodder (1998) stress the importance of knowing in which context and for which purpose a document or any material was intended. The language and symbolism within may differ depending on the intended audience and thus poses a challenge when interpreting it. When analysing the data collected it was also important to maintain a certain degree of objectivity, which Strauss and Corbin (1998, p. 35) defined as: "*The ability to achieve a certain degree of distance from the research materials and to represent them fairly; the ability to listen to the words of respondents and to give them a voice independent of that of the researcher."*

4. Empirical data analysis

This chapter will present the empirical data collected and the findings from the analysis of it. As stated in the methodology chapter 3.5 I have used an open coding process in order to categorize the relevant data collected into the following four concepts:

- Informal and unofficial knowledge flow and sharing
- Official collaboration and knowledge sharing
- Open innovation
- Regional culture

For each of the main concepts the data will be presented from the three perspectives depending on the organisational level of the cluster the interviews are from.

- Perspective of the employees in the cluster, defined as workers
- Perspective of management within the cluster, defined as leadership
- The perspective of the cluster project GCE Blue Maritime

Relevant data collected through second hand sources will also be presented after the points of views in order to contribute to both a higher accuracy of the data as well as a deeper insight in some of the cases. In the final section within each part the findings are seen in the context of and linked together with the theoretical framework presented earlier in chapter 2.5.

4.1 Informal and unofficial knowledge flow and sharing

4.1.1 Perspective from workers

The first point of view to look into the informal and unofficial knowledge flow and knowledge sharing in the cluster will be from the perspective of what I have defined as the workers of the interview objects. For the engineer working at the R&D department of a large offshore design and shipbuilding company in the cluster there had not been given any specific constraints in terms of how they can use external information and knowledge. Neither had they been asked

to sign a confidentially declaration beyond what is covered in a standard Norwegian labor contract, which represent the only official directive from the company. Through out the interview I interpreted his way of talking about the subject in the way that this was largely directed by the culture in the company and by what can be referred to as common sense. A main talking point for the interview was about how he shares knowledge and experience from his work outside the workplace and in social interactions. The response was that many of the people in his personal network outside work that also work within the maritime cluster, but none of which worked directly in the same field as an engineer. Within this personal network they often keep each other updated on their work situation and the current tasks they are working on at a superficial level. However he reckoned that it would be far more likely that they would have talked about and shared information at a more detailed level if the other also had the same background as an engineer. He also clearly stated that in the degree that they share information about and from their work it is never anything that can be regarded as company secrets. He also stated that he would strongly appose against sharing this kind of information. He also felt that even if he wanted to it would be very hard for him to gain access to this kind of information about competing companies through his connection within the cluster. A reason he suspected to be a strong contributing factor to this was the traceability of such information in a small town like Ålesund. However he felt that information and knowledge from the company that are not deemed to be company secrets or of a strategic importance could be shared more openly in his network. His assessment about this knowledge sharing was that it is something his superiors are aware off and have chosen not to influence or take any actions against.

In his strive to continuously improve their products he would always be open to use information and knowledge from external sources, as well as internal sources from other entities of the company. If an idea or a work process sounds smart and have merit he would adapt it into is own work if possible. He believed this to be a position that several of his co-workers share. And in fact he talked about one of his co-workers that had a background from another company within the maritime cluster actively uses knowledge and experience he gained from his previous employer. Both in terms of specific technical solution they can use and improvements in the work process. He strongly felt that talking with other people and gaining input from the outside of his department, weather it would be outside the company or

not, can in many cases help to highlight certain aspects and improve the innovation they are working on.

In the case of the employee at the head office for a large offshore shipping company in the cluster he had been asked to sign a declaration of confidentiality, but part of his job entails the handling of sensitive personnel information. However the management in the company encouraged their employees to be more open and transparent. In this sense they actively used the phrase “we collaborate when we can and compete when we have to”. He also stated that many of his personal connection outside work also works within the maritime cluster in the region. He pointed out that these personal connections have jobs in several different areas of the value chain in the maritime cluster. Their conversations also often consisted about their current work situation and keeping each other updated on both their personal tasks and on the company in general, but also they do so at a superficial level. He clearly stated that the information shared would never be anything that could be considered as company secrets and his personal experience was that no one in the region really talked about secrets. However, he often receives information and knowledge directly from other parts of the value or organisation chain, such as a sailor for instance, instead of through official channels. Experienced based knowledge is easily accessible from him through informal and unofficial networks and offers him many inputs and a more diversified aspect in many cases.

This view was also strongly supported by the person that is employed as technical support at a large IT and communication company within the cluster. He also provided a very similar description on how the informal, outside the work place information flow works. That is, knowledge about and experiences from all the different aspects of the maritime cluster are easily accessible at a superficial level, but still can provide valuable inputs and points of view. He also added that in a small town like Ålesund information about whom you are working with on contracts or planning collaborate or purchase products from can easily be spread simply by people observing and recognizing people that are meeting together. In terms of constraints regarding knowledge and information sharing from the company’s side also he had not signed a declaration of confidentiality beyond what is covered by a standard Norwegian labor contract. Recently a person from the top management in the company he

worked at had directly informed all employees through an email that on of the main focus area for the company in the year to come was “openness”.

The contract manager at Rolls-Royce Marine clearly stated that in his perspective there is undoubtedly a very high degree of informal contact and unofficial knowledge sharing within the cluster. He elaborated that since so many people are involved in the maritime cluster in the region a natural talking point in all social interactions outside work will be about the cluster and the maritime industry as well as updating each other on their current work situation. However he also clearly expressed that information shared is never of a character that should not be shared outside the company walls. His perspective was that everyone knows where the line is and do not step over it, in terms of what information and knowledge can be shared. He also noted that at Rolls-Royce Marine they have an internal ethics policy to not take advantage of and exploit information they have wrongfully received, this could either be a wrongly sent email or secret information about competitors that someone have shared.

For him personally the informal links and knowledge flow often provides him with valuable information and connections that he can use in his work. This may be easier access to towards the correct person in a company or in order to more quickly get hold of products or information that he may seek. His experience was also that the informal links and communication channels could in many ways help ensuring that it is the right message and intentions that are communicated. He perceived the high degree of informal knowledge flow within the cluster as something positive and beneficial for all parts, a point of view he believed most people share. This high degree of informal contact and knowledge sharing across organisational boundaries is in his experiences something all his employers have perceived as something positive. In one cases one of his employers paid his membership fee in an interest organisation that arranged conferences and social event to bring people together and create networks, an arena that strengthen the informal ties between companies.

4.1.2 Perspective from leadership

When approaching the subject of informal and unofficial knowledge flow and sharing while talking to Børge Nakken, head of project department at Farstad Shipping, his first response was “*transparency*”. He underlined that an important factor for Farstad Shipping is to be

transparent. And from a management position it is a conscious decision that their employees in all levels of the organisation should be open and share information that are not considered company secrets. He underlined that he believed that the informal knowledge flow in the region is one of the core strengths of the maritime cluster. One of the key aspects of the knowledge flow is the close proximity for all parts of the cluster within a relative small geographical that creates an open channel of communication. He described the information and knowledge flow in the cluster as sharing of both experience and knowledge between all links of the cluster, all the way from the deckhand on a ship and up towards management level. This reduces the communication time and provides a more direct and accurate communication that can be beneficial for the rate of innovation.

The second person that provided a leadership perspective was Per Olaf Brett, the deputy managing director at Ulstein International that is a part of Ulstein Group. They do not lay any specific constraint on their employees in terms of knowledge sharing that goes beyond the confidentiality clauses that are included in a standard Norwegian labor contract. When asked how he perceives the unofficial and informal knowledge flow that takes place outside the company he replied, *"it is probably overall positive".* And elaborated his response by stating that the exchange of knowledge and experience in most cases are for the better, despite that it also means that there is quite a of leakages between the companies. But since the knowledge flow and potential leakage describe above are in all likelihood constrained within it region the might result in a positive resonance for the region as a whole, which again is beneficial for Ulstein Group. He also considers it to be a good lightning rood for the employees, especially now as the maritime cluster is facing one of its hardest challenges in recent time due to the low oil prices in todays markets. The reasoning being that it is healthy for the employees to talk with others and knowing that they are not the only ones facing uncertainties in their work situation in the time to come. Even though the importance of this informal communication channel of knowledge and experience might be of questionable importance Per Olaf Brett stated that *"...it profits us more then it harms us, that I am convinced about."*

He also informed that they in recent years have become more at ease when it comes to the potential risk of knowledge leakage from their organisation. And even though that they some times can recognise their own measures taken in other companies they usually assess it as not

being harmful for their business and have decide to not take action. He also pointed out that Ulstein group do not perform any sort controlled of knowledge leakage, but it is something that has naturally developed. Per Olaf did not consider leakage out of the region to be of any major concern. He perceived the capacity for innovation to be at such a high level in the Møre region that many of their competitors in China for instance would probably not have the capacity to pose any real threats. Companies within the cluster will be able stay one step ahead through continuously innovating.

For him a key aspect in the cluster is the exchange of knowledge and human resources between the companies. Ulstein Group have a high level of personnel exchange with Rolls-Royce Marine, which is a major actor in the cluster, that in turns leads to a high level of knowledge and experience flow between the two rivalling companies. But even more importantly this dynamic in the workforce between companies benefits them all by constantly providing them with new impulses from each other and increases their learning intensity. He describes this as having a not inconsiderable positive effect. Recently the government have decided to invest in constructing and building a bridge (HAFAST) that will provide Ulsteinvik with a land based connection with the region. He firmly believes that this will create an even more dynamic and flexible region with a higher mobility in the workforce and a more diversified business region.

