CHALMERS
UNIVERSITY OF TECHNOLOGY

Knowledge creation in inter-organisational collaborations

A case study in the Swedish shipping industry

Master's Thesis in the Master's Programme
Maritime Management

FILIP FEURST
RIKARD LAVITSKIJ SÖDERLING

Department of Technology Management and Economics
Division of Entrepreneurship and Strategy
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2017
Report No. E 2017:026

MASTER'S THESIS E 2017:026

Knowledge creation in inter-organisational collaboration

A case study in the Swedish shipping industry

FILIP FEURST
RIKARD LAVITSKIJ SÖDERLING

Tutor, Chalmers: KAMILLA KOHN RÅDBERG

Department of Technology Management and Economics
Division of Entrepreneurship and Strategy
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2017

Knowledge creation in inter-organisational collaborations
A case study in the Swedish shipping industry

FILIP FEURST
RIKARD LAVITSKIJ SÖDERLING

Master's Thesis E 2017:026

Department of Technology Management and Economics
Division of Entrepreneurship and Strategy
Chalmers University of Technology
SE-412 96 Gothenburg, Sweden
Telephone: + 46 (0)31-772 1000

Chalmers Reproservice
Gothenburg, Sweden 2017

Abstract

In the wake of rising global concerns regarding the environmental impact of humans, the shipping industry is facing stricter regulations, especially in sensitive areas like the Baltics. In Sweden, a new collaboration platform called Zero Vision Tool was created to find new solutions complying with the new sulfur regulations. This thesis aims to grasp what parameters influence the creation of knowledge in an inter-organisational collaboration and how the collaboration platform has made the Swedish shipping industry more innovative and environmentally sustainable. A qualitative case study was conducted on an umbrella project under Zero Vision Tool, where ten participants from both management and staff from two sub-projects were interviewed. Data was also collected from documents in the form of reports, emails, and white papers.

Literature suggests that at least three inter-dependent parameters influence the success of a knowledge creating collaboration: leadership & organisation, trust and communication. The findings from the case study support this, and the importance of close interaction between individuals. It is suggested that common goals from the project are to be set at an early stage. Further, looser leadership roles promote knowledge creation and that both inter-organisational and inter-personal trust is important for the success of the project. The thesis further concludes that face-to-face communication should not be substituted with other forms of communication when solving complex issues and that the frequency of the partners' meetings are important. Finally, it is concluded that Zero Vision Tool has worked as an incubator for the sub-projects where most of the knowledge was created.

Key words: Inter-organisational collaboration; knowledge creation; collaborative innovation; shipping; SECI model; trust; leadership; communication; Nonaka; Huxham

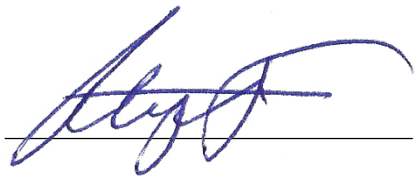
Acknowledgement

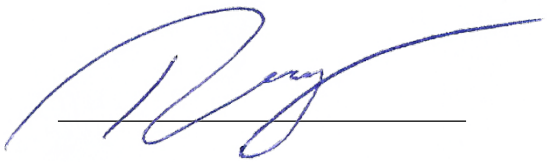
This master thesis has been written by two students at the masters' program *Maritime Management* at the *Department of Mechanics and Maritime Sciences* at Chalmers University of Technology, Sweden. It was conducted from January 2017 to June 2017 the *Department of Technology Management and Economics* at Chalmers University of Technology. It was conducted from January 2017 to June 2017.

We want to extend our gratitude to Kamilla Kohn Rådberg, our supervisor at Chalmers University of Technology. Your enthusiasm, professionalism and willingness to share experiences and knowledge have been of great help when guiding us though the process.

We also want to express our appreciation to the interviewees and organisations that gave us the opportunity to meet and discuss the studied projects.

Many Thanks!





Filip Feurst

Rikard Lavitskij Söderling

Gothenburg, May 2017

List of figures

Figure 1 Thesis outline....4

Figure 2 Kaats and Opheij (2014) Collaboration position based on Gomes-Casseres (2003) ...7

Figure 3 Himmelman (1992) continuum of complexity and commitment in collaboration (author illustration 2017)....8

Figure 4 A Process Framework of Collaboration by Ring and Van de Ven (1994) (author illustration 2017) 10

Figure 5 The Knowledge Creation System of Nonaka, illustrated by K. Kohn Rådberg (2017) and simplified by the author's (2017) 13

Figure 6 Organisational knowledge model by Nonaka et al. (1996) 15

Figure 7 Inter-organisational and Interpersonal Trust. Author illustration 2017, inspired by Zaheer et al. (1998)....19

Figure 8 Vangen and Huxham's (2003b) Trust-Building Loop (author illustration 2017) 21

Figure 9 Theoretical gap found in the theory of KC and IOC (author illustration 2017).....24

Figure 10 PILOT LNG, FLEXI and LNG CONV in a wider context, illustrating two levels of analysis (author illustration 2017)....35

Figure 11 Picture of Fure West with LNG tanks on deck (Furetank 2017)....36

Figure 12 An concept illustration of Coralius which is the vessel name of the project FLEXI (Sirius Shipping 2017)....38

Figure 13 Project leadership structure (author illustration 2017) 42

Figure 14 Schematic communication channels in sub-projects, Pilot LNG and ZVT (author illustration 2017) 52

Figure 15 Interactions between IOC and KC (author illustration 2017) 70

Figure 16 How ZVT has driven KC and innovation in the Swedish shipping Industry (author illustration 2017) 71

List of tables

Table 1 Fure West ship's particulars 37

Table 2 Ships particulars for the FLEXI project.....38

Table 3 A list of the interviewed participants in the study 39

Table 4 Main empirical and main analytical findings 40

List of abbreviations

EU	European Union
HAZID	Hazard Identification Study
IMO	International Maritime Organisation
INEA	Innovation and Networks Executive Agency
IOC	Inter-organisational collaboration
JAP	Joint Authority Project
JIP	Joint Industry Project
JUP	Joint University Project
KC	Knowledge Creation
LNG	Liquefied natural gas
NO_x	Nitrogen oxides
R&D	Research and development
SAFER	Vehicle and Traffic Safety Centre
SO_x	Sulfur oxides
SSA	Swedish Shipping Association
TEN-T	Trans-European Networks
ZVT	Zero Vision Tool
ZVTREF	Zero Vision Tool reference group

Table of content

Abstract ..... **I**
Acknowledgement ..... **II**
List of figures ..... **III**
List of tables ..... **IV**
List of abbreviations ..... **V**
Table of content ..... **VI**
1 Introduction **1**
1.1 Background 1
1.2 Problem 2
1.3 Aim and research questions 2
1.4 Delimitations 2
1.5 Thesis outline 3
2 Theoretical framework **5**
2.1 Inter-organisational collaboration for innovation 5
2.2 Knowledge Creation 11
The SECI model and their corresponding Ba 12
2.3 The parameters for IOC and KC 15
Leadership & Organisation 16
Trust 18
Communication 22
2.4 Identified theoretical gap 24
3 Methodology **25**
3.1 Research strategy 25
3.2 Research design 26
3.3 Literature review 27
3.4 Data collection 27
3.5 Quality of study 31
3.6 Ethical Considerations 32
4 Description of the case study **33**
4.1 Zero Vision Tool 33
Zero Vision Tool Method 33
4.2 Pilot LNG 34
TEN-T and INEA 35
4.3 LNG CONV 36
4.4 FLEXI 37
5 Empirical findings and analysis **39**
5.1 The interviewees 39
5.2 Main empirical finding and main analytical findings 39
Main empirical findings **40**
Main analytical findings **40**
Leadership & organisation **40**
Trust **40**
Communication **40**
Leadership and organisation 42

Trust....46
Communication....52
Implications of Pilot LNG....54
6 Discussion....57
6.1 Leadership & organisation....57
Role of the JIP-leader....57
Leadership and knowledge creation....58
Stages of partnership....59
Common goals and values....60
6.2 Trust....61
Personal & organisational trust....61
Trust and building psychological contracts....62
Lack of trust....63
Trust and knowledge creation....64
Reciprocity....65
6.3 Communication....66
Communication channels....66
6.4 Implications of Pilot LNG....68
6.5 Research question discussion....69
7 Conclusion....72
7.1 Concluding remarks and further research....73
Personal reflections....73
References....75
Appendices....80
Appendix A – Interview guide....80
Appendix B – References and the fields of theory....82

1 Introduction

This chapter introduces the thesis and its purpose. A background of the thesis is presented, followed by a problem description, aim, research question, delimitations ending with an outline of the thesis.

1.1 Background

In 2015, shipping companies operating in Northern European waters faced a new regulation regarding the sulfur oxide (SO_x) emission from vessels, to protect the vulnerable waters in the area and to counteract the respiratory health issues caused by the airborne pollution. New technological solutions or alternatives to conventional fuels were needed to meet the new regulation and it was the ship owner's responsibility to meet the requirements (IMO, 2014). New, unproven solutions are often accompanied by high risks and costs to bear for single actors, and by engaging in collaborations over organisational borders within the industry, the risk could be mitigated (Powell et al. 1996). In 2011, an organisation called Zero Vision Tool was created by industry actors with the intent of functioning as a pioneering platform and a collaboration method where the industry, authorities and universities could test and create industry solutions together. The main goal of the platform was to speed up the technology transition before the new regulations (ZVT, 2016) came into force. Since the start in 2011, multiple projects co-funded by the European Union and other collaborations have been conducted. For the reduction of SO_x, three large pilot projects were launched under ZVT, Pilot Methanol, Pilot LNG and Pilot Scrubber. The project Pilot LNG, gathers several projects concerning the intention of using Liquified Natural Gas (LNG) as a marine fuel. LNG fulfills the new regulations of reduced SO_x emissions, as well as significant emission reductions of nitrogen oxides (NO_x) and some reduction of greenhouse gases (Bengtsson et al. 2011). The objective of Pilot LNG is to enable a viable infrastructure for LNG and to offer possible solutions for running vessels on LNG, through its several sub-projects. These include LNG CONV, which is a project to convert an existing vessel to be able to run on LNG, and FLEXI, which is the construction of a flexible bunker vessel capable of also acting as a feeder vessel. Together, the projects of Pilot LNG are to act as a driving force for a capable LNG infrastructure in Sweden.

The concept of creating alliances to work together is as old as civilization, the Greek city-states fought together when faced with threats to the ancient Greek world (Kaats & Opheij 2014). In modern collaborations over organizational borders, the desired result is less violent, but the basic idea is the same. By combining the resources and knowledge of partners with different competences and having them work together, they can achieve objectives otherwise out of their possible scope (Gallaud 2013, Wallin & von Krogh 2010). It is with this spirit that ZVT aims to support projects and create a wide-spread movement towards sustainable solutions within the Swedish shipping industry. One of the cornerstones of the ZVT platform is to allow the sharing and creation of knowledge among the involved project partners (ZVT 2016). The act of creating knowledge within an organisation is complex, and efforts to investigate and explain the process has been done by Nonaka et al. (1996), whose theories seek to explain how tacit

and explicit knowledge is constantly transforming in the knowledge creation process inside an organisation.

1.2 Problem

The aforementioned sulfur regulations will be problematic for the Swedish shipping industry, and companies will have to find industry-wide solutions together. Making an inter-organisational collaboration function effectively is a complex process, as is the act of creating new solutions. Creating knowledge in a collaboration with multiple organisations is even more difficult. Researchers claim that their theories of knowledge creation within companies is also applicable in an inter-organisational setting, however there is limited research that confirms this. In a similar fashion, it has not been tested if and how the Zero Vision Tool collaboration platform fulfils its objective of creating new knowledge and solutions for the Swedish shipping industry.

1.3 Aim and research questions

The aim of this master thesis is to explore if and how new knowledge is created when different companies collaborate in an inter-organisational setting using the Zero Vision Tool platform in the Swedish maritime industry. To do this, parameters that are important and bridges the research fields of knowledge creation and inter-organisational collaboration are to be studied. Factors of the parameters will be explored in a case study on the umbrella project Pilot LNG along with two of its sub-projects. To achieve the aim of the thesis, the following research questions are to be answered:

What parameters exist within inter-organisational collaboration for knowledge creation and what factors of these parameters affect the success of these collaborations?

How has the Zero Vision Tool collaboration platform enabled the creation of new knowledge in the Swedish shipping industry?

1.4 Delimitations

Pilot LNG consist of several projects other than LNG CONV and FLEXI. Due to time constraints and in order to limit the scope, the decision was made to only focus on the main project Pilot LNG by using LNG CONV and FLEXI as examples of the sub-projects. This means that the process and results from other projects are not examined, although it should be noted that these may have influenced the Pilot LNG project in its. As the project was officially concluded in end of 2015, there was no possibility to perform interviews or collect data during the running of the project. Thus, the data must be collected retroactively. The intention is to only interview the individuals who were somehow participating in the projects, which means that there will be no outside perspectives of the projects taken into consideration in the thesis.

Knowledge creation lies within the theoretical sphere of knowledge management, which is a very broad body of knowledge and includes more fields that influences the knowledge held in

an organisation. However, this thesis focuses solely on knowledge creation. Further, the thesis deals with knowledge creation in an inter-organisational setting during Pilot LNG or its sub-projects. Thus, knowledge created that is not connected to the projects will be excluded from the thesis, as it is irrelevant for answering the research questions. While there are many parameters that influence botch KC and IOC, this thesis focuses on those parameters that both fields of studies share.

1.5 Thesis outline

The thesis' outline is viewed in Figure 1. The first chapter outlines the background and framework for the thesis and presents the objectives of the thesis and the research questions that the thesis aims to answer. The second chapter discusses the necessary theories that are necessary to answer the questions. A theoretical gap is found and important parameters that govern the theoretical fields of KC and IOC are presented. In the third chapter, the methodology chosen by the authors are presented. The ethical guidelines followed is presented, and the merit and validity of the methods and tools chosen are discussed. In the fourth chapter, the case study is described. The project Pilot LNG and the two sub-projects FLEXI and LNG CONV are presented, and all involved organisations are described. In chapter five, the main findings of the study are presented. The findings are analysed with regards to the governing parameters for KC and IOC found in the theoretical framework. The findings from the two sub-projects are brought up to context for the main project. Following is chapter six, where the analysed findings are discussed and examined together with the theoretical framework, in order for the authors to answer the posed research questions. In the seventh and last chapter, the authors closes the thesis with concluding remarks and suggestions for future research.

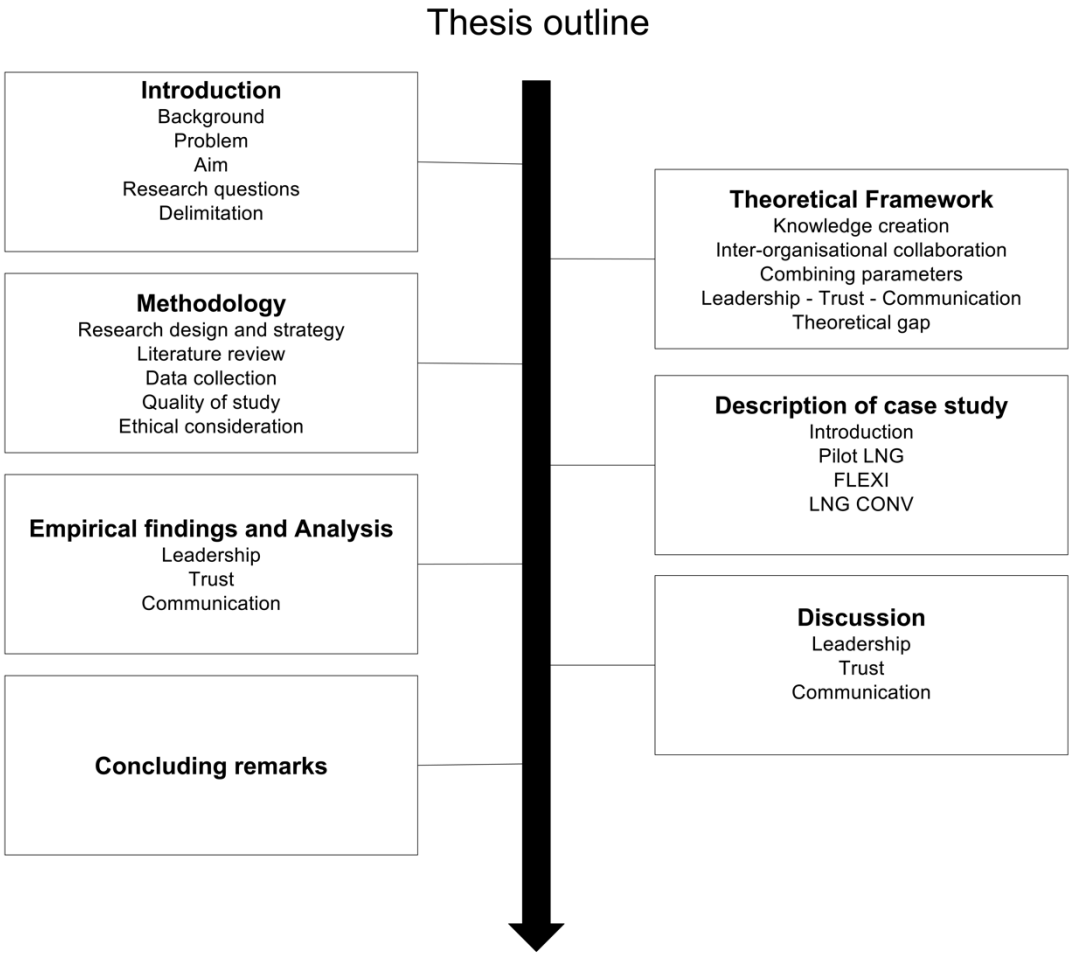


Figure 1 Thesis outline

2 Theoretical framework

This chapter presents the theoretical framework and is divided into two main bodies of knowledge: inter-organisational collaboration and knowledge creation. The first section introduces different levels of inter-organisational collaboration viewed from different perspectives. The second section introduces knowledge creation in general, and the SECI model in particular. The two main sections are followed by three sub-sections introducing found parameters that are important influencers for knowledge creation in an inter-organisational setting.