4.1.3 Perspective from GCE Blue Maritime

Per Erik Dalen, CEO at GCE Blue Maritime and ÅKP described the informal knowledge flow and communication channels as one of several important keys behind the high innovation rate that define the cluster. If he needed to consult someone or need information he could do so in person and have a more informal chat, instead of having to go through the official communication channels that might slow down the process. He described a large degree of the knowledge and information flow going through informal relationships and unofficial communication channels between the different actors of the cluster. He also stated that this informal and unofficial knowledge flow might be a considerable strength for the cluster but that it in certain situations also could pose a risk.

The communication manager at GCE Blue Maritime and ÅKP, Frank Emblem, informed that one of the focus areas for the cluster project GDC Blue Maritime have been to create meeting arenas for companies within the cluster and facilitate for increased inter-company communication. For the most part these are directed at the firms themselves instead of employees and may lead to more formal collaboration. But with the dynamic of knowledge sharing in the region these could also work as excellent networking arenas that may lead to new informal communication channels.

4.1.4 Second hand data

In the application written for the cluster project GCE Blue Maritime there is a section regarding collaboration arenas, such as conferences, seminars and network meetings. These include Verftskonferansen, the Ålesund shipping conference, InnoTown, Fosnavåg conference and ÅKP incubator along with several other more specialized seminars. This is not conclusive evidence of a informal and unofficial knowledge flow, but combined with high degree of informal and unofficial knowledge flow described further up and the excellent networking and meeting place these arenas potentially are, it is highly likely that they are a contributing factor in increasing the knowledge flow.

In an article by Amdam (2014) as a part of the MarCo research project he describes two people from the Møre region that meet at Gardermoen airport in Oslo after traveling abroad on business. He describes the two people as sales persons for their separate, but not competing companies and how they talked loudly about their business trip and how it went. This is also something I have personally experienced several time on my flights between Copenhagen and Ålesund. People are talking about their work situation and keeping each other updated, but never revealing any information of strategic or great importance for their employers. These examples are good descriptions on how the informal and unofficial knowledge flow works in many cases. The same article also talks back to the start of the cluster when it was a handful of shipyards building fishing vessels in order to help the fishermen reach further out at sea. The fishers came back to the shipyard and through informal conversation and personal ties they shared their experiences and hands-on knowledge from operating the vessels at sea, which gave the shipyards valuable information to continue develop and innovate new ship solutions. Another interesting article that also is a

part of the research project MarCo it written by Halse and Bjarnar (2014). It points out that the cause behind the historically high innovation ability in the region is party due to extensive sharing and transferability of knowledge and user experience between actors in the region.

4.1.5 Findings

In the information provided above there are many interesting aspect of the informal and unofficial knowledge flow and knowledge sharing within the maritime cluster. The first that stands out is the unanimously agreement about to which degree it happens in the cluster, it is very high. Equally everyone agrees that the information shared is of what can be considered to be of a mundane character But it does certainly open up communication channels and new inputs that in some cases can prove to be helpful as described by the Contract Manager at Rolls-Royce Marine. And by the CEO of GCE Blue Maritime they where defined as a key aspect essential for the cluster success. By definition these are networks of practice and there was also descriptions of communities of practice within companies. An important remark is that all of them talked about sharing of experience and that it goes across profession, or practices. These practical user experiences are easy accessible for all participants of the cluster. This can also be seen as peripheral learning within the cluster where even a passive participant will learn from its surroundings. And despite the theory stating that networks of practice are not as strong as communities of practice they still seems to be quite strong within the cluster. Børge Nakken stating the importance of close proximity within the cluster underlines this. Also one of the worker explicitly pointed out that the small size of Ålesund also contributed to the information flow through networks.

An important aspect with unofficial knowledge flows and sharing is the mobility of the workforce. All organisations are in essence based on the relations between the human resources within the organisation, and the knowledge embedded in the organisation are also embedded in the human resources. Thus when you have a region, such as Møre, with a flexible and mobile workforce that exchange workplaces across organisational boundaries they bring with them their embedded knowledge into the new organisation. As mentioned HAFAST (land based connection for Ulsteinvik) will only increase and reinforce the mobility and flexibility of the workforce in the region. Per Olaf Brett at Ulstein Group mentioned this to be important for their future access towards knowledge and a competent workforce. This is also supported in

the theoretical background where the importance towards a well-qualified workforce is stated. Also this will lead to knowledge spill overs and open up new opportunities for new open innovation collaboration links.

Another highly interesting aspect is in which degree everyone both management and workers are aware of the vast knowledge sharing but all deems it to be for the majority part inherently a positive factor. At the core definition of open innovation it is a purposively manage flow, and even tough this might not be a managed flow, I would still argued that it is purposively. In my opinion the fact that they not only are aware of it but they also fully intentionally let it continue and sometime even encourage it make it into a consciously choice, even though a passive one. This alone is not nearly enough to define the process as open innovation but it should be seen as a tendency towards the transcending of the company's organisational boundaries. One important remark was by Per Olaf Brett stating that they have become less concerned about limiting knowledge leakage from their company in the latest years since they have seen that it benefit them more then it hurts them overall.

Also a clearly positive affects in terms of faster communication channels and lower barriers for sharing experiences across organisational, profession and hierarchy levels can also be identified. And a key point here is the clusters inherent ability to absorb and utilize the shared knowledge and experiences through these communications. The workers showed little concern about utilizing external knowledge sources and rather applauded them as a highly useful source of inspiration, so in terms of barriers there are few. However it was clearly stated by all interviewees that they never shared important knowledge of strategic importance or knowledge that could directly be implemented in their innovation work through these networks of practice.

These informal and unofficial knowledge flows and links can account for and support the claim that the cluster participants have an ambient awareness of what its close competitors are up to and an overall understanding of the cluster. However, the informal and unofficial knowledge flow and knowledge sharing, despite many of its positive sides, does not account for how ideas and knowledge of a more useful character is spread and drives the innovation process within the cluster forward.

4.2 Official collaboration and knowledge sharing

This second part of the empirical data analysis aims to look into if and how knowledge and information is shared through the official collaborations and links between organisations. We start out with looking into how these collaboration and links are perceived and how they work from a management perspective.

4.2.1 Perspective from leadership

One of the first things that Børge Nakken, head of project department at Farstad Shipping, said on the topic of knowledge flow and knowledge sharing was *"We collaborate when we can and compete when we have to."* He clearly expressed the importance of collaborations within the cluster and even though their main role in the cluster is that of a customer they still sees it at their task to contribute in pushing development and new knowledge creation within the value chain of the cluster. They are currently involved in several research projects in collaboration with NTNU and other relevant local companies within the cluster. However, despite all their collaborations and knowledge links within the cluster they rarely collaborate directly with other offshore shipping companies that are direct competitors. In some research project, especially those at the early research stages such as "move", they are more willing to collaborate with competing companies. But he said that whatever knowledge or information they deem to be of a of strategic importance for their company they are careful in making sure to keep away from their rivals.

The collaborations mentioned above have for the most part a long-term perspective but Farstad Shipping is also involved in more short-term innovation processes that are on a more commercialized stage. This knowledge flow and sharing have the potential to a higher degree to influence and contribute more directly in the product innovation processes itself, usually through the process of contracting a new ship. He explained that during the process of contracting and building new ships they are usually in contact with several competing companies in order to negotiate the best offer, both in terms of price and quality, before they make any decisions. In other words, they often gain excess to knowledge about new development that might be applicable for the ship they are building and in return gives feedback and corrections on what they, as the customer, sees the need for based on their

experiences. They insert themselves and take part in the development and designing process all the way from the beginning and through out the completion of the ship. He stated that he perceived the interactions, openness and knowledge flow within the cluster as being unique compared to any other place worldwide. In essence he described the formal and official knowledge flow towards ship designers, research projects, shipyards and equipment manufacturers as quite high and very productive and essential for the clusters competitiveness in the future.

How the collaboration and knowledge flows are and how they are perceived could differ depending on what role you play in the cluster. Børge Nakken and Farstad Shipping have the role of the customers in the cluster, at least as far as ship designing and building goes. The subsequent part will examine the same concept but from the perspective of the Deputy Managing Director at Ulstein International, Per Olaf Brett. They are an influential and vital part when concerning strategic decision and market as they are the analytical part of Ulstein Group and they have a concentrated focus on business development within the company.

"*In terms of collaborations you can say that in each level of the value chain the collaboration on the innovation activities are quite limited. But you have a strong vertical participation in the projects. It is preferable to not have a competing company in the innovation activity, but you may very well have complementary companies involved, so you rather look vertically then horizontally*." - Per Olaf Brett

In general Ulstein Group have seen that if there are to many competing companies participating in the same innovation project it is far less likely that they end up with a good innovation project. Instead their focus is towards complementary companies they can learn from instead of compete with. Also, they usually benefit and have the best return from collaborations and projects of a pre-competitive nature. In which the different actors are contributing towards the same knowledge creation they can use separately in a later stage of their innovation process. Typically you could say that collaborations last until a commercial opportunity arise, as Per Olaf explained: "*Because then there will be different interest and we do not see any good projects where you have developed a shared product or a product with shared contributions. You rarely success with this*."

Per Olaf felt that the cluster phrase “we collaborate when we can and compete when we have to” to a certain degree describe the situation, but in that respect they also compete far more then they collaborate. However he believed that it would be most valuable for them to collaborate in an early phase of the research and development processes that could become mutually beneficial if conducted together and sharing their common knowledge. As the projects are moving along and when they might start to see an opportunity for commercialization of the product that the competition comes out, and it is undoubtedly in the early phases the knowledge flow and sharing is largest.

They have also over the last few years developed a new way of collaborating with other companies and customer. The new tendency is to move towards a consultant role in their interactions. This process of changing the way people think about collaborating is a slow process that takes a considerable amount of time, to long time in his opinion. One reason for this change is the realisation that it is not enough to just have a good ship anymore, because what is a good ship? He believed it would be beneficial for them if they could make available a whole reportorial of knowledge and expertise for the customers in the early stages of contracting new ships or solutions.

Ulstein Group are collaborating closely with the ship owners and they often actively approach the shipping companies to collect feedback and first hand experience directly from the customers. They have their own field development program where they go out on the ships and collect terabytes of information ranging from user experience and interface to equipment performance and durability that can help them to develop improved solutions and ships in the future. These projects have generated a very positive response from the ship owners and especially those who work on board the ships. He mentioned an example they recently had great success with where two of their employees joined on board a Subsea 7 ship for two weeks collection information and learning how the ships operates in practice at sea.

4.2.2 Perspective from GCE Blue Maritime

Frank Emblem, communication director at GCE Blue Maritime and ÅKP, expressed that a core notion in the cluster is that companies are always open for collaborations. Even if some

companies are fierce rivals and compete for many of the same contracts they are still open to wards working together and collaborating on other projects where it is mutually beneficial.

Per Erik Dalen, CEO at GCE Blue Maritime and ÅKP also seemed to share this point of view. During the interview he expressed that there is willingness towards collaboration and exploring opportunities that may be mutually beneficial within the cluster. He reckoned that this stems from a highly pragmatic approach in combination with risk willingness amongst the companies in the cluster. Companies have a clear tendency towards collaborating with companies placed horizontally of them in the value chain and therefore are not direct competitors. It is through these collaborations the companies can access knowledge, also from companies placed vertically of said company. Per Erik Dalen explained this knowledge and information sharing in the following way: "…*when the ship owners consults two or three ship designers and start talking about developing new ships and have some ideas and bring with some ideas about this new ship then you distribute the same ideas to the three design companies. But then you have to choose one before you move to the next step, which is the ship yard and the same process happens again and knowledge gets spread*."

A part of his work at GCE Blue Maritime is to strengthen the collaborations within the cluster and gather the shared values and expertise and collectively lifts them. However he made a clear distinction between the collaboration that regards strategic, early phase research projects and short-term direct product development collaborations. Companies are very willing to contribute and work together on a strategic and overall level. But as soon as they start to sense a market or a product that is of commercial interest for them this willingness quickly fades away. Only a few days before the interview they arranged a think tank with many of the top executive leaders of the largest and most influential companies from the cluster. The aim for the think tank was to discuss new opportunities and long term strategic plans and he described all the participants as relatively open and cooperative. It is clear that they want to contribute and in a sense pull in the same direction to strengthen the cluster and region as a whole, as this in return will be beneficial for the companies operating within the cluster. In his opinion the cluster phrase that "they collaborate when they can and compete when they have to" is somewhat misunderstood, and that the truth might be closer to the opposite. What he means with this is that even though the companies want to strengthen the

cluster collectively their main target is still their own profitability. But the companies in the region are good at acknowledging that they can help each other achieve this and that collectively they are stronger.

A key object for GCE Blue maritime long-term perspective is to raise the general competence level in the region. In this perspective the recent merge between the local city college and the university NTNU can potentially play a significant role. Per Erik Dalen was a strong advocator for the merger and believe it will have a positive affect on the region. As most of the companies in the region are very technological advanced NTNU became the logical option. And even though most of the collaborations and projects will continues as they are the merger will bring more academic weight to the school. However, this merge also brings with it a change for the whole region, as Ålesund now have become a university city. Per Erik Dalen predicts that this will have a strongly positive effect on their host focus and host attractiveness, which is a key goal for GCE Blue Maritime. Ålesund new status as a university city could prove to be beneficial both towards attracting skilled students, scholars, researches as well as companies. An effective way of increasing the general competence in the region is to attract new competent personnel and GCE Blue Maritime works towards this. They also work towards establishing connections with other academia such as MIT, which they are currently working with on a project regarding entrepreneurship. Per Erik Dalen stated that they are always looking for new environment and research that can bring new and relevant knowledge and competence into the region in effort to strengthen the cluster.

It is important to note that the steering group of GCE Blue Maritime consist of the top leaders from the largest and most influential companies in the cluster. Their meetings and strategic plans for the future is a defining part for the future of the whole cluster. They could in Per Erik Dalen view be a part of deciding the future path of the whole cluster, as they are leaders and pioneers for all the SMB in the region. A part of their participant in the steering group is both that they are benefited of having a voice there, but also the agreement that they can be stronger together.

4.2.3 Perspective from workers

The engineer employed at the R&D department of a large ships designing and building company in the cluster informed that they often collaborate on development project with other companies. In order for the product or specific part of a product they are developing in the projects to be mutually integrated in the project they have to share a large amount of information during the process. However in his experience they rarely received more information or details about the process and products involved then what is necessary in order to complete the project and make a compatible solution for the project. The company he is employed by often collaborate with other companies in shipbuilding, often as a result of them owning their own shipyards in contrast to other design and manufacturing companies in the region. Note the similarity with Ulstein Group in that respect. This makes collaborations and co-building of ships as an end product a natural part of his workday. When co-building a ship in collaboration with another company it is apparent that a large degree of knowledge sharing is essential for the success for the building process. But despite the vast amount of data they gain access to through the project it is only information that is strictly necessary for the success of the project. This information is in his experience of little use for them beyond the current project and not something they are able to exploit, neither something they are aiming to exploit. In the degree they gain access to new information, knowledge or ideas it usually stems from the customers themselves. He described them as very contributing in the design and development process of the products and they often have clear preference on how they want their systems to operate. This could either be from their own experience with something that has worked well in the past, even if the systems come from a rivalling company, or a new concept that have caught their interest. Apart from this they have, according to him, a very low degree of knowledge sharing and flow, in terms of knowledge that may be useful in an innovation process.

Interestingly enough, the person employed at the head office for one of the largest offshore shipping companies in the region first response while talking about collaboration also was *"we collaborate when we can and compete when we have to*". It is apparent that this phrase is widely spread and adopted in the cluster, at least figuratively speaking. In his experience this was also to a great extent true in practice as well. They collaborate closely with ship designers, builders and equipment suppliers on the development of new and more efficient

ships. He described a process where they as customers are directly involved in the innovation process itself with the shipbuilders and equipment developer and manufacturers during all phases of the building and maintenance process of their ships.

However it is important to note that not all of these are competing companies, but companies belonging to different parts of the clusters value chain. Their main object with these collaborations is to develop new and more innovative ships that may give them an advantage in the market competing against other ship owners. He also experienced a high degree of competitive instinct amongst competing companies that in many cases leads to a great extent of secrecy between the companies. However he often observes other companies in the cluster that might be rivals in part of their business that are collaborating in other business areas where they are not direct competitors. In basics he said that companies that have complementary products and have a mutually benefit of collaborating often do so.

The perception of the person employed as technical support at a large IT and communication company was that there is a low degree of collaborations and knowledge sharing in between competing companies. But for companies that belong to different parts of the value chain he described a completely different picture. Then there is a high degree of collaborations and knowledge sharing and companies are in general very flexible. Companies might talk with several suppliers, designer or owners and pitch some of their ideas to them quite openly, which then again gets shared with their rivals when they talk to other part of the value chain. In this way rivalling companies within the same part of the value chain despite not talking to each other, still do so in some way.

At Rolls-Royce Marine the contract manager described a situation where they are “forced” to collaborate closely with other companies since Rolls-Royce Marine do not own a shipyard. Their business is based on developing and producing all parts of a ship, including design blue print except for ship hull it selves. He described it as a step-by-step kit of different parts and plans for external shipyards to build into a ship, also note that sometime these plans includes parts or systems from other competing companies. This result in a need for an extensive knowledge sharing towards the other companies they collaborate with, despite some of these companies being fierce rivals. However what he described as very important for Rolls-Royce

Marine was not to protect the information about the products themselves, but rather the information and processes that lies behind them. The knowledge sharing through these official channels goes both ways, but often it is limited to what is considered to be strictly necessary, especially if it is towards a competing company. In the planning process before signing the contract the customers often come with input on what they want and what they have seen the need for in his experience. A natural part of the negotiating and planning phase in collaboration with the customers is to share an extensive part their knowledge and detailed product information. Without giving away anything that might reduce their competitive edge, which is the core knowledge on the underlying process.