2.1 Inter-organisational collaboration for innovation

Collaborating increases the ability to become more innovative together, when organisations work together with each other and pool resources, such as knowledge and skills to develop an invention that fits the market and become an innovation. The aim of the collaboration is to access the knowledge of the other organisation, especially the tacit knowledge, so that they can together can create something that none of them would have accomplished by themselves (Gallaud 2013). There are multiple fields of study that addresses collaboration over organisational borders, such as network, collaborative innovation or open innovation. Even if the terminology is wide, a lot of the expressions are synonyms and describe the same or similar (Huxham et al. 1996). The term collaboration can be interpreted in multiple ways (Huxham et al. 1996). The definition of collaboration taken from Himmelman (1996) in Huxham et al. (1996) and will be used throughout this thesis:

> *"Collaboration is defined as exchanging information, altering activities, sharing resources and enhancing the capacity of another for mutual benefit and to achieve a common purpose".*

According to Kaats and Opheij (2014) collaboration across organisational borders is useful for almost any type of organisation. Major issues such as changes in the industry landscape, rules and regulations or changes in competition can be reasons for collaborations. The understanding of how a collaboration functions is important since most industry organisations are involved in external collaborations (Powell et al. 1996). Regarding the innovative capabilities in organisations, studies have also shown that there is a correlation between the effectiveness of the internal R&D department and the number of inter-organisational collaborations (IOC) (Powell et al. 1996). Powell et al. (1996) points out that organisations do not have the internal capabilities to singlehandedly stay competitive over time when the pace of technical development in the industry is high. Gaining knowledge and know-how is vital to stay competitive and it can be done effectively through interactions crossing the organisational borders. The reasons why organisations decide to collaborate with other organisations is because the knowledge cannot be found inside the organisation but is also not easily available outside the company (Powell et al. 1996), meaning that new knowledge instead have to be co-created in collaboration between the organisations.

To achieve an effective collaboration there needs to be incentives to do so. According to Huxham et al. (1996) the partners must aim to achieve something unusually creative that none of them would have been able to create themselves. In other words, through collaboration with other companies, the organisation should achieve their internal aims better than they otherwise would have done. Gray (1989)agrees by stating that the parties should take advantage of their differences and *"search for solutions that go beyond their own limited vision of what is possible*". In a wider perspective, the collaboration can possibly succeed in doing something that is not just an improvement for the involved organisations, but also for the society which affects stakeholders outside the borders of the collaboration (Huxham et al. 1996).

A collaboration can take many different shapes and forms and have many different names for describing it. There is an extensive body of knowledge for both *market exchange* and within an organisation (internal – mergers and acquisitions). However, in between these two, the body of knowledge is not as all-encompassing. Market exchange is when an organisation have occasional arm's length purchases or sales with a supplier or customer (Gomes-Casseres 2003). On the other end of the spectrum, one can find internal mergers and acquisitions where two or more organisations merge into one organisation. Inter-organisational collaboration (IOC) is in between the two externalities of interactions. A variety of different terms used for collaborations, for example joint productions, knowledge networks, public-private partnerships, supply chain or open innovation. Kaats and Opheij (2014) have made a chart with two axes compiling Gomes-Casseres (2003) different forms of collaboration, shown in Figure 2. The Y axis represents the duration of commitment of the collaboration, meaning how long time the partners will collaborate. The X axis shows the joint decision making, meaning the power-balance between the partner considering the decision-making. The umbrella term IOC describes all terms in the grey area in Kaats and Opheij (2014) Figure 2, which originates partly from Gomes–Casseres (2003).

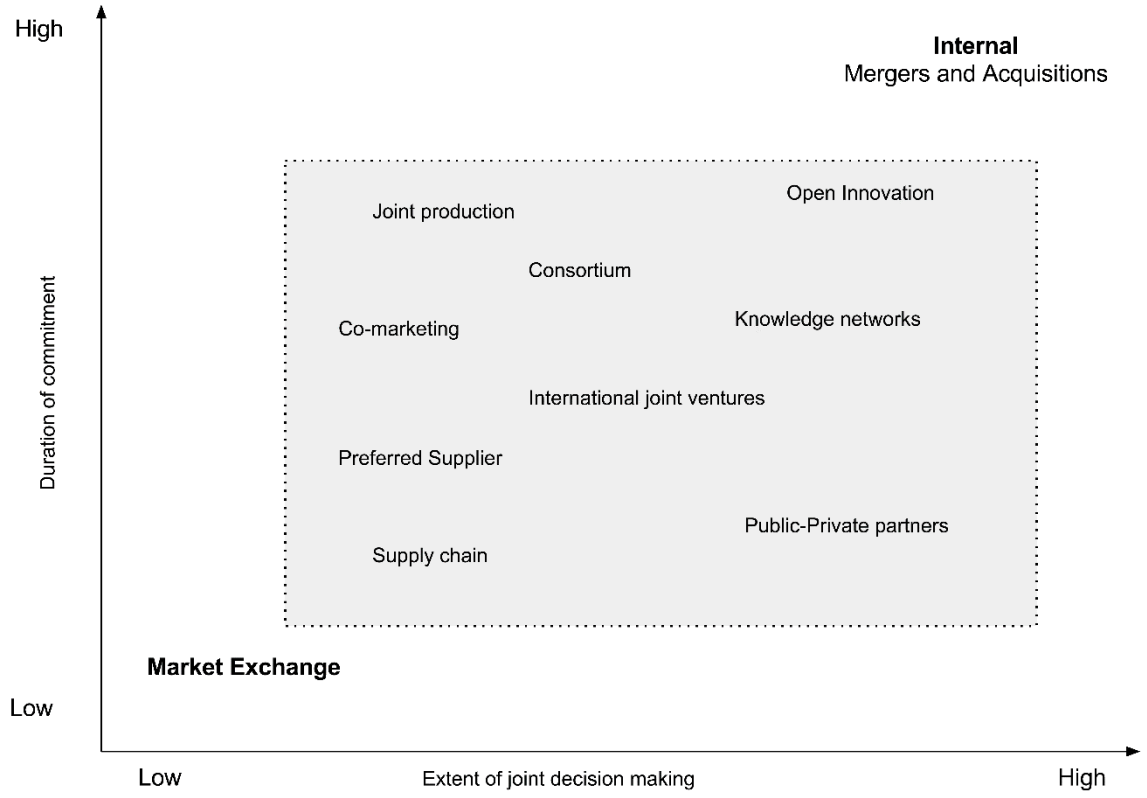


Figure 2 Kaats and Opheij (2014) Collaboration position based on Gomes-Casseres (2003)

One of the terms shown in Figure 2 is Open innovation, coined by Chesbrough (2003). According to Kaats and Opheij (2014) open innovation is the closest one can come before engaging in mergers and acquisitions, and is therefore one of the more open forms of collaboration. It has both high duration of commitment and high joint decision making. It is a form of collaboration where a company make the borders to their research and development department more porous, so that knowledge, know-how, intellectual property, and resources can flow more freely in and out of the company (Chesbrough 2003). Companies using this approach have a philosophy that no organisation can accumulate all skills, know-how and other resources, therefore it must collaborate with others to stay competitive. The collaboration discussed in this thesis will not be as open as open innovation, instead it will be referred to the definition by Huxham et al. (1996).

IOC can also be explored from another perspective. Himmelman (1996) writes in Huxham el al. (1996) that before IOC can be achieved, the companies need to pass three other stages of partnerships differentiated along a continuum, starting with networking and ending with collaboration, shown in Figure 3 below.

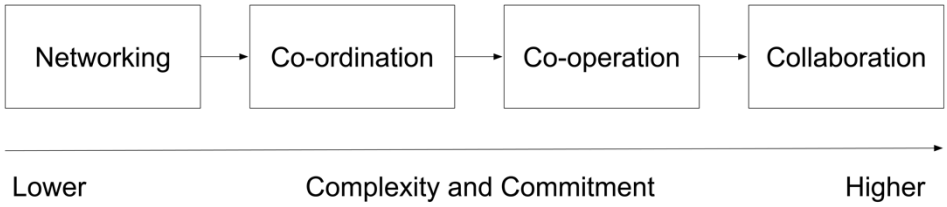


Figure 3 Himmelman (1992) continuum of complexity and commitment in collaboration (author illustration 2017)

Networking between organisations contain the lowest level or commitment and trust. It is best attained between the individuals in the organisations rather than between the organisations. Information is shared between the individuals for mutual benefit. For networking to be efficient, the people in the organisation need to know whom in the other organisation that carries the information they require. According to Himmelman (1996), *"Co-ordination is defined as exchanging information and altering activities for mutual benefit and to achieve a common purpose"*, which makes it more complex than networking. An example of co-ordination is when two organisations share information to adjust coherently to be able to take better care of their joint customers. The third stage of the continuum is co-operation. Here, the organisational commitment is greater and it is not unusual that the commitment is binding through written contracts. Co-operation is when you share resources between the organisations. According to Himmelman (1996): *"Shared resources can encompass a variety of human, financial and technical contributions, including knowledge, staffing, physical property, access to people, money and others"* which makes the definition of co-operation similar to the definition of collaboration used in this thesis, with the exception that it lacks the part regarding enhancing the capacity of the partner to achieve mutual benefits. Thomson and Perry (2006) further distinguish collaboration from co-operation by saying that collaboration has a deeper level of interaction, integration, commitment and complexity than co-operation. Järrehult (2011) also discusses the differences between co-operation and collaboration. He also argues that both co-ordination and collaboration share resources, but with one distinction. He says that partners in a co-operation enters the partnership with similar resources and have an idea on how to share the resources and gain benefits from it. But at the same time, the aim of the collaboration can differ between the partners. During a collaboration, on the other hand, partners enters the partnership with complementary resources and the partners are aligned around a common goal (Järrehult 2011). However, Kaats and Opheij (2014) argues that: "*Not everyone involved in a collaborative partnership has exactly the same interests*".

Taking collaboration one step further, Ollila and Yström (2016) talks about co-creation which is a partnership with even stronger relationship ties between the partners. The partners are jointly creating new knowledge and meaning and are very much in the exploration phase and not as much in the exploitation phase. An organisation should, according to O'Reilly and Tushman (2004), focus on both exploitation and exploration to stay competitive and innovative over time, being a so called ambidextrous organisations. On one hand an organisation needs the incremental and small innovations of company products or operation. On the other hand, more radical changes and innovations are needed to stay competitive in the long run. These two types of views can in some context be contradictive since the radical changes can cannibalize on the

core business activities. However, the co-creation step of partnership focuses more on searching for new solutions and innovations, not by themselves, but together with other organisations with the same goal and aim.

Another take on collaboration is to look at it as an iterative process. Instead of looking at it as a linear process shown in Figure 3, it can be seen as an iterative circle that evolves over time. This process framework originates from a well cited article by Ring and Van de Ven (1994) and was called the Process Framework of the Development of Cooperative of Inter Organisational Relations and can be seen in Figure 4. Thomson and Perry (2006) adjusted the framework slightly and put it in a collaborative setting. Negotiation, commitment and implementation are the three stages of the framework and are repeated over time and "*implies a cyclical process of renegotiation*" (Thomson & Perry 2006). In the theoretical framework there are, for analytical purposes, borders between these three stages. However, in real life the borders are blurred (Ring & Van de Ven 1994). Usually, the cycle starts with negotiations between the involved parties. Here, the individual goal of each organisation will be aligned into a common goal and aim of the collaboration. It is decided what kind of resources that will be shared, investments to be done and what risks the collaborations have. To be able to identify risks in the collaboration, formal bargaining is alternated with more soft negotiation trying to make sense of the parties in the collaboration. The commitment stage brings an agreement regarding the governance between the parties. It can either be in form of contracts or informal agreements such as verbal agreements or a handshake. The final stage is the executive stage. Here, the approach that the parties have decided to use for achieving the common goals, is executed. In this last stage, the parties are starting to interact, and with the interaction comes inter-personal relationships (Ring & Van de Ven 1994). Thomson & Perry (2006) interpretation of collaboration using the processes framework is sum-up like this:

> *"In order for collaboration to evolve, the integrative elements manifest in personal relationships, psychological contracts, and informal understanding and commitments need to supplant the aggregative elements manifest in formal organisational roles and legal contracts. Finding the right balance between integration and aggregation – not relying on formal institutional structures such as memoranda of agreement and standard operating procedures – may be the key to sustaining collaboration over time."*

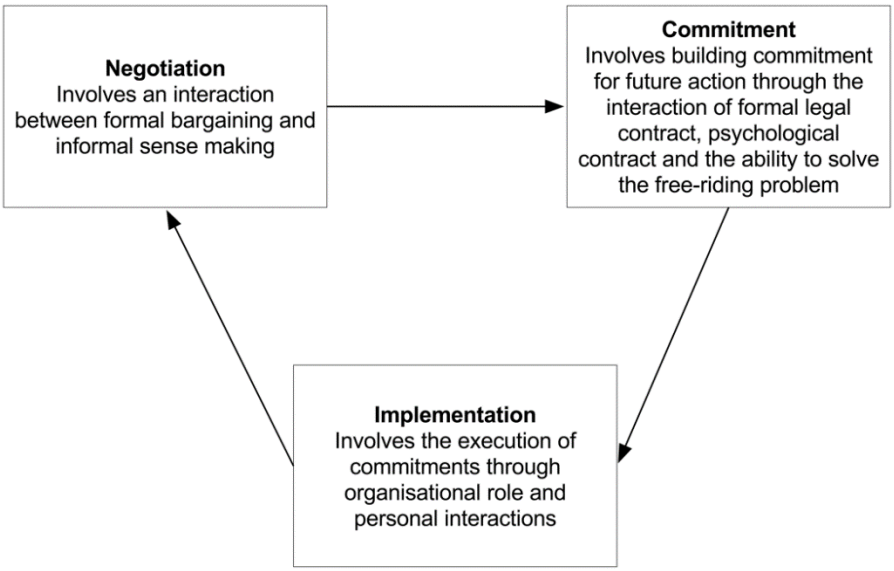


Figure 4 A Process Framework of Collaboration by Ring and Van de Ven (1994) (author illustration 2017)

The organisations are continually assessing the partnerships at all steps of the collaboration. If the aim and goal are driven by an agreement or obligation that bind each of the parties in an equal fashion, the collaboration can continue. If there is no mutuality in the collective actions of the organisations, the cyclic process will be terminated. In other words, the collaboration will end if the partners have derived what they promised or if the partners have not delivered what they have promised. In both cases no renegotiations will occur and the cycle will stop in the negotiation step (Thomson & Perry 2006).