In the experience of the contract manager the ship owners usually have a quite clear picture of how they want their new ship to be built and what needs it will have to cover. In addition the customer typically have some issues or specific needs that they have to come up with a solution for. This process is often defined by going “back and forwards” for a little time as the customer often have other designers or consultants involved in the process or a parallel process. In the end when the different competitors have come up with their best solutions, concepts and deals the customer makes a decision based on their need and the contract is signed and the ship is built. In the contract managers opinion the ship owners are very good at including their employees into the design and planning process of all new ships. Often you will see the chief, ships engineer and skipper that will be operating the ship are involved in the early phases of developing the concept for the new ship. Their first hand experience from existing solutions and operating a ship in practice often provides the designers and developers valuable knowledge and insight for the further innovation process. Also during the building period it is normal for the ship owner to have an experienced crewmember or inspector to represent them at the shipyard. The contract manager is also in regular contact with the representative from the ship owner both under the construction period and also through out the guarantee period for the vessel. He also noted that it often was easier to collaborate and enduring a good information and knowledge flow while collaboration with local and Norwegian ship owners.

4.2.4 Second hand data

In the 2015 operation report "Innovative interplay in practice" from ÅKP it is stated that the maritime cluster in the Møre region is one of the worlds most comprehensive marine clusters that covers all of the important functions of the whole value chain. And that close collaborations between industry, suppliers, colleges and research institutions has developed within the cluster.

"Innovations have been developed in close dialogue between customer and suppliers." – (ÅKP 2015, p. 19)

In the same operations report there is an article, "Highlights – From the global performance benchmark analysis" (Jacobsen 2015), which concludes that the innovativeness in the cluster stems from, amongst other, from the *"openness, faith and long tradition of collaboration."*

The cluster project GCE Blue Maritime has 8 SMART (specific, measurable, ambitious, realistic and time-related) goals they work by according to the same 2015 operation report by ÅKP. Of these there are two goals that are of particular interest in terms of official collaboration and knowledge sharing:

3. Strengthen global knowledge connections for world-leading technology and knowledge environments: *Chart and connect with the right research environments, networks and clusters. Enter partnership with relevant environment.*

4. Strengthen national knowledge connections with research environments, clusters and maritime companies: *Further develop and strengthen existing cooperation agreements. Develop new, complementary networks and specific cooperation projects with other relevant Norwegian clusters and knowledge environments.*

In the application document for the cluster project GCE Blue Maritime, also published by ÅKP, several cooperation and ways of knowledge sharing are identified. It points out the close ties between cluster participants and leading research and development communities. It also identifies campus Ålesund as a driving force for the cluster that was established after a joint

comprehensive strategy between the industry academia and government. The result of this strategy was that Campus Ålesund should be built on three equal legs: education, research and industry. And today there is *"an intensive cooperation between the industry and the academic community on campus*". The application also looked into collaboration arenas and noted "*the cluster has a long-standing tradition for cooperation and has several cooperative bodies that work on common challenges like recruitment, reputation and competence-raising for SMB´s."*

4.2.5 Findings

It is evident that there is a far higher degree of collaborations vertically in value chain of the cluster in relation to the horizontal level that often defined by secrecy and rivalry. It seems like a large part of the knowledge on specific products or processes is shared through the ship owners as intermediaries. The knowledge is not shared vertically or directly with competitors, however they share a great deal of information horizontally. Here the ship owning companies are a key part of the knowledge distribution. They often gain knowledge and information from the different companies within the same levels of the values chain through the development and contract processes. But since they often run these processes simultaneously with several companies they share some of the information back to other companies in that level within the value chain. The knowledge is spread through the company's openness towards customers or suppliers and then through their network towards said company's competitors. This can be thought of as network of practice, but between whole organisations instead of between people. The questions then becomes if this is a purposively managed knowledge flow, and the answer is no. There is no indication that it is a managerial decision towards knowledge sharing, but rather a latent characteristic of the cluster.

It is also interesting to see how all companies collaborate vertically through the value chain in the cluster towards the end product, world leading advance offshore vessels. Even Farstad Shipping, which in the context of the cluster is the customer, goes a far way in transcending their own organisational boundaries and share their experience and knowledge in order for their suppliers to produce more advanced ships. The cluster as a whole can been seen as a "innovation ecosystem" which is defined as *"…the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution."* (Adner 2006,

p. 96) It is also highly interesting to see the importance of collaborations between academia and industry in the region especially through Campus Ålesund. The theoretical background gives strong indications towards the important role academia and research plays in a cluster.

Companies try to avoid collaborating with direct competitors. However the top management of the largest and most influential companies does collaborate together and share ideas and information at a strategic and overall level regarding future markets and in which direction the cluster should move. This does not mean they necessarily follow it, but they make sure everyone knows in which direction they are moving and what they believe to be the future of the cluster. For these processes the cluster project GCE Blue Maritime often functions as a meeting place for the companies. It amplifies the ambient awareness within the cluster. It can also be theorized that though these meetings the top managements are able to affect the whole business ecosystem in the cluster. Both through the obvious fact that they control the most influential and defining companies of the cluster, but also through the cluster project GCE Blue Maritime and the actions it takes to further develop the cluster. Also by looking at the cluster as an ecosystem the practice of sharing information and future market plans can be given a lot of merit, as someone´s loss in many cases will become someone´s gain.

There is a pragmatic realisation within the cluster companies that together they are stronger and that they are mutually benefited by a strong and prosperous cluster. The cluster phrase "collaborate when we can and compete when we have to" might not be accurate all the time, but it illustrates the openness towards collaborations that may be mutually beneficial. Also in Silicon Valley, which is a classical example of a cluster, a similar attitude was identified: "*Although companies in Silicon Valley fiercely compete, there is also an attitude that all can gain from sharing knowledge that is not company-secret*". (Lee et al. 2000, p. 10) In that instance the open standard and environment came to life from the knowledge sharing and open up to win-win exchange of knowledge. The same can be seen and identified within this cluster as well.

4.3 Open innovation

This part of the analysis will look into how the empirical data can be connected to the notion of open innovation and to what extent the use of open innovation can be identified.

4.3.1 Perspective from GCE Blue Maritime

Per Erik Dalen, CEO of GCE Blue Maritime and ÅKP, has through his position and work a unique view and insight into how knowledge is shared and distributed in the cluster. When asked about how his perception of the openness within the cluster is he defined it as a semi-openness where the ship owners as customers are key actors. If you look at the cluster as a value chain he explained that there is a high degree of openness and sharing of new knowledge in the vertical steps. However, horizontally in the value chain it is a quite different story as we saw in the previous analysis part "official collaboration and knowledge sharing". He is very clear that in terms of openness this is not information that in any way is publicly shared or easy obtained, but it is open towards a limited audience. The knowledge sharing and innovation processes are driven forward in cooperation with the customers. But at the same time he reckoned that there is an acknowledgement that after the ship is launched and christened the knowledge is in some way open for everyone since there are usually not taken out patents to protect it. This can enable the competitors to take advantage of if and this pushes everyone to always take a new step and continuously improve their ships. Per Erik is highly positive to this mechanisms and describes the effect of it as "… *in a sense get both the effect of innovating together as well as you always have the internal competition*." He agreed to the notion that companies let knowledge that is not company secrets essential to their strategic business model spill over to other actors in the cluster. But only to what can be considered to be a closed community within the cluster, which could be both their suppliers and customers that in a sense also works as communication channels.

"Part of the main innovation engine are the ship owners" – Per Erik Dalen

The companies in the region are also very quick in adapting and implementing new solutions. He described the interplay between the scholar community and companies in the region as highly transformative and with a short way from theory to implementation in practice. To take the example of these SFI (centre for research based innovation) such as “move”, he would expect that many academia such as NTNU to typically produce a long and comprehensive end report that may take months if not years to complete. In Ålesund however these report tends to be far less comprehensive about all the potential possibilities in the project and instead have the key findings and solutions already implemented in ships. The key point being that when the companies are a part of these research projects they do not sit around and wait. They take an active role and have the ability to take in new knowledge and quickly implement it in their innovations.

The main objective for the cluster project GCE Blue Maritime is to strengthen the cluster in the long perspective and a key element of this is to raise the general competence within the region. They have three focus areas: market, technology and human factor. They have established an SMB forum and arranged courses, lectures and conferences aimed towards SMB in the region. They also work towards increased collaborations in between the SMB, but Per Erik was very abdomen that it always has to be the companies themselves initiating this and not something they are pushing them towards. But rather act as a mediator if there are two companies looking for someone that may be beneficial to work together with. They are helping to create new networks across the cluster and also aims to do the same across industries. Currently they are working towards connecting the offshore focused cluster up to the bio marine industry and the potential for crossover, as one example. One step in this is the construction of their new arena for virtual prototyping he believe might help the companies from different industries to talk to each other more openly and try to come up with and try out new solutions in this new virtual reality. Also Frank Emblem, communication director at GCE Blue Maritime and ÅKP, talked about the importance for them to create platforms and meeting arenas for companies to communicate. They do not wish to govern or directly be a part of the innovation processes within the companies, but rather facilitate and provide them with opportunities.

4.3.2 Perspective from leadership

The largest and perhaps the most defining offshore shipping company in the cluster, Farstad Shipping, openly shares all information or knowledge if it is not considered to be company secrets according to their head of project department, Børge Nakken. In his perspective it is essential with collaboration across all parts of the cluster if they are to remain world leading in their industry. Farstad Shipping is therefor working towards strengthening the cluster as a whole and they sees it as their role to be a part of contributing to and also pushing for new knowledge and new innovations. "*We as a cluster are better off together*," Børge Nakken explained. On example of this is an SFI (Centre for research driven innovation) called "move" where several companies, such as Ulstein Group, are involved at the early research stage for developing autonomous ships for the future. He said that in general they make their knowledge, ships and crew available for collaboration and in use for further development for equipment manufacturers in order to push for improved product innovations. They often make their ships available for the equipment manufacturers for testing new equipment. In return of their role in promoting and strengthening the cluster they gain access to world leading innovations and products that can help them to stay competitive in the international market. During planning and construction of new ships it is not uncommon that they contact and negotiate with several companies, which have their own field of excellence, collaborating together such as in the example of the ship Far Solitaire. This was developed, designed and built as a result of a joint collaboration together with Vard and Rolls-Royce Marine, and it won the award "ship of the year" in 2013.