In a collaboration, there are several risks for the collaborative parties. Hamel et al. (1989) states that while costs and risks can be reduced by engaging in a collaborative setup, there may be a heightened risk of losing the competitive edge through the leakage of knowledge to competitors that may either be a part of the collaboration or through the networking with parties in the collaboration. There is also the risk of administrative costs and loss of time offsetting potential gains. Vangen and Huxham (2003b) argues that the parties of the collaboration automatically takes risks by collaborating, as it is impossible to ascertain how the other parties will contribute, and indeed if the set goal of the collaboration will be achieved or not.

Gallaud (2013) also states that there are some risks associated with innovating in collaborations, mainly the risk of stifling the internal creativity and knowledge creation when opening for joint knowledge creation. There are of course risks attributed with the right of ownership to the products of the collaboration. This risk can naturally be somewhat mitigated by contracting between the parties before the collaboration gets underway (Newell & Swan 2000).

In a collaboration, organisations can have a certain degree of openness towards each other. Openness is, in this thesis, refereed to what degree of permeability the organisation has for new ideas, skills, knowledge or solutions from outside the company (Chesbrough 2003). This has not always been desired, instead it was believed that openness could cause undesirable spillover of knowledge trough partners to other companies and competitors (Baldwin & von Hippel

2011). However, this mind-set it outdated and now it is argued that openness to new ideas and knowledge is a cornerstone of innovation (Herzog 2008). Employees should instead be open to and appreciate new ideas and a positive culture towards new things should be established (Herzog 2008).

To answer the research questions, another body of knowledge must be presented in this thesis – knowledge creation. Hardy et al. (2003) argues that IOC is not only transferring knowledge but also facilitates the creation of new knowledge as a synergy effect of the collaboration. Powell et al. (1996) claims that knowledge creation occurs not so much in the organisations but rather in between them. New capabilities such as knowledge gained through knowledge creation is one of the core parameters that fosters innovation (Popadiuk & Choo 2006). The theory of knowledge creation functioning as a spiral, developed by Nonaka et al.(1996), is foremost oriented to knowledge creation inside organisations. In theory, the knowledge spiral applies in inter-organisational settings, but the creation process faces steeper barriers.

2.2 Knowledge Creation

It is widely accepted (Nonaka 1991; Drucker 2007; Quinn 1992) that knowledge is a vital asset for successful businesses, comparable to or of greater importance than tangible assets such as manufacturing plants or financial leverage. The academic interest in the field of *knowledge management* erupted during the early 1990's, something that can be attested by the virtual non-existent number of articles in the field published before this time, and the surge of publications from after 1994 and forward. The ongoing rate of publications suggests that knowledge management continues to be a field of academic interest, even though the interest from the businesses dealing with management services has dwindled (Hislop 2010).

Alavi and Leidner (2001) states that the field of knowledge management can be split up into four processes; the *creation (construction), storage/retrieval, transfer* and *application* of knowledge. These processes were first introduced by Holzner and Marx (1979) and serves as a sectioning of the organisational framework for knowledge management. Due to knowledge not being static in nature but rather flowing (Nonaka et al. 2014), it can be argued that the barrier separating four processes are rather porous in nature. For example, in order to create new knowledge, it is suggested that existing knowledge has to be applied (Hardy et al. 2003; Nonaka et al. 2014; Powell et al. 1996). As this thesis primarily aims to study the relationship between collaborative work between organisations and innovative solutions, the theoretical framework will focus on knowledge creation, as the process is closely tied to innovation (Du Plessis 2007). In other words, the creation of new knowledge is one of the major corner stones of innovation (Beckman & Barry 2007).

Nonaka (1991) claims that *"successful companies are those that consistently create new knowledge, disseminate it widely throughout the organisation, and quickly embody it in new technologies and products."* In the modern business climate with short development cycles and short life-times before products becomes obsolete or outdated, these statements are still very relevant. Building upon his previous research, Nonaka, together with Umemoto and Takeuchi

(1996) explored the creation and conversion of knowledge, resulting in the well cited SECI model. Standing for *Socialization, Externalization, Combination and Internalization*, the SECI model aims to explain how tacit and explicit knowledge is shared, created and converted within an organisation. The model relies heavily on the definition of tacit and explicit that was developed by Polanyi (1966). According to Nonaka et al. (1996), tacit knowledge is of the kind that is difficult to express and share with others. It is highly personal in its nature as it directly relates to the experience and know-how of the individual. Explicit knowledge is systematic and documentable in nature, thus enabling more to take part of it. In addition to Nonaka et al., Wallin and von Krogh (2010) argues that explicit and tacit are the two extremes of a continuum. Knowledge is not purely tacit or explicit and always contains some part of the other (Nonaka et al. 2014).

The SECI model and their corresponding Ba

As previously mentioned, the SECI model, developed by Nonaka et al. (1996) demonstrates how knowledge is converted via social interaction within an organisation, leading to the creation of new knowledge. Four phases of conversion are presented by Nonaka et al.:

1. Tacit to tacit knowledge conversion, called *socialisation*;
2. Tacit to explicit knowledge conversion, called *externalisation*;
3. Explicit to explicit knowledge conversion, called *combination*;
4. Explicit to tacit knowledge creation, called *internalisation*.

Shortly following the introduction of SECI, Nonaka and Konno (1998) introduced the concept of *'ba'* (Japanese translation of "space"), the environment and context that promotes knowledge conversion in the phases. They claim that there are four dimensions of *'ba'*, each corresponding to a phase in the SECI model; *the Originating, the Interacting, the Cyber and the Exercising 'ba'*. The connection between Ba and the different phases of the SECI model are presented in Figure 5.

Socialisation and Originating 'ba' is closely tied to the sharing of experiences and face-to-face interactions between individuals. Examples involve learning through observation and practicing in order to gain knowledge. *Externalisation and Interacting 'ba'*, deals with the transformation of tacit to explicit and is recognised as a difficult process, not only by the founders of the SECI model but also by other researchers in the field of Knowledge Management (Gallaud 2013; Wallin & Von Krogh 2010). The translation of knowledge is here done by creating concepts of the tacit knowledge and trying to put it in words by using metaphors. Nonaka et al. (1996) notes that this is often a collective process, and is achieved through applying different methods of reasoning, such as both inductive and deductive approaches, such as a combination of marker research and company vision. *Combination* of knowledge is the act of putting two or more sources of explicit knowledge together and creating new knowledge from them. It is connected to the *Cyber 'ba'* and thus thrives in an environment that utilises information technology such as databases or networks to promote knowledge creation. An example would be to implement an existing business analysis model in a new

locale. The *internalisation* of knowledge is achieved by testing and experiencing explicit knowledge, such as changing a work process from a written instruction and discovering its effect, thus creating tacit knowledge at an individual level. This phase is empowered by an *exercising 'ba'* that stresses active participation and application of the explicit knowledge in order to facilitate it on an individual level in an organisation.

Together, the four phases, supported by their corresponding *'ba'*, generate a continuous knowledge creating process, starting with socialisation, moving through externalisation to combination and finally internalisation before repeating the process again. This occurs continuously, contributing to an expanding pool of knowledge, starting with the individuals and moving from them to teams working together. The knowledge is absorbed by the organisation and translates to best practice and corporate culture, which in turn is transferred to an individual level. This continuous knowledge spiral (Figure 5) fuels the innovation of the business. Wallin and von Krogh (2010) echoes this sentiment, stating that *"innovation cannot occur without knowledge"*. It is important to remember that the SECI model serves as an outline for knowledge creation, and that the practical creation of new knowledge can deviate from the model (Nonaka & Konno 1998).

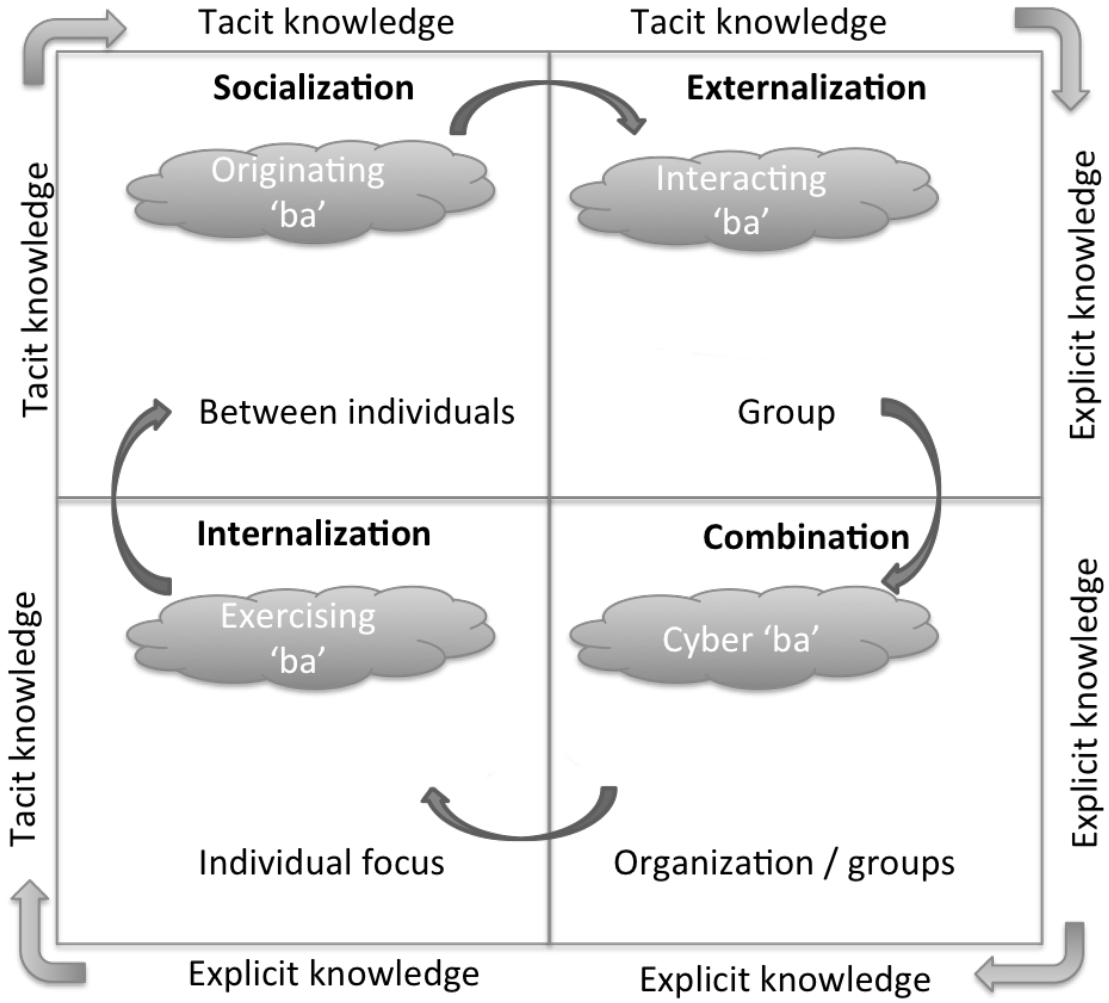


Figure 5 The Knowledge Creation System of Nonaka by K. Kohn Rådberg (2017) simplified by the author's (2017)

Nonaka et al. (2014) argues that a third type of knowledge exists, *phronesis*, resulting a knowledge trinity alongside explicit and tacit knowledge. Phronesis is the synthesis that powers the knowledge spiral, and takes the form of leadership capabilities that enables the timing of the critical decision-making within the organisation. The authors reaffirm their belief that the most significant asset of many modern businesses is knowledge, and the humans in the company are the one who possesses the knowledge. The theories of Nonaka and his co-authors are written from an inter-organisational centric perspective, with a majority of the case studies presented, such as those of Canon, Toshiba or Apple (Nonaka 1991; Nonaka et al. 1996; Nonaka et al. 2014) , being creating knowledge on an intra-organisational level. The cases have also had a high focus on new product development, with a significant lack of studies on knowledge creation in service suppliers, which is the common organisation found in the maritime shipping sector. Even though studies on the theoretical framework of Nonaka in inter-organisational settings has been made by several researchers (Bartolacci et al. 2016; Rice & Rice 2005; Toikka 2007), more studies on how the concept of SECI and *'ba'* are translated into real-world environments and cases are needed. As Bartolacci et al. (2016) points out, the cases presented by Nonaka are exclusively intra-organisational and a majority is of Japanese companies.

From a collaborative inter-organisational viewpoint, Powell et al. (1996) claims that "*Sources of innovation do not reside exclusively inside firms; instead, they are commonly found in the interstices between firms, universities, research laboratories, suppliers and customers.*" This claim suggests that there lies potential for knowledge creation in an inter-organisational environment. The knowledge spiral model that Nonaka et al. (1996) launched, seen in Figure 6, acknowledges that there is an inter-organisational level in the model. This level has been present in the model from the beginning, but has not been the focus. The question of how the framework holds up in inter-organisational setups, where different corporate cultures can affect the knowledge creation process is still uncertain territory and needs to be further explored.

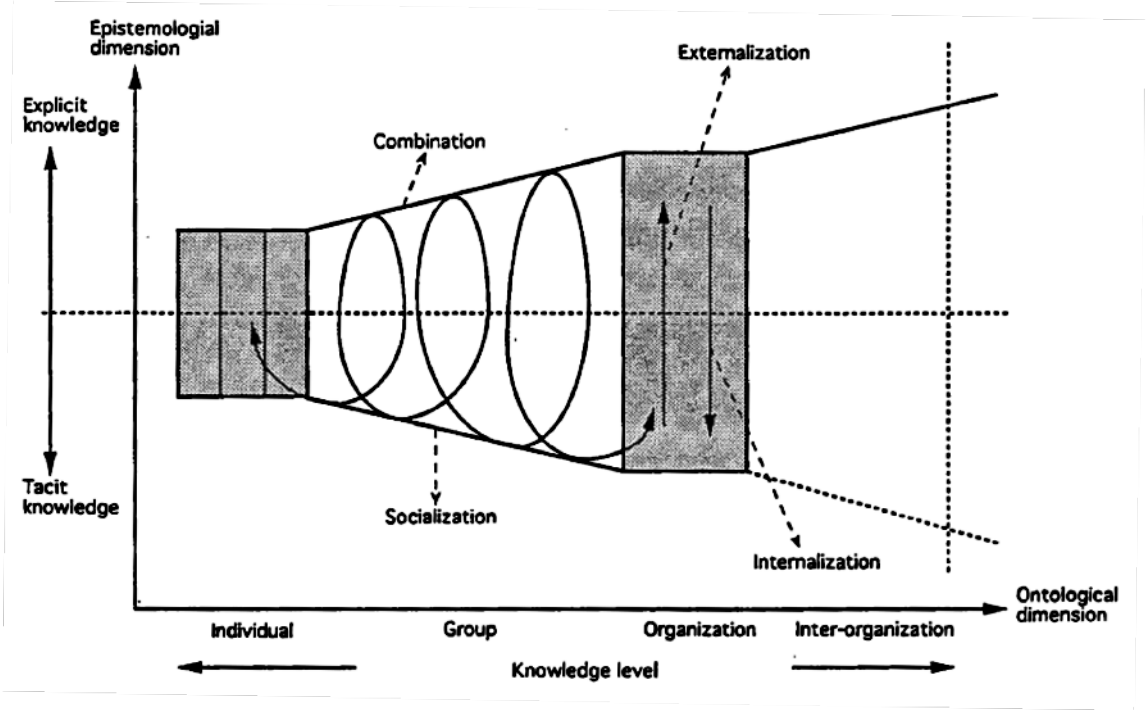


Figure 6 Organisational knowledge model by Nonaka et al. (1996)

Knowledge creation in inter-organisational collaborations have become a more common occurrence in emerging, fast-paced, high-technology industries (Toikka 2007) where complex operations and projects are undertaken globally. Li and Gao (2003) argues that the use of the knowledge creation spiral is not necessarily the optimal solution for smaller firms for obtaining knowledge. By gathering and emulating knowledge from these agents, the firm actively practices a continuous knowledge learning cycle instead of a continuous innovation cycle. It is argued that this might be a more effective method if the business is not overly complex. For knowledge transfer in collaborative settings, it has been observed that the effectiveness of the transfer differs based on the type of collaboration. Mowery et al. (1996) finds that collaborative setups such as joint ventures have a higher capability of knowledge transfer compared to a more traditional contract-based agreement. Their research also implies that distance between collaborators and different cultures are essential factors that can have a negative effect on the amount of knowledge transferred over organisational borders. Another critical factor is the absorptive capacity of the knowledge acquiring organisation. The absorptive capacity is the ability of the organisation to, according to Cohen and Levinthal (1990); *"...recognize the value of new, external information, assimilate it, and apply it..."*

2.3 The parameters for IOC and KC

There are many parameters to take into consideration when entering an IOC for creating new knowledge. Essential parameters that connect the theoretical fields have crystallized during the study of IOC and KC which, will be discussed in this thesis. The identified parameters are: *leadership* (Huxham & Vangen 2000; Ansell & Gash 2008), *trust* (Vangen & Huxham 2003b; Seppänen et al. 2005; Alter & Hage 1993) and *communication* (Ansell & Gash 2008; Vangen & Huxham 2003a). Thought-out leadership and organisation in an IOC setting helps maintain

and achieve common goals but also to build trust. According to Nonaka et al. (2000), leadership provides a crucial role in the creation of new knowledge. A successful leadership of the organisation promotes and facilitates the knowledge creation by recognizing and enabling Ba and the knowledge spiral. Trust between partners is something that is crucial for IOC to work efficiently. Trust between organisations in collaboration is fundamental and almost a prerequisite for a successful partnership (Darabi & Clark 2012). For knowledge creation, trust between the parties is imperative, as it affects the willingness to receive and send knowledge. In particular, the sharing of tacit knowledge is heavily dependent on mutual trust (von Krogh 1998). Regarding communication, Gray (1989) states that: "*participants must also establish a basis for communication if they are to reconcile their different interests and if synergy is to occur*". In other words, for communication to be effective, common IOC structures are to be established at the early stage of the collaboration (Hardy et al. 2003). Communication is an integral part of KC, as different forms of communication, from personal dialogue to the use information technology, serves as a medium for the knowledge flow in the spiral (Nonaka & Konno 1998).

Leadership & Organisation

A lot has been written about leadership inside an organisation, but when it comes to leadership in a IOC setting, the body of knowledge is not very broad (Huxham & Vangen 2000). Multiple researchers have acknowledged that leadership in IOC is important to steer the projects towards a successful outcome (Ansell & Gash 2008). A definition of leadership in organisations is: "*Leadership, by definition, is concerned with a formal leader who either influences or transforms members of a group or organisation – the followers – in order to achieve specified goal*" (Huxham & Vangen 2000). However, this cannot be translated into leadership in an IOC setting since the people or the followers, come from different organisations. This opens up the possibility that the leader is not a physical person, but the organisation itself can be seen as a leader – a leading organisation (Lynch 1993). It is not clear which of the partners that should influence and which ones that should be influenced. As previously mentioned, it is difficult to agree on a common goal since the organisations can bring so many different goals and aims in the start of the collaboration. It is not uncommon that when the collaboration starts, decisions are made without a consensus being established. The leadership plays a role in transforming the participants different values and leading the alignment of these in order to lead the collaboration forward (Huxham & Vangen 2000).

Huxham & Vangen (2000) view leadership in IOC through three perspectives – *structure*, *process* and *participants*. *Structure* is equal to the structural connections between the organisations and they: *"play an important leadership role because they determine such key factors as who has an influence on shaping a partnership agenda, who has power to act, and what resources are tapped"*. The structure can either be open or tight, with a wide variety of structures in the spectrum in between. In an open structure, where organisations can, for example, bring any representative to the meetings and it is up to each organisation to decide if they will attend a meeting or not. It can be somewhat problematic to coordinate and implement actions if the meetings contain different individuals from time to time. In the other end of the

spectrum, we find tight where a dedicated set of individuals from each organisation attends the meetings often and they do not have the choice to attend or not. The problem with this tight structure is that partners and individuals that only want to update themselves on irregular basis will be excluded. Some of the partners might believe that one of the partners should act as a leader because of their position in the partnership structure (Huxham & Vangen 2000).

Leadership through *process* includes the way the partners communicate. It can be through multiple channels such as meetings, phone or email, in both formal and informal settings. Some of the processes support to reach a common understanding of what things that should be done to proceed forward with the projects. Workshops can for example foster the partners common understanding on things and align a common language within the group. However, processes are not only determined by the members of the collaboration – there are also external forces that are out of control of the partners, such as funding deadlines. Huxham and Vangen (2000) says that: "*such time pressure can have a positive leadership function, in that it promotes task-focused activity*"

Leadership through *participants* means that any member partner that have the knowledge on how to influence and get things done can take the lead in a IOC. A natural leader could be the organisation where the collaboration physically takes place, or the organisation that initiated the collaboration (Huxham & Vangen 2000). A steering group, containing stakeholders from the organisations, can also act as a leader using joint decision-making. The leadership can also be rotated among the partners to balance power and workload. An external leader appointed by the steering committee, can be an objective leader from a consultancy firm whose only task is to lead the collaboration. This provides a helicopter perspective which can give the leader a greater understanding of the collaboration. Huxham and Vangen (2000) argues that the external leaders: "*their personal beliefs and values are likely to dictate the energy with which they drive different agenda items forward*". This means that the external leader's agenda propel the project, and if the person lacks enthusiasm and energy, it can affect the project.

According to Von Krogh et al. (1997), a process of KC behaves differently from other processes and cannot be managed as such. The role of the leader, or activator as it is called in KC, is to enable the creation of knowledge, not to force or control it. It is the KC activators role to facilitate '*ba'* within the organisation, by promoting and providing tools for the different '*ba*'. A successful KC leader should be able to recognize and connect different projects and initiatives that can enhance and share in order to create new knowledge in the organisation, and to secure future innovation. It is important to note that leaders do not create knowledge themselves. The willingness to create new knowledge must exist within the company and it must be encouraged by the top management. Management should focus on developing a knowledge vision and communicate this throughout the organisation, defining what, why and where knowledge is to be created (Nonaka et al. 2000). According to Nonaka et al. (2000a), the management team can serve as these activators. Not only should the leadership focus on *'ba'*, they should also promote the SECI process and make room for the continuous knowledge spiral. To do this, the management must actively look for opportunities for KC and facilitate these in the process. Leadership and organisation is important for many different reasons. It can align the

collaborative spirit of the stakeholder, it maintains clear goals, build trust, establish communication and empower stakeholders (Ansell & Gash 2008). Leadership also helps the creation of structures in which the IOC takes place (Vangen & Huxham 2003a).

Trust

The research on trust in IOC settings have emerged in the last decades. However, according to a study of the literature on trust in IOC from 1990-2003 by Seppänen et al. (2005) the field of trust in IOC is done in many different ways and at different levels of analysis. Some studies aim to measure the trustworthiness between the partners and some on the mutual trust. In this thesis, the field of trust will regard both mutual trust and trust in partners.

For partners to be able to even discuss future expectations of an IOC, a significant amount of trust must be present (Vangen & Huxham 2003b). Inter-organisational trust, and trust in almost any setting is multifaceted. The definition written by Mishra (1996) contains four dimension which is discussed in the trust literature:

> *"Trust is one part's willingness to be vulnerable to another party based on the belief that the latter party is 1) competent, 2) open, 3) concerned, and 4) reliable"*

Mayer et al. (1995) explains the vulnerable part of trust in this way: "*Willingness of a party to be vulnerable to the actions of another party based on the expectations that the other will perform a particular action important to the trustor, irrespective of the ability to monitor of control that other party*". In order to understand trust in IOC, the four dimensions are examined, starting with dimension of *competence*. If an organisation have acknowledged that the partnering organisation can deliver, for example, products with high quality, they will not check the quality of the product upon delivery. In other words, a greater level of trust is achieved. *Openness* can both strengthen and weaken trust between parties. Trust is strengthened when the partners believe in each other and that they are speaking the truth. However, if the partners are totally transparent and telling the complete truth, presenting organisational imperfections and too many details about it have the opposite effect and lower the level of trust. The *concern* dimension is that a partner can trust another partner that they will not take advantage of the other, meaning that the partners are concerned about the interests of the group and the other parties and not just its owns self-interests. The final dimension of trust is *reliability*, which is the alignment between what the partner is saying that they will do, and what they will uphold. It will be more difficult to establish trust if the gap between word and action is too wide (Mishra 1996).

Trust between collaborating organisations is fundamental and almost a prerequisite for a successful partnership and the enabling of knowledge transfer (Darabi & Clark 2012). To achieve the level of communication needed to facilitate innovations in IOC, Dodgson (1993) argues that high level trust must be in place. Often, trust need to be established rapidly due to

tight deadlines in the IOC project where skills, expertise and competences are shared between organisations for mutual benefits (Panteli & Sockalingam 2005).

Dodgson (1993) claims that two levels of trust exists within inter-organisational collaborations; inter-personal trust and inter-organisational trust viewed in Figure 7. He argues that while the personal relationships between managers and personnel in different collaborative setups are essential for effective communication and learning, the inter-organisational trust is the true builder of long-standing mutual partnerships regarding common learning. A high level of inter-organisational trust built up over a long period of time can withstand the breakdown of trust on the individual level. When looking at negotiation effectiveness between the partners, Zaheer et al. (1998) confirms by stating: "*High inter-organisational trust appears to compensate for low interpersonal trust and thus to explain the low level of negotiation costs*". This means that even if the individuals in the collaboration have a lower level of trust, this can be overridden if the institutionalized structures of the organisation support high inter-organisational trust. Findings from a study made by Zaheer et al. (1998) indicates that trust at on organisational level has a large impact on performance, effectiveness of negotiation and level of conflict. On the other hand, inter-personal trust has little effect on those factors. Even if this is the case, they also argue that inter-personal trust can influence the inter-organisational trust.

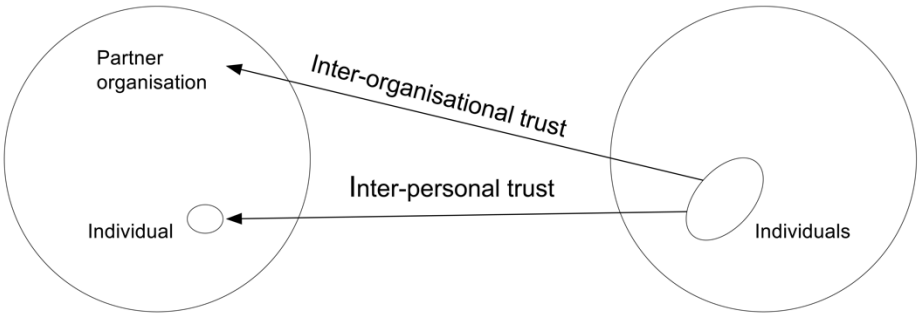


Figure 7 Inter-organisational and Interpersonal Trust. Author illustration 2017, inspired by Zaheer et al. (1998).

In knowledge creation theory, von Krogh (1998) claims that trust is a fundamental parameter for KC on a deeper level. As the principle is built around Nonaka's theory (Nonaka 1991), it is primarily discussing intra-organisational relationships. Trust is built on caring relationships between parties, and while KC can occur in a low caring environment, companies with the intent of being innovative needs to facilitate trust-building activities so that the organisation can foster trust on both personal and organisational levels. A low level of trust gives rise to a knowledge culture where the individual is only willing to share knowledge when he can expect comparable returns, whereas higher trust leads to a willingness to share between partners. The level of trust also connects to the concept of *'ba'*, as trust is an central parameter in creating and accommodating *'ba'*, especially for the *originating* space (Nonaka et al. 2000). To facilitate a growing trust in the organisation, von Krogh (1998) gives several examples of possible actions, such as learning-focused project debriefings, incentive systems with focus on co-operation or social events in order to stimulate relations and accommodate *'ba'*.

Newell and Swan (2000) find three types of trust from the body in trust: *Companion trust*, *commitment trust* and the previously mentioned *competence trust*. Companion trust can be related to inter-personal trust where trust develop over time as people in the organisations get to know each other. This trust takes a long time to establish and have strong ties which are strengthen trough continual mutual exchange of benefits. In other words it is: "*based on judgements of goodwill and personal friendships*" (Newell & Swan 2000). Commitment trust on the other hand is based on formal contracts between the organisations. The contracts allow the organisations to trust one another to deliver what they have promised to deliver. Hopefully the contract will not be used to resolve conflicts in the future of the collaboration since having to use them for that purpose is a sign of weakening trust. Organisations that fail to commit to the obligations in the contracts, will probably not be picked for future collaborations. As mentioned previously, *competence trust* is when an organisation can trust the other organisations that they can provide their share of skills and abilities to the joint project. Skills and abilities that the other organisations is not capable of completing on its own (Newell & Swan 2000). Competence-based trust is also central when it comes to knowledge transfer, especially the transfer of tacit knowledge. On partner must believe that the knowledge that the other organisation is transferring is of high quality for be able to assimilate the knowledge (Levin & Cross 2004). The competence based trust can be on an organisational level but also on a personal level. The reputation of the company can be enough to trust the person the company is dealing with. But, if there is a discrepancy between the expected company competence and the delivered personal competence, the trust can weaken (Newell & Swan 2000).

The level of trust between organisations is not static, but rather under continued development. Previous collaboration experience between organisations forms new means and condition for the next joint collaboration. It is more likely that two organisations reach a joint goal if they begin with a project with modest expectations and low level of risk. After they reach the first joint goal, it reinforces trusting attitudes with lay a foundation for a more ambitious collaboration. This is visualized in Figure 8, where Vangen and Huxham (2003) show that enough trust and willingness to take risk is necessary to start the first project and indirect start a virtuous circle if the project succeeds. New reinforcing attitudes are accumulated for every successful collaboration, which enables a more advanced collaboration with higher ambitions and risk.

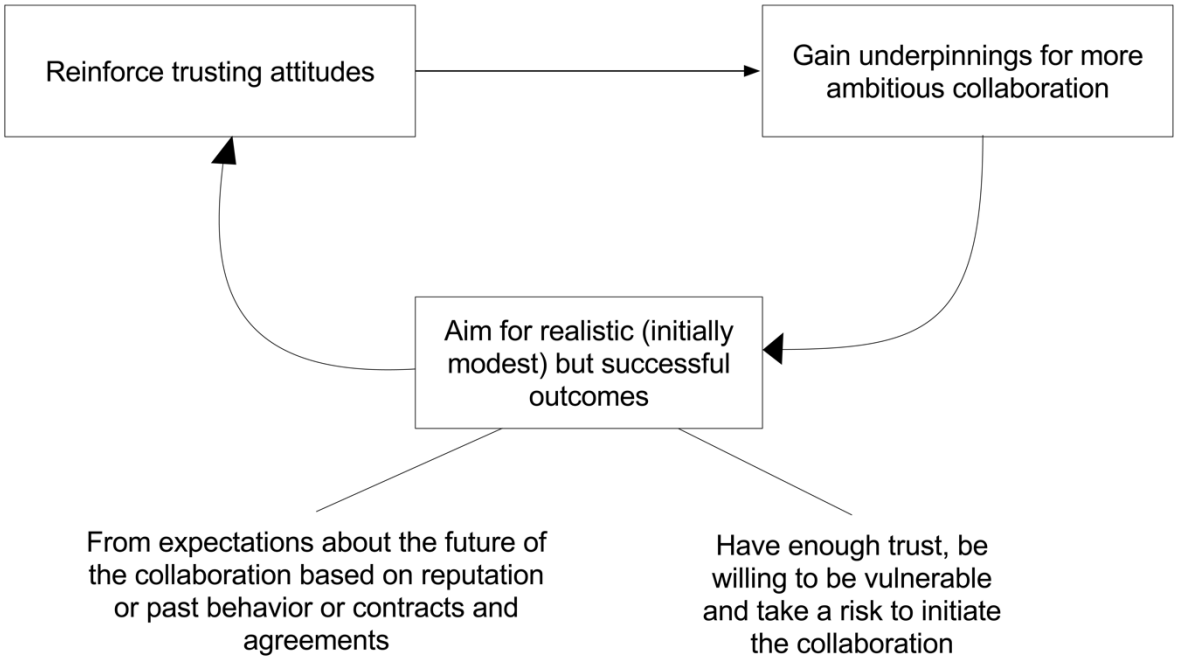


Figure 8 Vangen and Huxham's (2003b) Trust-Building Loop (author illustration 2017)

One must consider that the conditions for collaboration is constantly changing, Vangen and Huxman (2003) therefor argues that the trust building loop is fragile and require effort and maintenance to stay effective with a high level of trust. Even in scenarios where trust is well under way they: "*Need to explicitly consider their management of communication, power imbalances and credit recognition, joint ownership, varying levels of commitment, conflicting views on aim and agendas, and so on*". One way to achieve this is through team building activates or similar.