At Ulstein Group, which is a ship design, developer and builder, they are not placing equally as much emphasis on the promotion and development of the cluster as a cluster. Instead one of the most important aspects for them is the regions ability to attract new knowledge and gaining new impulses from external environment according to Per Olaf Brett. For him the most important is to always have their feelers out and look for new impulses and state of the art knowledge they can exploit in their innovation processes. They are especially focused on early phase knowledge development and research projects of a pre-competitive art. In recent years there have been a focus towards using the term "cluster" for the maritime industry located in the Møre region. This way of thinking as a cluster and focusing on the term "cluster" does not carry all that much importance for them, it does not change or influence any of the

mechanisms within the industry or cluster. However, in his opinion the term “cluster” have a lot of merit in an industrial political context. The term helps to simplify and highlight the primary, secondary and tertiary industry in the region as one more dominant industry. It also contributes to emphasise the possible consequences and implications some decisions or actions may have for a whole industry or cluster in a political context. However this should not be interpreted as them dismissing the notion of clusters or an industry located within a limited geographical area as having a positive and reinforcing effect. Quite the opposite as it certainly bring with some positive effects they are trying to exploit. Their focus is not towards trying to promote and advance the cluster as a cluster in the same way as the cluster project GCE Blue Maritime is, but rather take advantage of the positive effects. Per Olaf Brett at Ulstein Group is very adamant that it would be beneficial to have a collective early phase knowledge development. They are therefor supporting almost all of GCE Blue Maritimes initiatives and are participating in many research projects, such as the earlier mentioned research project “move”. And despite them having a different perspective then GCE Blue Maritime, Per Olaf was clear that they play an important role in the cluster and that it is arranged in a highly effective way today.

An important aspect of the cluster is the significant exchange of personnel and knowledge between the companies, which raises the learning intensity and can bring new impulses to companies. Another interesting aspect Per Olaf pointed out is that it makes controlling intellectual property rights and taking out patents more challenging, but also less expedient. New innovation are shared and adapted by the rest of the cluster within a relatively short time period. This compels companies to ensure a high learning intensity and innovation rate to compensate for not being able to sit on an expertise for long before other companies also acquires it. Some of this could probably be contributed to the simple fact that people live close to each other in a cluster. On the broad subject of openness and knowledge transfer between the different levels of the clusters values chain in general, Per Olaf said “*the vertical openness is relatively high, while the horizontal is quite closed*”. This is also true for Ulstein Group.

"*We used to be extremely horizontally closed but in the last 5-6 years we have opened up more horizontally. This has probably something to do with our increase collaborations with academia and universities. If we want those to succeed we need to be more open since they are operating that way. If we want to receive we will have to give, and that is essential*" – Per Olaf Brett

Ulstein Groups vision is "We create tomorrow´s solutions for sustainable marine operations" and according to their webpage they will get there through innovation, expertise, quality and added value. And according to Per Olaf Brett their objective is to launch a new ground breaking innovation into the market every third year. In order to accomplish this it is essential for them to always seek new information and knowledge that can stimulate and motivate their innovation activities. An important focus area for Ulstein Group is relationship building towards academia in order to gain access to new knowledge they can tap into and utilize. They are therefor deeply involved in several collaborative arrangements with several universities and always seek to connect with the presumptively most competent institutions around the world. In order to get hold of the necessary knowledge and competence they need to further develop their business they have a knowledge creation program that normally lasts for 3-4 years. Previously this programs topic and objective have been internationalisation for three years and then organisational development for three years. Currently the program is focusing on what they call "management of design" where digitalisation is a key subject. This is a deliberate action they take in order to strengthen the areas of the companies they feel will best position and benefit them in the future. It could be described as going out looking for and handpicking specific elements of competence their organisation will require to stay innovative and competitive in the future. He also stated that in their collaborations with academia there is an extensive knowledge sharing and flow going both ways.

Their effort to obtain new knowledge is not only focused towards academia but also towards other industries. One example of this could be the car- or airplane industry, which they have learned substantially from, but also more surprising industries such as the hotel- and the pharmacy industry. They can see very strong inspirations from these industries that give way for new interesting ways and methods to think about their own maritime industry. And these inspirations and motivations from other industries are in many ways more important then

what they can learn from their own industry and he categorized it as perhaps being the main drive force behind their innovations.

In essence they are striving to create knowledge links and a purposively flow of information and new knowledge into their organisation, which they hope they will be able to capitalize on through new ground breaking innovations at a later stage.

4.3.3 Perspective from workers

The engineer at the R&D department at a large ship design and building company did not describe a typical open innovation process at his workplace. He described them as having a much more internal focus, but he also mention that he knew about other departments that worked on research projects together with NTNU Ålesund. Also, in his opinion there was no clear obstacle or barrier for them to use external knowledge and they are always open for new ideas and knowledge from external source as long as they display a sensible amount of scepticism. He would also be open to sharing relevant information or ideas that they are not using themselves with people outside the company.

In the opinion of the employee at the head office of a large offshore shipping company the notion of open innovation fits well together with the maritime cluster in Møre. As mentioned in previous sections he also stated the cluster phrase "we collaborate when we can and compete when we have to." One of the communicated core value at his workplace was transparency and being open towards both the cluster and the community as a whole. He described a situation where several companies often could come together to co-create and develop new innovative ships and equipment. As a description he used the example from Farstad Shipping with the 2013 ship of the year Far Solitaire that was a joint project together with Rolls-Royce Marine and Vard.

The technical support at a large IT and communications company shared many of the same opinion as the employee at the head office of a large offshore shipping company. Within his company they received in the beginning of the year they received an email from the CEO that on of their main pillar for 2016 would be "openness". For the cluster overall he described a situation where companies are good at taking advantage of external information and

knowledge they may need in order to meet future market. Companies are also good at working together in order to achieve this and he said; "*This way they start good collaborations together where the aim might not new patents, but rather a collaboration that could create an environment where new products and new technology might prosper*." That said, he still believed that the competition between the companies far outweighs the openness especially between rivalling companies. But between the different levels within the clusters value chain he perceive there to be a large degree of openness and flexibility.

Also the contract manager at Rolls-Royce Marine described the same openness between the different levels of the value chain within the cluster. He believed having all of these different levels of a value chain within a very limited geographical area to be unique and that the collaborations in between them to be one of the strongest side of the cluster. However in his situation at his department the product they are marketing and selling is the knowledge in it self so naturally they are more concerned about protecting it. He did not talk about taking out patents or efforts to keep other for utilizing the information they share instead he believed in using common sense in regards of which information and knowledge that can be shared or not. And to focus more on keeping in house the innovation processes it self, such as work method, calculation and considerations instead of the knowledge that make up the product. As mentioned before they often received vital first hand experiences from the sailors in the development and conceptualization process together with the ship owners. But also in general he described their process as always utilizing external knowledge and experienced that in his opinion undoubtedly is greatly beneficial in their innovation process. He also informed that they as a company have several joint research projects both with the local university, NTNU Ålesund, as well as other academia and companies without going into specifics about them.

4.3.4 Second hand data

In the 2015 operation report "Innovative interplay in practice" for ÅKP (Ålesund Knowledge Park) there is a leading article written by Per Erik Dalen. This article points out that the entrepreneurship success in the region that is largely thanks to the innovation system within the region. New entrepreneurs need access to the market and existing business networks as well as funding agencies. The article points out the necessity for collaboration between the

public and private sector both in order to expend knowledge network, host attractiveness and funding opportunities for entrepreneurs that can challenge the established private sector.

ÅKP (2015, p. 6) describe themselves in the same operations report, as "*a regional centre of innovation and industrial development and they facilitate, amongst other things… Blue Maritime – Global Centre of Expertise*." Amongst all their activities they work "*…actively to transfer knowledge and experiences within innovation processes, organisations and cultures to other industrial environments and public activities."* It also state that their main strategy is: *"Innovative interplay in practice – Be a driving force for innovation connecting industry, academia and the public sector in processes that create sustainable value creation."* The ÅKP 2015 (p. 35) operation report also stated "ÅKP and SIVA are setting up a new company that will contribute to implementing the futures open innovation arena on Campus Ålesund."

The operations report also have a short overview of the SFI (Centre for research-based innovation) "Move" that have been mentioned earlier and state its main object as: *"To establish a world-leading research and innovation centre for demanding marine operations".* (ÅKP 2015, p. 33) It also lists several academic environments, universities as well as several of the key players in the cluster as participants.

4.3.5 Findings

Several of the interviewees were in general reluctant to define the process as open innovation. However, it was highly interesting to see that they worked actively towards creating a purposively inflow of new knowledge and information across their organisational boundaries. Especially from academia and early phase knowledge development collaborations. And the openness within the cluster was unanimously described in interviews as very high on the vertical axis of the cluster value chain. In other words, companies are quite open and willing to share knowledge with external actors, as long as they are not competitors. Per-Erik Dalen CEO of GCE Blue Maritime defined the cluster as "semi-openness". But it is important to note that semi-openness does not exclude open innovation as this might as well can be towards a limited environment or in this case a cluster.