Benefits such as risk sharing can be jeopardised if there is a lack of trust between the organisations. Giving up the internal organisational control of the joint project, the complexity of the project, organisational ability to accumulate knowledge and skills are also factors that can halter the collaboration (Powell et al. 1996). Järrehult (2011) argues that trust is vital in collaboration but not as important in co-operation. Instead, in co-operation, fairness is needed. The partners must deliver what they have promised and there must be a balance in the result of the co-operation, so that each partner gain equally much from it. Trust is on the other hand vital in collaboration, since the partner cannot achieve the goal by themselves. It is expected that the end achievement of the collaboration is shared equally between the parties and if they are not, distrust can grow and undermine future collaboration with the partner (Järrehult 2011).

Lack of trust

When there is a lack of trust, conflicts can surface in a collaboration. The theory on conflict in an IOC setting suggest that a conflict has a negative effect on efficiency and effectiveness of a partnership (Panteli & Sockalingam 2005). Conflict is defined by Hocker and Wilmot (1985) as: "*an expressed struggle between at least two inter-dependent parties who perceive*

incompatible goals, scarce rewards, and interference from the other party in achieving their goals". A conflict can arise for many reasons, for example unbalance in power between the partners, disagreements on who is responsible for the different parts of a project or misalignment of goals (Panteli & Sockalingam 2005). It can also occur if partners are not consistent in their goals or have contradicting goals between the partners. Inkpen and Tsang (2005) argues that a clear and common or almost common goal among the partners reduces inter-organisational conflicts, and that it should be negotiated between the partners. This is not an easy task, since it is time consuming to satisfy all partners goals, and the partners should expect that it takes a long time to reach a common understanding (Huxham et al. 1996). However, the sometimes long process of reaching this common goal in itself can actually lead to conflict (Vangen & Huxham 2003b).

Organisation culture also have an impact on the collaboration. Culture, professional language, and preconceived notions of how things work in the partnering organisation are all factors that can lead to conflict. Conflicts can also arise if one of the partners are promptly pushing their way of doing things onto to the other partners (Inkpen & Tsang 2005). Even if there are many factors that can foster conflicts in an IOC it is important to manage them well. Stronger relationships and trust can develop if conflicts are managed well, which leads to greater knowledge sharing and creation and innovations, on the other hand, when poorly managed, partners can become angry and skeptical which damage the collaboration (Panteli & Sockalingam 2005).

Communication

Communication is a vital parameter in an inter-organisational collaboration (Ansell & Gash 2008). The frequency of how often the partners interact and meet have an obvious effect on the overall process and result of the collaboration (Vangen et al. 2015).This is echoed by Gray (1989), who claims that it is not enough to be part of a collaboration with other parties but that: "*participants must also establish a basis for communication if they are to reconcile their different interests and if synergy is to occur*". In other words, effective communication gives rise to strong structures of IOC, and have to be established in the early stages of the collaboration (Hardy et al. 2003). Communication can be facilitated through multiple ways. Face-to-face meetings between the collaborators are not only significant in the start-up phase (Panteli & Sockalingam 2005), but is also important throughout the whole duration of the collaboration (Ansell & Gash 2008). However, Panteli and Sockalingam (2005) argues that technology-mediated communication can act as a sufficient substitute in the middle periods of the project, but only if trust and shared understanding have been established during the initial phase of the project. They continue by stating that the use of technology-mediated communication is more viable when the collaboration is well-structured, and not of a more freeform brainstorming structure, generally associated with innovative endeavours.

The direct dialogue between individuals facilitates the understanding of the mutual objectives in the collaboration. The mutual goals, or the understanding of them, are generally developed in increments through the interactions between the collaborative partners (Ring & Van de Ven

1994). Workshops and seminars are used to communicate the views and progress of stakeholders so that other stakeholders know how the collaboration is faring, such as the community or the public, on progress (Vangen et al. 2015). It helps the project move forward on with their agenda. Although these face-to-face meetings are important, Knoben and Oerlemans (2006) claims that geographical distances can be overcome if the partners share a 'community of practice' which means that the organisations have social, cultural, institutional and cognitive similarities. This means that it is possible to share and create knowledge between one another, via modern communication technologies, even if the collaboration partners are physically separated in different areas, if the partners have similar frames of reference.

Face-to-face communication is also central in the KC process. It is argued that in the *socialisation* and *externalisation* phase, the physical proximity between people involved in the knowledge flow is imperative for the creation of new knowledge. For the knowledge flow on a tacit-to-tacit level, the communication between individuals does not need to be verbal, but can rather be observational in nature and communication is secondary to sharing experiences. An elevated level of competence in both verbal and visual communication skills is however needed for the conversion of tacit-to-explicit knowledge. The conversion is achieved by engaging and driving thought-provoking dialogue, by using metaphors or visualization techniques in a group setting, in order to explain and simplify the tacit knowledge of the group so that others can make sense of it (Nonaka & Konno 1998).

In the *combination* and *internalization* phase, communication also plays a vital role in KC. By combining newly acquired knowledge from outside the organisation and combining it with knowledge that exists within the organisation, new knowledge is created, which is then spread throughout the organisations. While much of Nonaka's theories emphasises on the need for proximity between individuals, this *combination* phase is particularly suitable for communication via IT systems, as one of the objectives is to spread the knowledge to a wider level. It also helps the storage of the knowledge, through databases, so that it can be of use to the organisation in the next iteration of the knowledge spiral. The *internalization* of the knowledge is not achieved by communication between parties but instead through the individuals in the organisation being provided the means as to embrace the new knowledge via the integration of it into relevant processes within the organisation (Nonaka & Konno 1998).

If the communication in the collaboration is not sufficient, especially by a lack of face-to-face interactions, partners have trouble keeping themselves up to date on how their partners are progressing. The internal goals of a partner in the collaboration might shift without the notice or acknowledgement of the partner. Knoben and Oerlemans (2006) argues that the failure of communicating: "*Even very basic information such as upcoming holidays*" can have an impact on the effectiveness of the collaboration. Insufficient communication can also hinder trust-building and the continuing trust between partners, which is one of the key variables of collaboration (Vangen & Huxham 2003b). Mishra (1996) also see that partners can drift away from each other, and stop reasoning in a similar way: "*not only emotionally but in the ability to think alike and predict the reactions of the other*".

2.4 Identified theoretical gap

In the literature review and the processes throughout this thesis, the authors have identified a gap in the study of knowledge creation in a IOC setting. Although Nonaka claims that the SECI model can be used in an inter-organisational setting (Nonaka et al. 1996), not many studies have been done in this field. The authors have identified three parameters, visualised in Figure 9, that in theory are important for the creation of new knowledge in inter-organisational setups; *leadership, trust and communication.* These will be integral in order to answer the previously stated research questions:

What parameters exist within inter-organisational collaboration for knowledge creation and what factors of these parameters affect the success of these collaborations?

How has the Zero Vision Tool collaboration platform enabled the creation of new knowledge in the Swedish shipping industry?

The influence of these parameters will be analysed via the conduction of a case study, examining a group of pilot projects regarding the use of LNG as a marine fuel in the Swedish maritime industry.

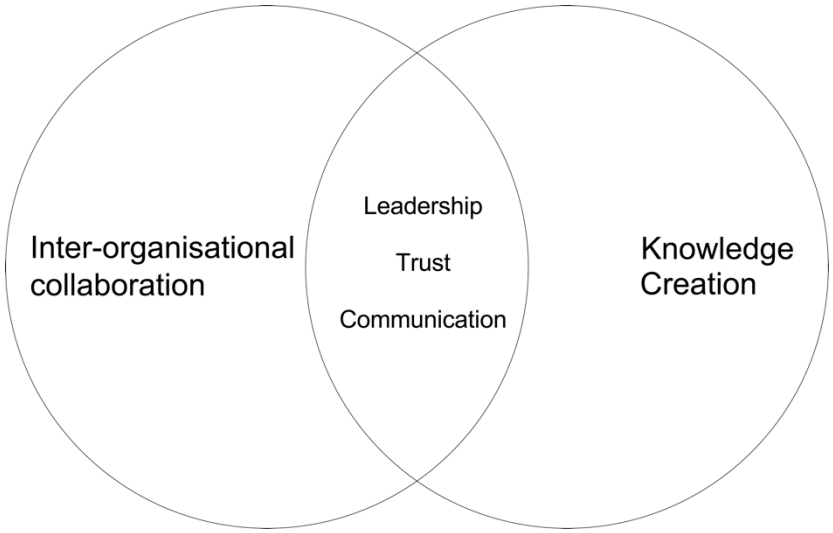


Figure 9 Theoretical gap found in the theory of KC and IOC (author illustration 2017)

3 Methodology

This chapter presents the methodological choices made by the researchers to produce the thesis work. The chapter starts with research strategy, followed by a description of the research design. Subsequently it goes through the literature review along with how the data have been collected. It continues with quality and ethical aspects and is summed up with a discussion ends regarding the method.

3.1 Research strategy

This study was conducted during the spring semester of 2017 at the Department of Technology Management and Economics, Chalmers University of Technology in Gothenburg, Sweden. By studying the interaction between the fields of KC and IOC, the authors hoped to contribute to the body of knowledge regarding the innovative capability in the Swedish shipping industry. The study was conducted in the west coast area of Sweden, which is the central region for the industry.

A qualitative study is, an appropriate approach when the research aims to increase the general understanding of the situation described according to Easterby-Smith et al. (2015). Qualitative studies are also the preferred alternative over quantitative studies when human interactions and opinions are to be studied (Bryman & Bell 2015). In the context of this thesis, collaborations that run across organisational borders are inherently tied to human relations and interactions, even more so within the studied field of knowledge creation, the qualitative approach provides a satisfactory fit for the thesis.

While exceptions exists, the qualitative study is often inductive in its nature (Easterby-Smith et al. 2015). Inductive research is based on observations from which conclusions and hypotheses can be drawn. With numerous observations in different set-ups, general knowledge can be derived from the hypotheses. Inductive studies are often iterative processes, with the collection of data and the processing of it taking place over continued period of time, and refined until the study is concluded. This is one of the main strengths of the qualitative study according to Easterby-Smith et al. (2015), as this enables the research to adapt to issues along the way. However, there are risks associated with uneven pacing and uncertain progress. Critiques to qualitative research is that it can be subjective, difficult to replicate and have problems with generalizations (Bryman & Bell 2015). Qualitative studies being subjective, means that the researcher is the one that, possibly in an unsystematic process, decides and prioritises what findings are significant and important in the study. Strict procedures are seldom used when conducting a qualitative study, which makes it difficult for other researchers to replicate it. Yin (2009) and Bryman and Bell (2015) argues that qualitative case studies cannot be generalised, as the sample size in the study is too small to draw wide conclusions. On the other hand, people that are interviewed in a qualitative study are not meant to represent a population. Rather, the findings from interviews are used to strengthen a theory (Bryman & Bell 2015).

3.2 Research design

The research design is the general plan of how the investigators are going to answer the research questions (Saunders et al. 2009). A case study design is used in this thesis, which is Yin (2009) defines as such:

> *"A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."*

The goal with a case study, and its contribution to academia, is to expand and strengthen the theories (Yin 2009), and in this thesis case, to bridge the gap between the fields of IOC and KC. One can say that this case study applies the empirical findings on a developed theory within the field of knowledge creation. The case study approach enables the researchers to investigate if the theory is possible to observe in a practical scenario. This enables a practical contribution of how the collaboration between the partners in the studied projects progressed. Since the case study design is less rigid it suits a study where the researcher wants to understand how something works or why a specific event has happened (Yin 2009). An important ability for the researcher when conducting a case study, is to be a good listener. The focus should be on listening and observing and not so much on talking or guiding. The researcher should also have an in-depth understanding of the issues being studied, and to be flexible and be wary of bias (Yin, 2009). The case study design is one of the most complicated designs to use when conducting research. According to Yin (2009), it is often naively viewed as an easier design. He argues that the use of a case study has four common concerns among researchers. The most frequent one is that it is not rigorous and does not follow a strict process path and because of that, it is possible that the result and conclusion can be influenced by biased views. It is also believed that it generates a large number of documents that takes long time to process. Finally, that a case study is understood to not support a true experiment which tests the cause and effect relationships.

The case study in this thesis will be a single case study with two embedded units of analysis. One can either use a single-case study design or a multiple-case study design. In general, the study will be stronger and more legit if two or more cases are investigated (Yin 2009). The reason for this is that the evidence found from this multiple cases are seen as more robust (Herriott & Firestone 1983). However, the study will include two levels of analysis. The first level will analyse the main project, Pilot LNG. This project serves as the nexus for a total of six sub-projects. The second level of analysis of analysis will be focused on two of the sub-projects to Pilot LNG. These are named LNG CONV and FLEXI. The thesis was first designed to use a multiple-case design (Yin 2009), with one level of analysis that were to focus on the two sub-projects. However, as the study proceeded, more and more relevant findings emerged that fell outside of the scope of these two projects. Several of the interviewees line of reasoning, since many of them were involved in several of the sub-projects of Pilot LNG, often discussed problems on a higher level than the projects. It was according to ZVT, where the sharing of knowledge and findings took place. Since the thesis still investigated the two sub-projects but

also the main project Pilot LNG, the design was changed to an embedded single-case design, which means that one case with multiple units of analysis was investigated.

3.3 Literature review

An iterative literature review was initiated in the early stages of the thesis. The purpose of the review was to gather knowledge regarding the key concepts of the thesis in order to establish the theoretical framework for the thesis. The purpose of the literature review was also to understand what scholars already have researched in the fields to reduce the risk of the thesis writers researching something that has already been previously examined, and to avoid reinventing the wheel (Bryman & Bell 2015).

In the early stages, the authors researched and reviewed articles and sources with connections to relevant topics to the thesis theoretical area, which is IOC and KC. These can be found in appendix B. The authors looked into the field of innovation in general and in connection to the shipping industry. It was found that the concept of innovation is too broad and somewhat difficult to define for the purpose of this thesis. Instead, the focus was turned towards the field of open innovation, since the authors believed that the ZVT method could be connected to the theoretical framework. After a triangulation of the main research areas found in these sources, the theoretical scope was further narrowed down, resulting in the identification of the two research fields of IOC and KC. The academic search engine Google Scholar was used as a starting point when narrowing down the relevant fields of research for the literature search. After that, databases such as ProQuest, Elsevier and Web of Science were used to get access to the literature, through the Chalmers library service. The academic papers found and used in this thesis mainly published in the 1990s. The authors have, through Google Scholar, checked with ones that have the core articles used in the two fields. Since many of them was written in the nineties, the articles that cites them are mainly from the millennium. The consequence from doing like this is that many older, but well cited, articles have been used. This means that the theoretical framework is not as updated as one could hope for.

Throughout the literature review, the literature found was organized with the web based reference software Mendeley, in which a workgroup was shared between the author's computers. The reference software was synced with the word processor, providing an up-to-date list of used references throughout the work on the thesis. The authors sought to only use literature that was relevant to the theoretical framework. Care was taken so that the literature used in the thesis have been peer reviewed and is well cited, or at the very least directly connected with the major works of the two theoretical fields. The theoretical framework starts with IOC viewed from different angels, followed by the theory of KC. Extra attention is given to the Nonaka's SECI model which he claims can be applied in an IOC-setting.

3.4 Data collection

There are three principles that an investigator should follow when collecting data for a case study: having multiple sources of evidence, creating a case study database and maintaining a

link between the research questions, the collected data, and the conclusions drawn (Yin 2009). These three principles are there to help the investigator in the process of data collection. The study will be more explicit and transparent, and thus of higher quality if the principles are considered (Yin 2009). A case study should contain diverse sources of evidence. The six that are mostly used according to Yin (2009) are: Documentation, archival records, interviews, direct observations, participant observation and physical artefacts. One of the major strengths of a case study is that multiple sources of evidence can be collected. If multiple sources of evidence are lacking the valuable advantage of a case study will be lost (Yin 2009). Using only one source of evidence, such as for example interviews is not recommended, it will then be more like an interview study rather than a case study. The case study in this thesis intended to use three sources of evidence: documentation, interviews and direct observations. During the course of the thesis work, there was no opportunity for the researchers to conduct a direct observation, and this therefore had to be excluded.

Documentations

Documentations can come in a variety of forms, for example letters, email correspondence, personal documents, minutes of meetings, progress reports and news. Its strengths are that these can be accessed repeatedly, they are exact and gives a broad coverage. However, they can also be biasedly selected by the researchers if not all of the available relevant documentation is used. Also, the content in the documents could reflect bias of its author. Some useful documents might not be given to the investigator on purpose (Yin 2009). It is also important for the researcher to evaluate and verify the findings of the documentation when there is reason to question the findings.