If we look at outside-in open innovation we see that this is the inflow of knowledge into the organisation and exploiting external knowledge source in internal processes. The aim is to combine external and pre-existing internal knowledge in order to innovate. There is wide range of mechanisms that can be utilized in order to manage the inflow of knowledge, some of which are: Suppliers, customers, universities and research programs. Through out the whole research there are clear examples and evidence to suggest that exactly this is taking place within the cluster. The clearest example of this is Ulstein Group which places a great importance on tapping into the presumptively best academia and other industries in the search for new knowledge they can innovate and capitalize on, as well as countless research programs they participates in. Also the notion of inside-out open innovation can be identified within the cluster through the cluster participant's willingness to let knowledge and information of low strategic importance flow out across their organisational boundaries. And as the theory predicts this can potentially lead to new markets or useful input back across the organisational boundaries at a later stage. There are also examples of coupled open innovation such as Far Solitaire where Farstad, Vard and Rolls-Royce Marine combined their knowledge in order to create ship of the year in 2013.

An interesting argument I would like to make is to see the whole cluster as coupled open innovation. This strictly does not meet the definition, but it at least raises some interesting points about the innovation mechanisms in the cluster. Coupled open innovation is a combination of outside-in and inside-out or in other words, the knowledge flow goes both ways across the organisational boundaries of the companies. As some stated in their interviews it is only natural that information flows both ways, and in the vertical openness of the clusters value chain the information must come for somewhere. Also it seems like many companies are not that concerned about protecting their IP rights and rather rely on their ability to make further innovations. This have been claimed to at least be a strong re-enforcer of the already high rate of innovation in the region. It is also stated in the theoretical background that coupled open innovation can be managed through ecosystems, which was pointed out earlier in the thesis that the cluster could be defined as. Within the concept of coupled open innovation there are two main direction it can take, bidirectional and interactive. There is an argument to be made that most interactions between companies in the cluster can be classified as bidirectional coupled open innovation. This since the knowledge

flows both ways between the company's organisational boundaries through the vertical openness and can be and are being utilized in their internal innovation processes. These can be seen as strait exchanges of knowledge between two companies and the innovation process takes place within each organisations. However, if we shift our focus over to the many joint early phase research programs that take place in the cluster we could identify them as interactive coupled open innovation. It can be identified this way since the knowledge is jointly created outside the organisations.

In the context of open innovation within the cluster GCE Blue Maritime can be seen as holding the role as an innovation intermediary, also defined as an innomediary. They act as an innomediary that offer the cluster companies help in the search for external knowledge, new technical solution or collaborations partner through creating a meeting platform. They do this through different initiatives such as, SMB forums, conferences and their work towards attracting new knowledge and highly competent workforce to the region. They mainly work within the first steps of orientation and exploration in the value adding by innomediaris and help companies' access both new insight, perspectives and knowledge. GCE Blue Maritime also enables many of the cluster companies to better utilize the cluster advantages. As Per Olaf Brett expressed not all companies are as concerned about promoting the cluster as a cluster, but rather look at the advantages a strong regional industry can provide. Campus Ålesund stands out in the region as where academia and industry interplay and work well together. It is not only a source of knowledge but also an arena for knowledge exchange between companies that participates in the same research and development projects. Also here GCE Blue Maritime plays important roles in both promoting and to some degree govern and facilitate for campus Ålesund as a part of the cluster. In sum the cluster project GCE Blue Maritime can be seen as an innovation innomediary that is a part of a naturally forming open innovation system within the cluster.

4.4 Regional culture

During the collection of the empirical data it became clear that there might be other contributing factors for the knowledge sharing and innovations taking place within the maritime cluster. Mainly the regional culture and how this has contributed and led towards the sharing of knowledge through the process of open innovation. This last part of the empirical data analysis will therefore look into the importance of the regional culture.

4.4.1 Perspective from GCE Blue Maritime

Per Erik Dalen, CEO of both Blue Maritime GCE and ÅKP, connected the collaborations and perhaps some of the origin of the phrase "Collaborate when we can and compete when we have" back from the old fisherman culture in the region. He illustrated it through an example of two fishermen helping each other launch their boat despite having no other connections and in some sense being rivals that do not like each other. Helping each other and collaborate in some areas was done out of necessity and have led to a pragmatic approach of helping each other in areas where they could not succeed alone.

Frank Emblem, communication director at GCE Blue Maritime and ÅKP, was adamant that one of the key success factors of the cluster was the inherent culture within the region. The culture allows for a strong drive towards improve and innovate better solutions. People in the Møre region are also known for being hard tradesmen with a strong competitive drive but they also have the realisation that they are stronger together.

4.4.2 Perspective from workers

Also the technical support at a large IT and communications company talked about the culture in the region as an important factor. He described the culture of being strongly competitive but also open and trustworthy enough that when it is mutually beneficial people will still collaborate to achieve their targets.

The contract manager at Rolls-Royce Marine also brought up the advantages of working together with customers from the same region and culture. In his experiences the communications and understanding of each other's objectives are greatly improved. He also

pointed out the local ship owners as being far more willing to test new solution and invest in new unproved technologies in the effort to continuously build superior ships.

4.4.3 Perspective from leadership

Per Olaf Brett, deputy managing director at Ulstein International, also describe the local ship owners and Norwegian companies in general as highly innovation willing. In his opinion Norwegians are exceptional willing to experiment, even at the expense of increased risk and sometimes lower profits. He claimed that there are no other country in the world that has a higher innovation rate and ability to realize innovations then Norway.

"There are some inherent qualities in Norwegians and the Norwegian culture that is highly stimulating for innovations." – Per Olaf Brett

In his opinion the cultural factor has been essential for the clusters and regions success. And this has been enabled by the cultural openness and mutual trust towards each other. He brought up the Hofstede analysis that identifies a high degree of trust within the Scandinavian culture. He stated that in all their intention they never want trick to anyone to make a profit and at the base of all interactions and business relations there is a mutual trust. He stated that innovating and being able to capitalize on innovations relies on credibility, which there is a high degree of in the region. In his opinion the region also have a phenomenal adaptability and a very mobilization capability when it is needed. Such as now during the difficult financial times caused by the low oil prices that affects their markets. He talked about an inherent cultural aspect in people that have been out at seas for generation to always solve problems and look for new solutions. Ulstein Groups history also dates back to the old fishermen culture where they started out as a shipyard that worked towards new solutions to enable fishermen to travel further out to seas and fish more efficiently. It is a culture that have been developed over hundreds of years.

4.4.4 Second hand data

An article (Halse and Bjarnar 2014, p. 10) in connection with the research project MarCo the regional culture is characterize as "*flat structure, trust, extensive cooperation and knowledge sharing between actors".* They also attribute the sharing of experience based and "silent" knowledge in the region to the regional culture. Further they state that this historical cultural practice have led to the high rate of innovation in the cluster.

4.4.5 Findings

It is evident that the cultural and historical aspects have played a vital role in the development and continuation of the knowledge sharing and what can be seen as an open innovation process within the cluster. The inherent ability in the region towards sharing information, knowledge and competing at the same time has developed out of necessity over the course of generations. It can also be argued that much of the credit for the high rate of innovation should be placed towards the regional culture. An interesting point is that where the theory often points to culture as a barrier for implementation of open innovation it seems to act as an enabler instead. It is clear that the regional culture of the cluster is a very important factor to consider while looking into the knowledge sharing within the cluster. The culture seems to a certain degree to enable and encourage the actors in the cluster to look into and utilize all the knowledge and inspiration sources they may find in order to be innovative.

5. Discussion

This chapter will discuss upon and highlight important aspects in order to reach a conclusion to the research question: "How is knowledge shared through the process of open innovation in a cluster?" This will be done through firstly answer the sub-research questions on the basis of the findings in the empirical data. The answer of these questions will provide for a nuanced discussion and insight into the topic needed to draw a conclusion upon the research question.

How is information and knowledge distributed within a cluster?

Information and knowledge are distributed within the cluster in several different ways were the main phenomenon's are; informal knowledge flow, workforce mobility, collaboration with academia and through the openness in the vertical axis of the cluster. Informal knowledge flow in the cluster is where information and knowledge are shared through informal and unofficial communications channels that largely consist of the personal networks between employees in different companies. Many say these are one of the key features of the cluster. Through these communications channels a large degree of information that contributes towards an inherent knowledge about other companies are communicated. Through these it is also possible to access user information and experience based knowledge that may provide new useful inspiration. However one important remark is that these channels for the most part communicate what can be said to be mundane information. The mobility of the workforce amongst cluster companies also contributes in distributing and sharing the inherent organisational knowledge and innovation culture amongst other companies within the cluster. The mobility of the workforce also contributes to knowledge spill overs and potentially new communication channels and possible open innovation links between companies. Research project in collaboration with academia can also be acclaimed for a notable portion of the new knowledge created and distributed within the cluster. In these projects the companies tend to focus towards early phase knowledge creation of a pre-competitive character. Companies contribute in the projects and are a part of creating new knowledge, which then will be distributed to all projects participants. However the by far most important distribution of information and knowledge in the cluster is through the openness in the vertical axis of the value chain in the cluster. This can only be described as the

key communication channel of ideas, new knowledge and valuable experience based knowledge in the cluster. The ship owners are often a key part in this distribution where they act as a link between suppliers through which information and new knowledge can flow.