In this case study, the projects were well-documented, as one of the out-spoken objectives of the ZVT platform is to disseminate and illuminate the projects and their findings. As such, ZVT hosts a web platform where the public can observe the progress of the projects. From this platform, the researchers have taken part of videos and reports. Of these, the most relevant and used works consists of the *Zero Vision Tool White Paper* (ZVT 2016), which contains information about the ZVT platform and many of the participating organisations, and the final report of the Pilot LNG project (Kalantari et al. 2015), which is a compilation of the background, work process and findings of the project Pilot LNG and its sub-projects. In addition to these, company presentations, emails and letters were provided by participating organisations. The sources of data have all been official and can thus be considered to be of authenticity and provide meaningful information (Bryman & Bell 2015). However, public and organisational reports have to be critically examined for bias, as Bryman and Bell (2015) points out that the writers of such documents can write from the perspective of the organisation, and may seek to push a particular agenda.

The majority of the findings from the documentation were used to increase the understanding of the case projects and the participating organisations. It was also used to cross-examine the findings gathered in during the conducted interviews.

Interviews

Interviews are one of the most important sources of evidence in a case study about human integration. Interviewees can, if they are knowledgeable about the studied subject, provide very valuable findings (Yin 2009). In this study, ten interviews were conducted, with a focus on persons who were involved in the two sub-projects, LNG CONV and FLEXI, and in the main project PILOT LNG. The interviewees involvement lead to relevant data for answering the stated research questions. The findings from the interview are the main source of evidence in the thesis. The purpose of the interviews was to provide insight in the projects through semi-structured questions and topics that focuses directly on the three parameters found in the gap of knowledge creation and inter-organisational collaboration. Strengths with conducting interviews are that they are insightful, meaning that the interviews provide causal implications and explanations (Yin 2009). The main weakness of interviews is the potential risk of bias due to poorly articulated questions and difficulties with understanding and analysing the response of the interviewee. The interviewee might also have unknown reasons not to tell the truth, and may communicate what interviewer want to hear (Yin 2009). Further, there is an important distinction between questing for actions, such as the descriptions of events, and when questing for personal views such as opinions. It is up to the researchers to be mindful about this difference and analyse accordingly. When conducting interviews, the aim is for the researcher to understand the interviewees perspective and as to why they hold that perspective (Easterby-Smith et al. 2015). Failure to do so only results in a superficial exchange of words and very little data is gathered (Easterby-Smith et al. 2015).

Easterby-Smith et al. (2015) insists that if in-depth interviews are to be a main source of evidence, an appropriate level of structure has to be decided by the researchers. For the interviews conducted in this thesis work, it was deemed that a semi-structured approach was suitable, as the nature of the questions require the interviewee to elaborate on the answers and can lead the interview in new directions to explore the issues at hand. However, there exists specific parameters and ideas regarding the main- and sub-projects that needed to be addressed, which means that some form of directive was needed for meaningful data to be uncovered. Both Yin (2009) and Easterby-Smith et al. (2015) strongly suggests that a semi-structured interview is to be guided by a general list of topics and questions that has been prepared beforehand and provides the backbone for the discussion. The topic guide used in this thesis can be found in appendix A. According to Yin (2009), a shorter interview of about one hour in length is suitable when the researcher wants to study, compare or corroborate the viewpoints of different sources on the same topic. The ten interviews in this thesis took on average a little bit over 50 minutes to conduct, the shortest and the longest was 30 respectively 70 minutes long. It is suggested that the interviews could be conducted at a convenient time for the participants (Saunders et al. 2009), so all interviews were conducted during working hours. The face-to-face interviews was conducted at respectively company, mostly in the Gothenburg area, however conducted in Uddevalla and Stockholm. The locations was chosen for the convenience of the interviewees, so that they would be comfortable and where the interview would not be disturbed (Saunders et al. 2009).

When it is time for the actual interview to take place, Easterby-Smith et al. (2015) are adamant that the focus for the researcher lies in listening and recognising what is truly relevant for the study and saving that data, either by taking careful notes or by recording the interview. In this study, all interviews except two was recorded with a mobile devise. Recordings cannot be a substitute for listening carefully during the interview to pick up cues or underlying meanings (Yin 2009). The purpose of the recordings was to save the data for later transcription and give a foundation for the analysis. Although the majority interviewees agreed to be recorded during the interview. One person declined to be recorded, so notes was taken by both the interviewers and a summary was sent and commented by the interviewee. Another one was through an expected teleconference that ended up as an ad hoc telephone interview where the mobile device for recording was used for the call instead, also where, the interviewers took notes and the summary was sent to the interviewee in accordance with suggestions by Bryman and Bell (2015). The interviewees were informed prior to the interview that they could stop the recording at any time in case they wanted to. Bryman and Bell (2015) continues by saying that the interview should still be conducted even if it cannot be recorded, since valuable insights and findings will most likely surface anyhow. Before each interview, the purpose of the study and the interview was described, and sometimes a small corporate presentation give prior to the interview. This starting discussion of an interview is essential to establish credibility and the interviewee's confidence to higher the interviewees willingness to open up and share (Saunders et al. 2009).

Face-to-face meetings are the most used form of collecting descriptions and are the form of data collation that can take body-langue and other social cues into consideration. The non-verbal information given can be added to the wording in the findings higher the ability to read between the lines of the answers (Opdenakker 2006). All of the interviews, except for one, were conducted in Swedish, since both the interviewer and the interviewees felt comfortable to use their native language. The findings were later translated into English. The quotes used in the analysis was translated with care to get the essence of what the interviewees said without keeping the Swedish word order. Even though utmost care was taken when translating the interviews, since none of the authors has English as their native language, translation errors or ambiguous referencing is possible. For the interview conducted in English, there is the possibility of misunderstandings during the interview, as none of the participants were native speakers, as well as translation errors.

The aim was to conduct all interviews in person, however, eight out of ten interviews were conducted through face-to-face meetings and two were conducted over telephone due to the location of the organisations which was in Germany and in the southern part of Sweden. There are some issues with telephone interviews. They are not suited for long in-depth interviews (Bryman & Bell 2015), and complex follow-up questions might be difficult to ask over the phone (Saunders et al. 2009). The body language or non-verbal behaviour that can be observed during a face-to-face meeting is lacking during the telephone interview (Bryman &Bell 2015; Saunders et al. 2009). Saunder et al. (2009) argues that telephone interviews are not suitable for unstructured interviews in a qualitative research. It can be used for some follow up questions after a face-to-face interview when the interviewee has established confidence and trust in the

interviewer. This is because if the interviewee lacks trust in the interviewer it is unlikely that valuable information is shared (Easterby-Smith et al. 2015). However, if physical distances would have hindered the data to be collected at all, a telephone interview is preferable (Saunders et al. 2009).

After the interviews for the study had been concluded and the findings analysed, it became clear that it would be difficult to accurately describe the full scope of the projects studied. A better, more fair analysis would have been possible if more interviews, both with new participants but also with already interviewed subjects, were to be conducted. Due to time constraints, this was not possible. In particular, there were no possibility to interview the activity leader of the project FLEXI project, which the authors considered to be one of the most important interviews. An interview with the MD was scheduled but later postponed until there was no time left to include the findings in the thesis. Although a there is data on the project in the form of other interviews and documentation, the lack of the findings from this interview have had a negative effect on the thesis.

Direct observation

The direct observations can include observation of meetings and provide additional information about the studied topic. For this thesis, an observation of one or multiple meetings was planned. Although it can be time consuming, hard to get a board coverage of events with limited resources and that the meeting might processed differently when being observed, one can by observing an event, one can cover real time events and context of the case (Yin 2009). The plan was to have both authors attending the meeting to increase the reliability (Yin, 2009).

3.5 Quality of study

Easterby-Smith et al. (2015) states that a study of high quality has to be robust and be able to stand up to scrutiny by peers and the academia. For this, the study needs to hold reliability, validity and generalizability in high regard. These three criteria form the overall for the quality of the thesis. Further, Easterby-Smith et al. (2015) suggests testing these individual criteria by discussing and reasoning around reliability, validity and generalizability. The validity of the study is determined by making sure that all relevant perspectives concerning the study are included and considered. For a reliable study, the findings made should be replicable, meaning that the same or similar results can be achieved with the same conclusions drawn. For the study to be transferable and generalized, the sample should be diverse enough so that the conclusions drawn can be put into context of similar research. The validity of the study is to be guaranteed by the inclusion of all relevant perspectives, meaning that the study should be believable and transparent, leaving no doubt of how data was procured or how conclusions were drawn. However, these criteria are thought to be more fitting for quantitative studies. For a qualitative case study, there are other alternatives to determine the quality of a case study, for example by using credibility, transferability, dependability, conformability and authenticity as criteria (Bryman & Bell 2015).

Credibility can be achieved through triangulation by using more than one source of data in the study, therefore making sure that the findings from different sources are checked against each other. Transferability is difficult to achieve in a case study, as they are often very contextual. Instead, the researchers should strengthen transferability by carefully using painting language and metaphors that can be translated to other cases. The dependability of the study is determined by how open the authors have been during the thesis work. It should be possible for a peer to follow, either by records or continuous audits, if the research has followed an appropriate process. Confirmability is achieved by ensuring that the researchers stay objective and have not let personal beliefs or values overly influence the research process. Last, the authenticity deals with the social status and value of the research.

3.6 Ethical Considerations

Research ethics refers to how to how the study is conducted, how data is accessed and collect and later used to analyse and draw conclusion from (Saunders et al. 2009). Bryman and Bell (2015) mentions four main ethical aspects to take into consideration: cause of harm to participants, the lack of informed consent, invasion of privacy and deception. An informative letter with the purpose and aim of the thesis, along with the topics, that was going to be discussed, was sent to the members of the studied project before the interviewees agreed to participate. According to Bryman and Bell (2015), the participants should be given enough information about the aim, purpose and their role in the thesis to secure that no lack of informed consent.

The participants were informed that their name would be anonymous but the company position would be used. If the interviewee requested confidentiality and anonymity it would be expected to eliminate the potential harm to the participants (Bryman & Bell 2015). None of the interviewees asked for full total confidentiality. In a qualitative study however, it is common that names are withdrawn from the thesis, but organisations are much harder to make anonymous without completely changing the collected data (Bryman & Bell 2015). Regarding the fourth ethical aspect, deception, which is when the researcher say that their research is something other than it is.

4 Description of the case study

This chapter presents the case study with a short description of Pilot LNG and the two joint industry projects. It is followed by a description of Zero Vision Tool and the method in general. The purpose is to give the reader an understanding of that type of project that have been studied.

4.1 Zero Vision Tool

The Zero Vision Tool (ZVT) platform is a continuation of the Baltic Sea Position project – a systematic co-operation project concerning emission and pollution from vessels in the Baltic Sea Area. The Baltic Sea Position project acknowledged that, to be able to achieve zero environmental impact from shipping, more stakeholders form the maritime sector, other than those from the shipping industry, needed to collaborate (BSP 2009). Therefore, stakeholders from the maritime sector and relevant authorities were invited to collaborate towards "*zero-system*" in accordance with the EU-commission. The aim of the project was to; invite stakeholders to create a joint position, put together and package already existing solutions, create solutions together with the stakeholders and then communicate and promote the zero-system. The targeted receivers where politicians in countries surrounding the Baltic Sea, other shipping organisations in the Baltic Sea area as well as the general public. The shipping organisations current solutions for a less environmental impact was collected, summarized and presented to the public in a palpable manner (BSP 2009). The Baltic Sea position proved that joint involvement across sectors, stakeholder and countries was possible and thus laid the foundation to the ZVT method. The ZVT initiative was launched in 2011 by the Swedish Shipowners' Association and Ports of Sweden. The overarching aim for the platform is to provide opportunities for cross-sectorial projects within the maritime sphere with the goal of reducing environmental impact, reducing energy consumption as well as reducing incidents such as loss of life or oil spills. (BSP 2009).

ZVT started out small but has rapidly grown in popularity and as of 2016 involves over 150 stakeholders. The common denominators for these stakeholders is that they all have committed some of their resources towards:

- Increasing economic growth
- Increasing welfare
- Increasing profitable transport by sea
- Reducing negative environmental impact, accidents and energy consumption

Zero Vision Tool Method

The ZVT works through the launching of cross-sectorial projects. These projects, called Joint Industry Project (JIP), Joint University Project (JUP) or Joint Authority Project (JAP) dependent on the inherent nature of the stakeholders playing the major roles in the projects. While a JIP may involve both the maritime industry, researchers from universities and government authorities, the major involved parties are industry-based. One of the most

important function that ZVT has, is the know-how of applying for financial support and research grants. Another central function is to disseminate findings and knowledge from the different projects that ZVT supports. As the different projects supported by ZVT are complex, involve many different stakeholders and are of a high-risk nature, they are financially cumbersome and resource intensive making external funding more necessary. One of the projects which is discussed in this thesis are Pilot LNG, which is a collective name for various JIPs that deals with LNG. Two of the JIPs, LNG CONV and FLEXI will be discussed in more detail throughout this thesis.

The ZVT has developed a methodology for organizing, applying and sharing information and knowledge gained from these collaborating projects. It starts with the identification of an idea on how to solve an issue or dilemma that the Swedish shipping industry faces. A group of organisations who have an interest in solving the issue is brought together and starts to collaborate to work towards the solution. The issue is broken down and divided in to five focus areas including: vessels, finance, infrastructure, research and development (R&D) and regulations. This is done to make sure to cover all aspects of the issue. When a JIP identifies an obstacle that they are unable to solve themselves, they can get support from a reference group called Zero Vision Tool Reference Group (ZVTREF). The reference group consists of stakeholders from public authorities, agencies and industry representatives. The group consists of the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Transport Agency, the Swedish Agency for Marine and Water Management, the Swedish Energy Agency, the Swedish Country Administrative Board, the Association Ports of Sweden and the Swedish Shipowners' Association. The found obstacles are categorized with a "traffic light" method. Green colour indicates that everything works well and that the JIP can solve it internally, yellow means that feedback and guidance from the reference group is helpful and red colour indicates an obstacle that cannot be solved without support. The ZVTREF group holds meetings quarterly. Before an obstacle is brought to ZVTREF, it is prepared by a steering group. The steering group decides how and what to bring forward to the reference group. ZVT also has a communication group which supports the participants with layouts, websites, press releases for internal and external stakeholders.

The history of ZVT shows that the method is currently changing and adapting to the correct demands of its stakeholders (ZVT, 2016). ZVT have, in the beginning of 2017, lost its financial aid from the Swedish Maritime Administration and the future of ZVT is currently uncertain as it needs a new financial solution.

4.2 Pilot LNG

Pilot LNG is, as has been previously stated, a part of a larger initiative to find solutions to meet the new SO_x regulations in the SECA area. It is an umbrella project containing multiple sub-project called JIPs. Pilot LNG is a shortening for "LNG Bunkering Infrastructure Solution and Pilot actions from Ships operating on the motorway of the Baltic Sea". The project extended from January 2012 to December 2015. It was part of the Trans-European Networks multi-annual programme. A total of 13 actors was involved in the project, from four European Union

(EU) member stats: Sweden, France, the Netherlands and the United Kingdom. The main purpose of the project was to implement a LNG bunker supply infrastructure in the proximity of Brofjorden and the Baltic Sea and deployment of new technologies LNG technologies. It included the terminal where LNG will be supplied, a bunker vessel to enable supplying customers near Brofjorden as well as both new built and refitted LNG propelled vessels as consumers. The project would also result in design recommendations, recommended best practice for operation and suggestions in the development of rules and regulations (European Commission 2014). Figure 10 shows how Pilot LNG is connected to the overall solutions how to meet new emission restrictions and the JIPs. Throughout the thesis, when Pilot LNG is mentioned it will be at the first level of analysis.