What role does communities and network of practice play?

Communities and networks of practice play a significant role in the cluster in terms of the informal knowledge flow as outlined above. They play the role of every day communication and raising the ambient awareness amongst companies within the cluster. It also contributes with spreading experienced knowledge that may prove useful as a source of inspiration. However the research strongly indicates that the information distributed through them is of low importance in terms of the recipient being able to develop new innovations of it. In general it can be said to play the role of an informal channel that eases the communication between organisations, both in terms of velocity and accessibility.

Can the use of Open Innovation, as defined by Chesbrough, be identified in the cluster?

There are clear evidences to support the identification of open innovation within the cluster. There is a vide spread use of outside-in open innovation where companies purposively manage knowledge flows from external sources across their organisational boundaries in order to innovate. This is best seen in case of Ulstein Group and their strong effort to access and utilize external knowledge sources, mainly academia. In order to stay competitive it is important for the cluster companies to always exploit the opportunities they can access through new knowledge. It also points towards being a low degree of barriers for open innovation within the cluster and it rather seems to be a cluster well suited for the notion of open innovation overall. There is also indication of inside out open innovation within the cluster, as many companies are not overly concerned about protecting IP rights and information that are not of strategic importance. A good example of this was Per Erik Dalen explaining that in general after a ship is launched and christened the knowledge is in some way open for your competitors to take advantage of. Some of the arrangement the companies have towards academia can also be seen as coupled open innovation. There are also examples such as ship of the year 2013 Far Solitaire that shows this type of open innovation also takes place amongst cluster companies. Then there is the cluster project GCE Blue Maritime that function as an innomediary for open innovation. Their role is mainly to strengthen the cluster

as a whole and its innovation capabilities. In this effort they act both as an intermediary to help companies in the search for external knowledge and new collaboration partners. They also facilitate new meeting arenas and help facilitate and govern several research projects and initiatives towards academia.

If the cluster is view as an organisation of companies we could almost make the claim that the cluster as whole are using open innovation in order to attract new knowledge and competence towards the region. The use of open innovation in this sense seems to be directed towards external knowledge sources in the form of early phase knowledge development projects and academia. The innovation process within the cluster as an innovation ecosystem can also be argued to be open innovation. The knowledge flow through the openness in the vertical axis of the clusters value chain could have been a perfect fit to the definition of open innovation. However, a key characteristic of open innovation is that the knowledge flow has to be purposively managed. And here lies the issue with defining it as open innovation as there is not any evidence to support that this is a purposively managed knowledge flow. In fact, it is quite the opposite as there are indications pointing towards this being a process that have developed over the course of generations.

Is the knowledge sharing process in the cluster affected by the regional culture?

There seems to be an inherent ability towards openness, trust and collaboration latent in the regional culture that has been developed over generations. It seems to have played an important role in developing the innovation system that is seen within the cluster today. And a key part of this innovation system is the process of which knowledge is being shared. In essence, yes the regional culture has an important effect on the knowledge sharing process. The regional culture enables cluster participants to both share and collaborate while still being competitors. In the degree the cluster phrase “we collaborate when we can and compete when we have to” is correct a large part of it can be contributed towards the regional culture. And where culture often is identified as a barrier towards the implementation of open innovation the clusters regional culture can be seen as an enabler instead.

"How is knowledge shared through the process of open innovation in a cluster?"

Clusters are complex ecosystems compositing of companies located within a limited geographical area and so are also the processes of knowledge sharing within them. In this thesis several processes in where knowledge is being shared have been identified. However the research questions the thesis sat out to answer is how the knowledge is shared through the process of open innovation within a cluster. For this purpose the term open innovation has been extended to also accommodate processes in where companies acquires and exploit knowledge beyond their organisational boundaries. Thus opening up to the notion of communities and networks of practice.

The key finding in order to explain how the knowledge is shared through such a process within the cluster is the vertical openness within the value chain of the cluster. This account for a large knowledge flow between companies located vertically of each other in the value chain. However the recipient of this knowledge flow, often the ship owner, brings this knowledge back down through the vertical axis to other companies that may be competing with the company first sharing said knowledge. Thus ending up with a process that strongly resembles open innovation between the companies but with the ship owners as intermediaries for distributing the knowledge. This process is illustrated by the figure below.

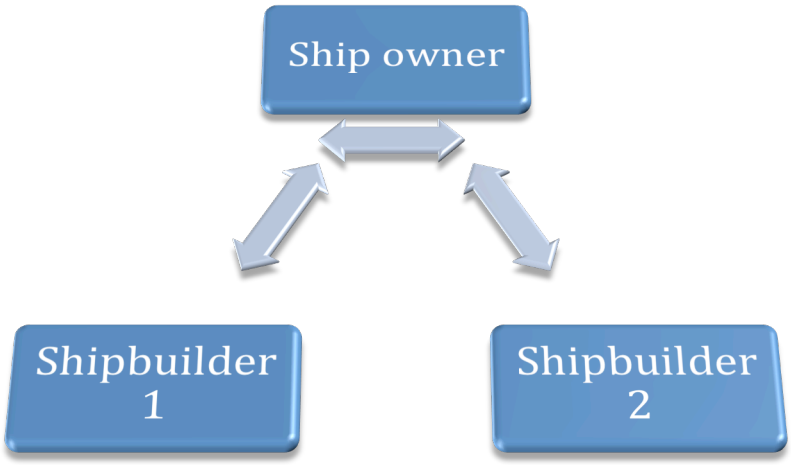


Figure 11- Vertical knowledge flow within the cluster

There are four findings that strongly indicate that this process is where the main flow of knowledge goes through. Firstly, in the analysis of interviews with workers it was brought up that a large part of their inspiration and ideas for new innovations stems from the ship owners. Secondly, companies can often recognize their product developments in other company's products. Thirdly, companies have a low degree of openness and knowledge sharing on the horizontal axis. And lastly, all interviewees clearly stated that knowledge that is of importance in the company's innovation process is not shared outside the workplace.

The process is enabled by the regional culture that seems to have played an important role in how the innovation system of the cluster has developed. There are some inherent abilities within the regional culture that not only enables it but also to some degree seems to be a key success factor of it such as trust, openness towards collaborations and the constant drive towards improvement and experimenting. However by seeing this knowledge sharing as an open innovation process there is one obvious element that needs to be addressed. This is not a managed process and therefor could not be seen as open innovation under the definition by Chesbrough that states that it has to be a purposively managed knowledge flow across organizational boundaries. But as stated above this thesis by the term open innovation process aims to look into how the companies share knowledge through openness and exploit knowledge sources outside their organizational boundaries, which can certainly be said to be the case here. It represents the same effect as open innovation and it is an integrated part of the innovation system within the cluster. It must also be pointed out that the knowledge sharing through the vertical axis also contains a large degree of user information and experience based knowledge. Which in reference to a point made above may also contribute towards bringing new knowledge and ideas through the vertical axis. The process can be seen as a semi open knowledge sharing towards a limited audience that overall leads to a continuous push towards new innovations within the cluster. Per Erik Dalen best described its affect as *"...in a sense get both the effect of innovating together as well as you have the internal competition."*

It has also been seen through the empirical findings that links towards academia constitutes an important role in terms of the knowledge sharing through an open innovation process within the cluster. As also seen in the theoretical background the access towards research

institutions is highly valuable for high-tech companies such as the advanced maritime solution developers within the cluster. But also the process in where companies access these valuable knowledge sources leads to knowledge spill overs and knowledge sharing, which also was theorized in the theoretical background. Campus Ålesund brings together both academia and companies in joint early phase research project. In which all participants have their own contributions and share the knowledge outcome. This can be seen as a coupled open innovation process of the companies where they share knowledge in order to later access knowledge they can utilize. The increasing collaborations with academia can also contribute towards companies opening up more on the horizontal axis of the cluster such as in the case of Ulstein Group. Per Olaf Brett described these collaborations as a probable cause for them to open up more horizontally and stated in this regard that *"if we want those to succeed we need to be more open since they are operating that way. If we want to receive we will have to give, and that is essential."* And this is exactly the point to be made, companies will have to open up more and give back, which is essential in this regard.

In general there can also be identified companies that to a large degree utilize open innovation as defined by Chesbrough where there is a purposively managed flow of knowledge across their organizational boundaries. This can especially be seen in their links towards academia both inside and outside the cluster where they actively seek ways to access new knowledge to be used in their innovation processes. This can also be seen in the cluster project GCE Blue Maritime that actively seek new knowledge they work towards bringing into the cluster in order to raise the general competence level within it. In terms of knowledge sharing GCE Blue Maritime also works more directly as an innovation intermediary where they aim to connect companies that are looking for companies that have a complementary knowledge and resource base they can collaborate upon. But a more significant part of their practice is their work as a facilitator for both new research initiative and meeting arenas for knowledge sharing such as conferences.

Communities and networks of practice were in the theoretical framework introduced as a part of an open innovation process as it is based on the same mechanisms of sharing knowledge across organizational boundaries as the concept of open innovation. In this respect the research has shown that it is largely experienced based knowledge and knowledge

that contributes to an ambient awareness of other companies within the cluster that are shared through these networks.

Companies seemingly have a low degree of concern of protecting their intellectual properties after the product have been released that can be contemplated as inside-out open innovation. Based on the before mentioned it could be theorized that some of this may be as a result of the high rate of innovation and knowledge sharing through the vertical axis. It seems like there is a realization within the cluster that knowledge and ideas will be spread anyway. So rather then spending time and resources on patents and protections it is more beneficial to push for new innovations instead.

These findings can also lead to some implication such as exposing the risk of disrupting the knowledge flow within the cluster if some of the key actors in cluster such as the ship owner were to relocate out of the cluster. If this where to occur in the future the channel through which ship designer, developer and builders gain access to some of their key knowledge within the cluster may be disrupted. Further, from a managerial standpoint for a company located in the cluster or that seeks to establish itself within the cluster it can contribute to an easier understanding of the knowledge flow. Understanding how knowledge is distributed may enable companies to improve their access and utilization of external knowledge sources in a more beneficial way. For the cluster project GCE Blue Maritime it strengthen theirs reasoning for working towards increased collaboration and interplay between industry and academia. Through their targeted effort towards strengthening the knowledge flows it seems highly plausible that they could be able to both affect and expand the knowledge distribution within the cluster to a new level.

From a theoretical standpoint these findings implicate that it do not seem to be one theory that can account for the complex knowledge sharing processes within a cluster. Through the discussion in this chapter it have been shown that neither open innovation nor communities and networks of practice are fully able to explain the phenomenon of knowledge sharing within the cluster. However from a theoretical point of view the key notion through out the thesis is that the knowledge flow seems to be at it upmost when the general openness is at it larges and organizations transcend their boundaries in order for knowledge to flow across.

6. Conclusion

The thesis has looked into and explored how knowledge is shared through the process of open innovation within the maritime cluster in Møre, Norway. The framework for the thesis was set within the notion of open innovation and communities and networks of practice. As a result of the research conduct the following conclusion can be drawn upon the research question: "How is knowledge shared through the process of open innovation within a cluster?" The thesis found that knowledge is shared through the openness on the vertical axis of the cluster as illustrated in the figure below.

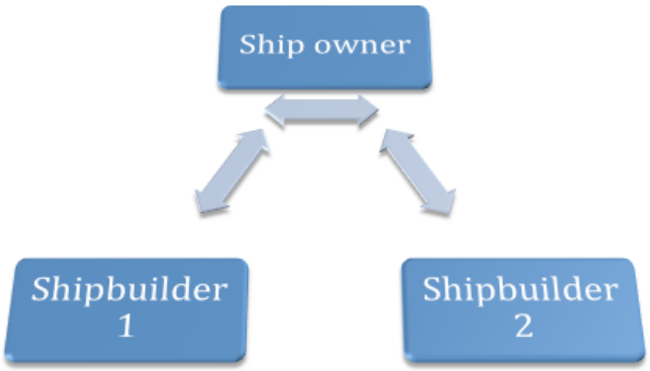


Figure 11- Vertical knowledge flow within the cluster

The process is not a managed process as called for by the definition by Chesbrough but rather a naturally developed process within the cluster that stems from the regional culture. It has also found that links towards academia plays an important role. Not only in terms of acquiring and developing new knowledge, but they also further transcends the organisational boundaries of the companies within the cluster and enables knowledge to flow across both in an inside-out and outside-in manner.

The thesis can enable companies to better understand how to access knowledge within the cluster. It also exposes the risk of disrupting the knowledge flow if key actors such as the ship owners were to relocate out from the cluster. From a theoretical standpoint it shows that knowledge sharing in a cluster may be as complex as the cluster itself. However it reaches the conclusion that knowledge flow follows openness of organisational boundaries. For future research it will be recommended to study how openness on the horizontal axis and a further push towards open innovation may affect the knowledge flow within a cluster.

Appendix A – Overview of interviewees

Persons interviewed contributing to perspectives of leaders.

Name	Position	Company	Type of company
Per Olaf Brett	Deputy managing director	Ulstein International, part of Ulstein Group	Specialized in ship design, building and maritime solutions.
Børge Nakken	Head of project department	Farstad Shipping	Large offshore shipping company

Persons interviewed contributing to perspectives of workers.

Name	Position	Company	Type of company
Anonymous	Contract manager	Rolls-Royce Marine	Specialized in ship design and maritime solutions. Note: largest company
Anonymous	Technical support	*Anonymous*	Large communication and IT company
Anonymous	Head office	*Anonymous*	Large offshore shipping company
Anonymous	Engineer at R&D department	*Anonymous*	Specialized in ship design, building and maritime solutions.

Persons interviewed contributing to the perspective of GCE Blue Maritime.

Name	Position	Company	Type of company
Per Erik Dalen	CEO	Global Centre of Expertise (GCE) - Blue Maritime	Cluster project run by ÅKP (Ålesund Knowledge Park)
Frank Emblem	Communication manager	Global Centre of Expertise (GCE) - Blue Maritime	Cluster project run by ÅKP (Ålesund Knowledge Park)

Appendix B – Interview guides

This appendix contains the interview guides used during the data collection for the thesis. It is important to note that these functioned as a topic guide with some open ended questions within each topic as a guideline. The main focus for the interview was to create an open interview with room for elaborations and follow up questions that followed the conversation instead of a rigid interview guide. The most important part during the interview was not cover all questions but rather to cover the talking points within each topic. During the interview the questions may have been phrased different and the conversation also may have skipped between topics in order to optimise to flow of the conversation. In this respect the questions may therefor been seen more as suggestions for questions within the topic. Before the data collection was conducted three different but yet similar interview guides was developed according to the position the interviewee held in the organisational level within the cluster, respectively workers, leaders and represent for the cluster project GCE Blue Maritime. The interview guides can be seen in the three consecutive pages of the appendix and they are structured in the following way:

Topic

- Questions for relevant talking points within the topic

Interview guide for workers

Official collaborations

- At your workplace to what degree are you collaboration with external companies?
- How would you share knowledge and information through these?
- How would you use knowledge and information you receive through these?
- Do you feel this may have contributed towards new ideas or knowledge?

Unofficial knowledge sharing

- In your personal network, do you have many people also working within the cluster?
- Do you talk with other people about your job outside the workplace?
- What kind of information would you be talking about outside the workplace?
- Have you shared or talk about information that could be considered a company secret?
- Through your connections within the cluster have you received or heard talk about information that you know should not have been shared?
- Do your employer lay any constrictions on what information you can share?
- Is there any difference in sharing information with people if they also work within the cluster or if they work in a different industry?

Open innovation

- Have you heard about the notion of open innovation before?
- (Explain what it is) How would you say this might be applicable to your workplace?
- Do your work include any links towards academia?
- Through your work do you share information that are not of strategic impotency?
- How do you feel towards using external knowledge sources in your work?

About the cluster

- Do you know about the cluster project GCE Blue Maritime
- Do your work include any links toward academia?
- How do you perceive the collaboration within the region and the cultural affect?

Interview guide for leaders

About your company

- To start out, could you tell me about your work and what that entails?
- How important is R&D and innovating at your company?
- What would you describe to be the main innovation engine at you company?

Open innovation

- How do you feel open innovation might be applicable towards your company?
- To what degree to you share information and knowledge towards other companies?
- To what degree to you perceive the openness in the cluster?
- Would you share knowledge that is considered non-essential with other companies?
- Have knowledge received from external sources leads to new ideas and innovations?
- Would you be sceptical towards utilizing knowledge from external sources?
- Do you have any formal links towards academia or research projects?
- What would be your motivation for being involved in a research project?

Official collaborations

- How would you describe your collaborations with other companies?
- To what degree is knowledge shared through collaborations with other companies?
- What would you say is the main motivation behind collaborating with others?
- How do you utilize knowledge received through collaborations?

Unofficial collaborations

- Do you lay any restrictions or guidelines for the employees in terms of sharing knowledge outside the workplace?
- In terms of sharing knowledge outside the workplace?
- In your perspective, how would you describe the unofficial knowledge flow?
- Would you perceive there to be a difference in sharing knowledge with other cluster participants or with companies outside the cluster?

About the cluster

- What do you perceive as the key behind the high rate of innovation in the cluster?
- What about the phrase “collaborate when we can and compete when we have to”?
- What importance would you say the regional culture has?
- How is your relationship towards ÅKP and the cluster project GCE Blue Maritime?
- Is it important for you to be a part in further developing the cluster?
- What do you think is important for the cluster to stay innovative in the time to come?

Interview guide for GCE Blue Maritime

About your organisation

- How do you work in order to strengthen the cluster?
- Your steering committee consist of the top management from the largest companies within the cluster… what influence does this have?
- I have seen you have many alliance and collaborations partners, could you elaborate on the distinction?
- How is your work towards NTNU and other academia?

Unofficial knowledge flow

- How would you describe the unofficial knowledge flow outside the workplace?
- What affect does the knowledge flow outside the cluster have?

Open innovation

- Would you say that the notion of open innovation might be applicable to the cluster?
- How do you perceive the openness within the cluster?
- Would you say companies are willing to share information that is not considered to be of strategic importance?
- Would you describe your self as an intermediary for sharing knowledge?
- How do you perceive the SFI (centre for research based innovation)?
- Do you work actively to bring external knowledge into the cluster?

About the cluster

- What is your take on the merge between NTNU and Ålesund City College?
- How do you perceived the future of the cluster?
- How can you be a part of influencing the clusters future?
- How do you perceive the regional culture in the cluster?

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