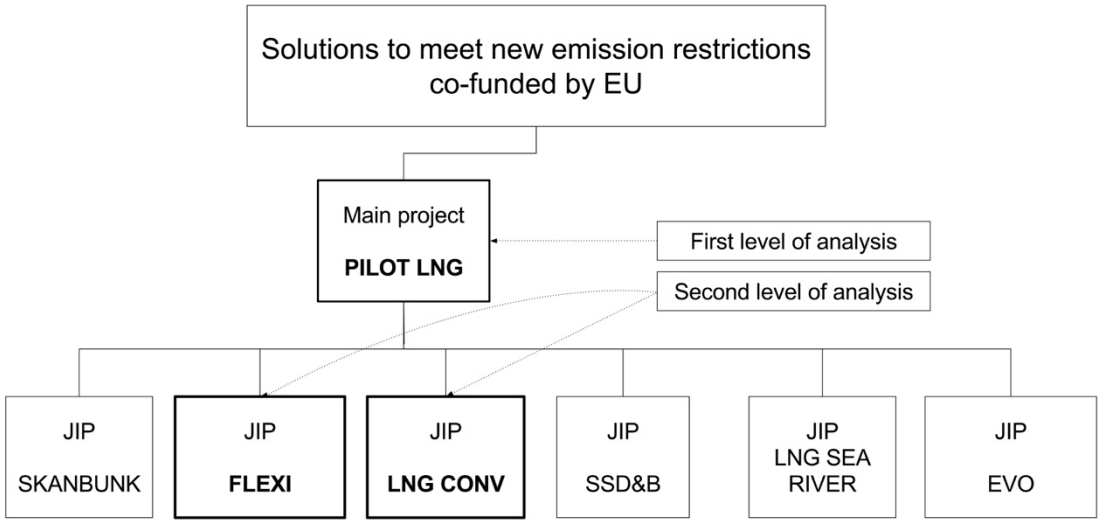


Figure 10 PILOT LNG, FLEXI and LNG CONV in a wider context, illustrating two levels of analysis (author illustration 2017)

The two sub-projects investigated in this case study are part of a larger initiative called Pilot LNG, which is also part of an even larger initiative called the Global Project with the aim to find a solution to meet the SECA regulations in the Baltic sea. All the projects included in Pilot LNG will form a infrastructure and logistic solution for LNG in Baltic sea (Kalantari et al. 2015).

TEN-T and INEA

Trans-European Networks (TENT-T) was a program that supported the European Commission, from 2006-2014, with upgrading of infrastructure in the EU. It financially supports inter-organisational and inter-regional projects that improve infrastructure, creates jobs and cohesion. Apart from supporting the maritime sector, it also supported infrastructure such as air, rail and road (TEN-T 2014). In 2014, TEN-T became the Innovation and Networks Executive Agency (INEA), which has a broader aim, to increase the efficiency of the technical and financial management of its programmes. The main purpose is to keep the global competitiveness of the EU from an innovative perspective (INEA 2017). Pilot LNG total project cost was €74,5 million Euros of which €23.1 was contributed by EU (European Commission 2014). All partners

involved in Pilot LNG had to comply with the obligations set by INEA. If the partners fail to comply with the regulations, it results in loss of eligibility for receiving the funds. For the sake of simplicity, TEN-T will be called INEA from now on.

4.3 LNG CONV

The LNG CONV project is the engine conversion of the vessel Fure West, displayed in Figure 11, owned and operated by Sp/f Nolsö Shipping, which is the subsidiary of Furetank Rederi AB. Furetank Rederi AB is a is a third-generation family owned shipping company from the Swedish west coast.

Figure 11 Picture of Fure West with LNG tanks on deck (Furetank 2017)

The headquarter is located at Donsö Island. Furetank owns six vessels but operates more than 20 vessels, mostly chemical and tanker vessels. Furetank also provides other services such as crewing, safety, vetting and chartering. The excising main engine on Fure West was on delivery, possible to convert from conventional fuel to LNG without replacing the entire engine frame. According to the projects website, the objectives of LNG CONV were to:

- Convert, and run, a main engine on LNG to show environmental benefits (+ identify pros and cons if converting auxiliary engines too),
- Lead the path to reduced operational costs,
- Identify, and evaluate, the workflow of the engine conversion to generate new technology development,
- Identify if new gas driven vessel solutions are needed,
- Generate lessons learned and identify education needs,
- Identify, and solve, safety risks and combine with environmental winnings,

- Implement energy efficiency ISO standards and investigate the total energy efficiency (Kalantari et al. 2015)

Table 1 Fure West ship's particulars

Length over all	144 m	Cargo capacity:	18833 m3
Breadth	21,50 m	Speed:	15,4 knots
Depth	12,50 m	Ship type:	Oil and Chemical tanker
Draft	9,75 m	Ice class:	Ice Class 1A
Dead weight:	17557 dwt	Main engine:	MAK 6190 kW
Gross	11548 t	Aux engines LNG	3 x 910 kW
Netto	5290 t	Bow thruster:	850 kW

As can be seen, part of the objective was to examine how the cost of LNG fuel tanks could be reduced, and how a LNG-driven tanker should be operated in a safe and efficient way. Connected to this is the scheduled and unscheduled shipyard activity for LNG vessels. LNG CONV is one of the first projects that uses a LNG conversion kit for a vessel of this size, and the hope is that this project will act as a template for more conversions for other vessels in the future. The conversion of Fure West was finished on time and achieved many of the objectives. It was found that a conversion of auxiliary engines was too complicated and instead the choice of insulating the LNG tanks were made. Consequently, only the main engine for propulsion of the vessel was converted to dual fuel. The project was delayed with approximately one year, mainly due to financial difficulties with one of the partners. But the actual physical conversion at the drydock, which is later called the “hot phase” was not delayed. Throughout the thesis, when LNG CONV is mentioned it will be at the second level of analysis.

4.4 FLEXI

The objective of the JIP FLEXI is to build and introduce a vessel, seen in Figure 12, that can provide the bunkering of LNG in the Skagerrak/Kattegat area. It also aims to develop a safe and efficient system for bunkering LNG. The vessel is meant to serve as an integral piece of the LNG infrastructure in the area and is to be owned by Sirius Veder Gas, a joint venture between Swedish Sirius Rederi AB and Dutch Anthony Veder. According to one of the representatives, the joint venture was decided as a mean to strengthen the financing and organisation of the project. The vessels original delivery date was 01/07/2015, but was post ponded twice, first to 31/12/2015 and then to the summer of 2017. The reason for the name Flexi is that it has multiple purposes. It is designed to for both short sea trading of LNG as well as ship-to-ship LNG bunkering. The vessel was nominated to Nor-shipping Next Generation Ship Award 2015 which is a prestigious prize and are awarded to ship projects demonstrating the greatest advances and innovative design. Nor-shipping agrees with the theory found in this

thesis by stating: "*Since innovative efficient designs often emerge through active collaboration between companies*".

Figure 12 A concept illustration of Coralius which is the vessel name of the project FLEXI (Sirius Shipping 2017)

Sirius Rederi AB (Sirius Shipping) was founded in 1994 on the Island of Donsö and is a family owned company. The core business of the company is the oil- and chemical tanker market as well as an extensive knowledge in the bunker segment. Sirius Shipping operates 11 tankers and LNG vessel. Sirius see themselves as mix of a traditional shipping company with modern and entrepreneurial spirit. The company has an in-house management with a close integration with the operated vessels. A letter of intent was signed together with a LNG provider which will operate the vessel on a long-time charter.

Table 2 Ships particulars for the FLEXI project

Length over all:	99,60 m	Ship type:	LNG gas carrier
Length between perpendiculars:	90,00 m	Ice class:	Finnish/Swedish Ice Class 1A
Breadth moulded:	17,81 m	Main engine:	Wärtsilä 6L34DF – 3000 kW
Breadth extreme:	17,95 m	Main gearbox and CPP:	Wärtsilä
Depth moulded to main deck:	10,00 m	Aux engines LNG	2 x 375 kW
Design draught:	5,70 m	Aux engines Diesel:	1 x 475 kW
Scantling draught:	5,90 m	Bow thruster:	Azimuth / tunnel, ZF – 600 kW
Dead weight:	3000 dwt	Stern thruster:	Tunnel, Verhaar Omega – 400 kW
Cargo capacity:	5800 m3	Steering gear:	Roll Royce 2 x 70 degree
Speed:	13,5 kts	Rudder:	Becker "Twisted full spade"

5 Empirical findings and analysis

In this chapter, the empirical findings from the data collected during the thesis is presented and analysed First, there is a short introduction of the interviewed persons. Second, a comprehensive list of the main findings and their analysis is presented. It is followed by an analysis of said findings.

5.1 The interviewees

The interviewees represent eight of the partnering companies involved in Pilot LNG and the two sub-projects. The interviewees and their function in their organisations are listed in Table 3

Table 3 A list of the interviewed participants in the study

Interview alias	Function in company	Company
Person A	MD	ZVT
Person B	Strategy and Communications	ZVT
Person C	Coordinator	Consultancy company
Person D	Manager Shipping Department	Petroleum Corporation
Person E	Project Manager	Ship designer
Person F	MD	Shipping company
Person G	Technical manager	Shipping company
Person H	Department coordinator	Drydock
Person I	Engineering supervisor	Engine provider
Person J	Portfolio Management and Logistics Director	LNG provider

5.2 Main empirical finding and main analytical findings

presents the summarized main empirical and main analytical findings. It is then followed by the analysis, is divided into three parameters mentioned in the theoretical framework. The findings are merged with the analysis and contains data from the interviews and documentation used in an alternated fashion.

Table 4 Main empirical and main analytical findings

	Main empirical findings	Main analytical findings
Leadership & organisation	• The leadership structure of Pilot LNG had more than one leader, each with different responsibilities • Many of the interviewees said that they expected more support from the designated JIP leaders • The rigid structures and requirements from INEA overrode the role of ZVT • Some of the participants in the sub-projects saw themselves more as suppliers to the shipping company than project partners • Aligning the goals in Pilot LNG have been difficult	• The project structure was unclear, participants had higher expectations of it • Need for leaders who can support the participating organisations • Supporting functions (JIP leaders/Structure) for EU financing were insufficient • Different kinds of leaderships needed • There was a lack of unifying leadership in Pilot LNG • The roles of the leaders held different weight in the project
Trust	• A high level of trust existed in the west coast Swedish shipping cluster prior to the collaboration • Trust in individuals is equal to the trust of the company they represent • Gained trust have been achieved between partners that have successfully completed their sub-projects • Participants were contracted to share their findings by ZVT and INEA • Some individuals attending Pilot LNG meetings was changed along the project's lifetime • Work continued even when time was short and compensation was discussed • Cultural differences and distance caused strain on relationship for partners • Most the interviewees agreed that, to share knowledge, they expected something in return • Not all knowledge was shared, commercial knowledge was kept private due to competitive reasons	• The need for higher levels of trust due to less shared values • Personal reputation and trust influences that of the company and vice versa • Knowledge sharing was not always voluntary • Psychological contracts were used when unforeseen changes emerged • Cultural differences affect trust negatively • Expected reciprocity of knowledge meant constraints for knowledge sharing and a lack of trust • Participants could influence what was shared
Communication	• There are mainly three communication channels in the collaboration • Pilot LNG meetings focused on inter-project socializing and discussing findings and issues from JIP's • ZVT is responsible for disseminating findings from Pilot LNG to the public and the industry, while SSPA responsible for reporting to INEA • There were mainly face-to-face meetings in the beginning of LNG CONV, teleconference and IT communication after initiation and daily face-to-face meetings in the "hot phase" • The communication channels were described as short and efficient • It was stated that you gain more by being an active participant in the project	• Even if the findings from the projects are disseminated, one learns more by being directly involved in the project • Meeting and collaborating face-to-face are important in order understand the real progress of the project and to understand the intricacies • Previously built up trust and familiarity between members shortened communication channels • The communication role of ZVT was mainly toward the public and national authorities, they were not so involved in communicating with the collaborations

Leadership and organisation

The organisation and leadership of Pilot LNG was somewhat unclear and complicated. Even though the leadership structure is well described in the documents, it was found in the interviews that this structure was not as clear to all participants as intended by ZVT. It was found that the leadership was divided into three roles in Pilot LNG and the sub-projects, shown in Figure 13.

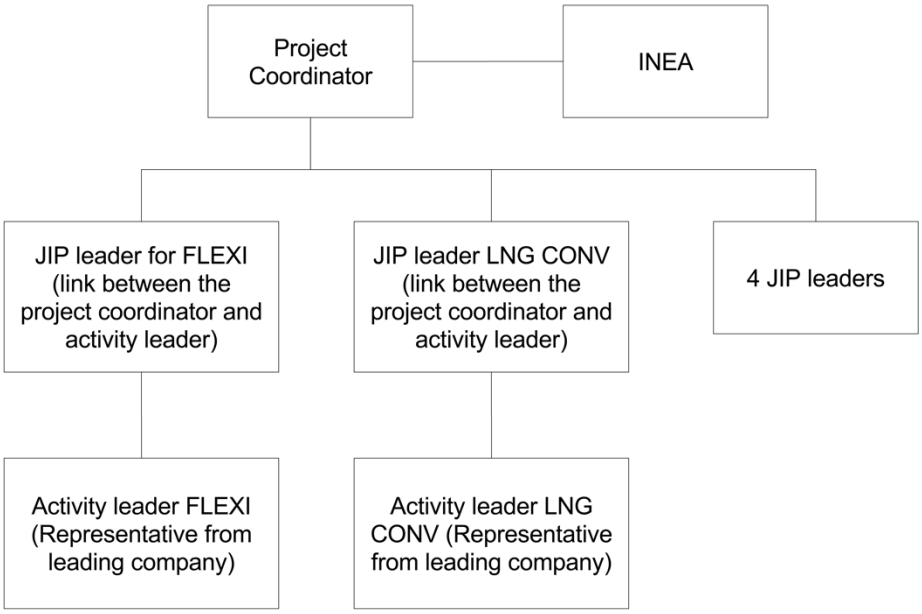


Figure 13 Project leadership structure (author illustration 2017)

At the top of the structure is the project coordinator, which served as the focal point of communication between the participants of the Pilot LNG project and the co-financer INEA. Primarily serving in a reporting function, the project coordinator compiled the reports submitted by the individual JIPs and passed them on to INEA. The assigned project coordinator of Pilot LNG had plenty of experience in project management, but had personally only worked with one of the involved project partners previously. The consultancy firm where the project leader was employed have had experience with this type of organisational setting and reporting from previous work, but many of the other parties have not. The sub-projects were obliged to save all documentation and make sure that the proper documentation was at accessible for the mandatory report to INEA. This was collected by the JIP leader which assigned by the consultancy firm.

The JIP leaders in the specific sub-projects, such as LNG CONV and FLEXI, acted as the localised project coordinator and compiled the reports and proceedings of the JIP to pass them on to the coordinator and ZVT. Their primary task was to support the activity leaders in order for them to fulfil their obligations to INEA and ZVT. The project coordinator said that the function of the JIP LEADER was to give technical and administrative support, and to put together the yearly reports and a strategic action plan.

The activity leader is the person serving in the role of the traditional project manager, managing the resources of the projects to reach the set targets. The activity leaders in the JIPs were in most cases a senior manager from the organisation that stood to gain the most from the project, and contributed with more resources. These organisations were often the shipping companies. The reasoning behind the separate JIP and activity leader roles were the additional burden of reporting that the co-funding by the EU entailed. Thus, it was deemed to be better or the project to separate the issue of reporting from leading the project. In the LNG CONV and FLEXI projects, the two ship companies acted as the activity leaders. In the LNG CONV project, person E expressed the opinion that it was the owners of the vessel, who were the de facto leader of the project, as their role as owner meant that they held the main incentive of the project. Person I however, felt that the leadership role was weaker and rotated between the involved parties, depending on which phase the conversion project was in, and who held the most competence in the relevant area. Person D echoes this sentiment, but at the same time experienced that involved transporters, such as the petroleum corporation or LNG provider, have had a lot of input in the projects, as they are the intended clients. It seems as if the organisational structure of Pilot LNG has had a limited hierarchal nature and instead the leadership was focused inside the JIPs. It seems as if the inter-JIP roles were centered around the functions and knowledge of the partners and that hierarchal bonds were of a softer nature.

> *"It was never explicitly stated that is was the technical manager at the shipping company, who should lead the conversion project, it just happened naturally since they were the vessel owners" Person E*

In both the FLEXI and LNG CONV projects, the JIP leaders changed several times during the project's lifetime. This was somewhat problematic, as it wasted time and resources getting them up to speed with the project, according to several of the interviewees. Person J illustrates this:

> *"...there were a lot of different individuals, which meant that you had to sit down and explain the situation. Repeating the same information over and over again" Person J*

Unclear roles

In addition to the changes of JIP leaders, some participants expected the JIP leaders to contribute more to the project. It seems like the role of the JIP leaders were somewhat debatable, as the documented description of the responsibilities are clear, but some participants were unhappy with the amount of support that the JIP leaders contributed with. An interviewee stated that this seems to vary between the persons who served as JIP leaders, as the amount of effort changed. This is reinforced by the fact that some projects were satisfied with their JIP leaders contributions, and some expected more support. Person J said the value of the project coordinator and the JIP leaders have mostly been as the communication link with INEA. The documentation to the EU have been quite demanding for many partners. Some of the issues might be explained due to changes in the organisations during the project. Person A says that the role of consultancy company and ZVT changed halfway into the project. This change was initiated due to the uncertainty of which organisation oversaw the leadership for all projects.

ZVT was owned and operated by the consultancy company in the beginning of Pilot LNG, but when ZVT separated from the consultancy company and became its own entity, the leadership roles became clearer. According to Person A, the consultancy company wanted to function as a supplier for services to ZVT instead of operating it themselves.

It was unclear how much time the participating organisations would have to spend on administrative duties connected to the financing by INEA. It seems like the directives of how the process of requesting funds were not clear enough during the start of the Pilot LNG, as several of the interviewees told of examples of how participating organisations had trouble getting compensation for their efforts, as they had miscalculated the effort needed. Interviewees described the funding process as cumbersome and a cause of stress, and that it had part in why the project was delayed. Person G voiced frustration over the inflexibility of the EU process when it comes to the possibility of co-financing. One specific issue found was the logging and estimation of project hours. Some interviewees stated that it was difficult to estimate the hours that would be required of them, especially regarding the reporting to INEA. This led to them getting less remuneration than they expected. It could be possible that the difference in culture between consultancies, where logging time on project is integrated into the work process, and other participants led to misunderstandings. However, the ship designing company, who is also a consultancy, also experienced this issue. It is therefore improbable that the issue can be explained simply as a cultural problem. The issues surrounding the process of receiving co-financing from the EU is a matter that possibly could have been redeemed with more guidance from the JIP leaders, as this fell under their responsibilities.

The role of ZVT

According to person B, the role of ZVT in Pilot LNG is to collect the created knowledge, the findings and the obstacles from the sub-projects, to structure it and then disseminate the knowledge in appropriate forums. It is also reported to the ZVTREF which can advance it further to the national authorities to make them aware of the progress and in the projects, and what kind of support the projects need to progress further. The authorities can then lift the findings to the International Maritime Organisation (IMO). The industry-wide problems that are to be solved have to be perused from many angles. By doing that, the ZVTREF can reach a common suggestion to a solution, which makes it easier to create a road map to solve the problem. The role of ZVT was not tied to the Pilot LNG project per say, but rather to the collaboration platform itself and ensuring that the communication surrounding it and the projects went smoothly. By effectively relaying hurdles and obstructions (through the green-yellow-red system) to the ZVTREF, it aimed to ensure that Pilot LNG moved along accordingly. Some interviewees were skeptical of what role ZVT had played in the projects, while others were adamant that they had played an important role in bringing the industry together in showing decision-makers and the public the willingness and innovative spirit of the project organisations, and many vessel owners who were part of Pilot LNG have sent requests for assistance to decision-makers via The Swedish Shipping Association (SSA) in order to keep ZVT going, as they now face financial hardship and risks closure. According to person C, the

steering function that ZVT have with their reference group impaired by the rigid regulations set by the co-financing EU organisation.

> *"ZVT had probably an important role in the initial application phase [for co-funding], however, during the execution, the project was strictly regulated by the contract to INEA" Person C*

Several interviewees stated that they had very little contact with ZVT during the projects, and it seems that the major communication with ZVT were conducted by the activity leaders. Several of the interviewees believe that while they were part of the JIP on paper, they mainly saw themselves as a supplier for the shipping company, and answered to them.

Interdependence between projects

Person C said that from an organisational point of view, it is important to understand that in a project network such as LNG Pilot, all projects are linked together and some of the projects are interdependent. One reason to why they are interdependent is the network effect of LNG. Person F gives some examples why the projects are interdependent by saying that there are significant risks associated with investing in new technology such as LNG, as it is not certain that it, in the end, will be the preferred technology in the industry. In other words, the return of investment in each sub-project will be lower or nonexistent without completion of the other sub-projects or if no more stakeholders – followers – are investing in the LNG infrastructure. Now when it is known that some of the projects in Pilot LNG was not completed, Person G voiced his frustration of having the shipping company taking the majority of the commercial risk of the project and that there were no guarantees that the LNG market would develop. It was also difficult to find a LNG provider that could give an estimated price of what it could cost to bunker LNG. There is a reluctance and uncertainty to move into a young and untested market. However, apart from the shipping companies converting and building vessels, the LNG provider also carries risk in the FLEXI project according to Person J who points out that the project probably would not have started without the long-term commitment to charter the vessel upon delivery. Which increases the overhead risk for the whole project. Since this is the case, it is central that the common goal is understood by all the stakeholders.

> *"A lot of organisations said that they could deliver LNG bunkering solutions, via delivery by container or such. All manner of crazy solutions. But when we asked about the price, we were told 'Oh, is it only for one vessel?'... And then no one was interested… They want to be a part of it [the LNG infrastructure] but are unwilling to take any risks. In the end, a single, tiny shipping owner became the risk bearer. Person G*

Common goals

Several interviewees stated how important the common goals of the projects were. Every project in Pilot LNG had a start-up meeting where the project group was instructed by ZVT to define their vision and goal, and to align their expectations. The same person B says that the organisational culture and environment can be very different between participants, but that the

collaboration can be successful if the partners want the same thing. Some of the key concepts for the Pilot LNG was to express mutual goals and the determination of sharing experiences between participants. Several interviewees emphasised on the value of trust in order to reach these concepts. Person D stresses the importance of these start-up meetings, since that is when the collaborative framework is set. Person C stated that the initial goals of the Pilot LNG had not seen any significant change during the project and that they are following the initial action plan. However, Person E said that the end goal for LNG CONV has been static, but the road towards it have changed. This is also emphasized by Person J who says that since the projects are very long, changes in scope can appear along the way. On a wider level, it was not clear of what the exact objective or aim for ZVTREF was in the initial stages. Person B said that it took almost a year for these to settle the expectations for these. Different stakeholders had different views on how issues should be prioritized. It seems like the participants throughout the Pilot LNG network agree on the importance of sharing common goals, but even then, there has been difficulties with setting these at a feasible level, from ZVT and down to the individual JIPs.

According to Person B, there has been numerous instances of knowledge creation in the different forums of Pilot LNG. Different projects have combined their experiences and found new solutions to their specific problems. Person J says that they have gained a lot of industry knowledge and contacts since there was a lot of partners involved in the projects. It is believed that the fact that all the projects were conducted simultaneously must have been a contributing factor in the increased body of knowledge regarding LNG within the Swedish shipping cluster.

> *"We are of the opinion that we would rather have a small piece of a big pie than a large piece of a small pie. In order for that to happen, everyone have to share their knowledge" Person J*

Person J have not had previous experience with the other parties in the project. By participating, the LNG provider got to know the project partners and the industry better, not only in their own project, but in the whole Pilot LNG group.

> *"For us, it has been a way to get closer to the customers and to what they think is important. That has also been an important aspect for us." Person J*

Trust

It was found from the interviews that trust in general is something that is deeply embedded in the Swedish maritime cluster. Many of the interviewees referred to Swedish shipping as a very person-to-person oriented industry, and that the there are many connections, formal and informal, between the companies operating in it. Person J compared the management of some of the shipping companies to be somewhat different from his experiences from the land based industries. He found the involvement and interest from the senior managers in the project to be inspirational and commented positively on the hands-on approach from top management. Person C states that the cluster is like an open book, and that trust and transparency is an essential part of the shipping industry. The same person also said that the Swedish shipping cluster is familial and that the partners in the projects meet in many other settings, for example

by doing business with each other, gatherings, fairs or other industry forums. Person A also expressed that it is important for trustworthiness and that after having been involved in the cluster, he both know and is known to the industry. Person D confirms, saying that their company are in contact with Swedish shipping companies on a regular basis. Trust between many of the participants in Pilot LNG has existed since before the project started, and has been an important collaborative factor for the projects.

Most interviewees did not differentiate between the trust in a company and the trust in the person in the company. Person D considers a partner's MD to be equated with company itself. Person E confirms this by saying the same thing about the MD of the other shipping company. This indicates a familiarity with the activity leaders in LNG CONV and FLEXI, both midsize family owned companies. This statement was shared by multiple interviewees and the quote by Person H sums it up like this:

> *"...The Swedish shipping industry is extremely small, and thus it's the individuals who are the companies and not the other way around. Personal trust is much more important than the trust to the company."*

When the LNG CONV team were put together, several of the partners had worked with each other in prior projects. In LNG CONV, the ship designer had designed Fure West, which led them to be natural partners for the redesign that was necessary for the conversion. The drydock had previous experience with Shipping company and was thus approached. As has been mentioned, multiple interviewees stated that there already was a very high level of trust between most of the participating organisations before the initiation of the project. Only a few of the organisations in the studied projects had not worked with a project partner before. Several of the project participants stated that the experience from previous joint projects had a considerable effect on the level of trust between partners in the both the main project but also one of the sub-projects. For example, a shipping company and a ship designer has a longstanding relationship dating back to the late 80s. The ship designer vouched for the shipping company when they were about to build their first own vessel and needed financial support. This gesture has made the shipping company hire the ship designer to draw most of their new vessels since that day. The ship designer adds that they felt safe joining the LNG CONV project since they have high confidence in the shipping company and knew that this was a serious project. Person E said that it is very easy to work with the shipping company and they have done they for many years. It is much easier to have a good dialog when you know them well on a personal level. In other words, the confidence in the project increased a lot because of the presence of the shipping company. One interviewee stated that they entered the collaboration since the initiator only starts "serious" projects. The start of LNG CONV was initiated prior to the start of PILOT LNG. Person G states that joining the Pilot LNG initiative with their sub-project LNG CONV felt natural, as they had a positive and long relationships with the promoters of the project. In this setting, trust is central on an individual level, and the difference between an individual and the organisation that she represents are small. There is a great deal of pride associated with trustworthiness within the collaboration platform. Person A exclaimed that they would rather perish than letting the projects down after committing to them

"Once we have committed to a task, we would rather die than fail, and let them down." Person A

The interviews indicate that there are different levels of trust. Person F said that it is much easier to discuss their project with organisations that are involved in one of the other sub-projects in Pilot LNG. But he also distinguished that there is a difference between the organisation that completed their sub-project and the one that did not complete their sub-projects. It was stated that it was easier to make a call and discuss current and future problems regarding LNG in general with the participants that had completed their projects. This indicates that the partners that have completed their projects have increased their trust between each other. Several of the projects in Pilot LNG were not realised or delayed. Some of the sub-projects in Pilot LNG failed to deliver a finished product. One interviewee believed that there might have been a few partners that entered the project with lower ambitions, without a clear goal, that was only there for the potential co-financing from the EU. However, this view was not shared by other interviewees, who stated that they had not experienced any free-riders in the two sub-projects studied. At the same time, some of the participating organisations had a less direct role in Pilot LNG, and functioned more as supporters of the project, contributing with valuable information in the beginning of the project as well as having the company's strong brand as part of Pilot LNG. There was a distinction between those organisations who saw the JIP in the perspective of business and those who had an interest in sharing and learning from the project. Person A said that there is a difference in the trust between the project group partners and the trust to their suppliers. The suppliers that wasn't used to work with the ZVT method had to be informed even more when interacting with the project. This indicates that organisations that was not a core member of any of the projects took longer time to familiarize with the working method, and had limited insight or access to the ZVT methodology.

Person G stated that the importance of trust varied during the project. The JIP started with a study of the necessary activities and solutions to the problems surrounding the project. During these discussions, a higher level of trust was demanded from the participants, rather than during the following phase, where the work activities and the actual conversion of Fure West was carried out. This phase followed a more traditional contractual framework between clients and contractors. Person G thinks that a lot of the contact and daily operations of the company works with external partners, but that the setting for LNG CONV was different, with an emphasis on teamwork, rather than to the usual contractual arrangements.

Lack of trust

Most interviewees believe that there were no major conflicts during the two sub-projects. However, one participant observed lesser disputes between shipping companies and contractors causing delay, which slowed down the Pilot LNG project as a whole. Another one states that problems and disputes was solved through effective communication before a conflict surfaced. Although, one interviewee states that there were instances in the process where some organisations were perceived as not contributing to the projects. According to Person B, there was never a need from the support functions to step in these instances, and that the organisations solved these issues internally. One of the obligations stated on the written contracts to entering

the Pilot LNG was to share the knowledge and findings and if the companies where not contributing, they would be excluded from the project. It was also stated that some organisations had the same individuals attending each meeting, and other organisations said that the individuals changed along the way. Especially the JIP-leaders but also some of the interviewees themselves.

In the end of the project, some parties disagreed about the remuneration, as there had been a miscalculation of the projected workload when applying for the financial support. It is an issue that is yet to be solved by the parties. Although, none of the involved parties claims that this issued never turned in to a real conflict. When the project was approaching deadline all project members had to work very intensively. There was a lot of extra work in the end, more than had been previously agreed on. Person E said that, because of the confident and trust in the shipping company, no new contracts were written, adding the extra working hours since that would take time from the project which was in the "hot phase". Person E added that he might have written a physical contract for the extra hours if they were working with another company. According to Person E some of the work was not in the scope of the agreement. The long history of trust and confidence between these two companies might have been the reason why no contract was written. The designing company saw that, stopping the process at the time to write a contract would be time consuming and capital heavy. The ties between them were so tight so that a suggestion to write a contract at the time might have caused greater damage than the current dispute, after the work was done.

> *"The new condition is not part of the scope of the contract. But, let's solve that after the hot phase and try to finish the conversion. There are some many people involved and it would cause a delay to stop and rewrite the contract now. Let's finish the conversion and take care of the paperwork afterwards." Person E*

Another issue that emerged during one of the sub-projects was that one of the sub-contractors to one of the main partners filed for bankruptcy during the project. The company made LNG-tanks, which have never been used in a marine setting before, the company lacked maritime experience. This led to an abrupt cut-off from knowledge about LNG systems. This was one of the reasons why the project was delayed in the first place, says Person I. This obstacle caused stress for all involved parties, but the interviewed persons maintain that this has not had an effect on their mutual trust. Nevertheless, the contractor has now established routines, by being active observers throughout the process, to make sure that the necessary knowledge from their sub-contractors are absorbed into the company, so that the risk of recurring loss of knowledge is mitigated.

Another potential issue to trust is the differences in culture between some of the companies in FLEXI. One interviewee said that differences in culture and profile of the two shipping companies that is building the vessel, but that they were put together since they complemented each other with different skillsets. It has been challenging, and it there have been some tension between the companies, and there is still some time left before the trust between the partners

have fully recovered. However, according to the interviews, the project was arduous for the parties, which has strengthened the trust in the collaboration. Even then, the relationship between companies were described as relatively frictionless during the project.

"When facing a common problem, one have to come together in order to solve them." Person J

Openness

According to the interviewed participants, there was an agreement among partners within Pilot LNG to open up and give internal knowledge if you were to have the right to receive knowledge from the other partners. Everyone should contribute with something, or else they should not be part of the project. Person B stated that the foundation of the collaboration is that the partners contribute with their specialty. This was agreed on both levels of analysis, the main and sub-project.

"We are doing this together. If I contribute with one piece of the jigsaw puzzle, I will receive another piece in return." Person B

Person G states that in order for a successful collaboration between different organisations, especially between firms of different sizes, all involved parties need to contribute to the project, or else it will not work. Person E confirms that all parties had something unique that they brought to the collaboration in one of the sub-projects. Person F says that they want to share as they believe in the positive effects of LNG, although it is a difficult balancing how much and when. When discussing what to share, there is also a trade-off between short term gains by keeping your knowledge for yourself and long-term gains by sharing the knowledge and expanding the market. Person D stated that the willingness to share technical knowledge between companies is one of the key success factors for the shipping companies at Donsö, where the two shipping companies in the study operates. This indicates that the culture of sharing existed prior to the Pilot LNG project. It is a culture that some of the companies brought with them into this collaboration.

"If I share my knowledge, others will share their knowledge, which I can use in the future. The mentality at Donsö and in shipping… I really believe the knowledge sharing is what it is all about." Person A

Almost all interviewees agreed that there was a distinct border between sharing technical aspects and commercial aspects such as customers or finances. Sharing technical solutions, safety solutions, and knowledge that enhance the projects potential to succeed was stated in the written contract established in the beginning of the project. It was not only stated by INEA that the technical findings sprung from the project was to be openly shared but also in the policy of ZVT. However, since many of the participator in Pilot LNG are each other's competitors, and some have supplier-customer relationships in their regular activates, the commercial aspects have not been reported. Person J believe in full transparency when it comes to safety, and almost full transparency regarding technical information. They willingly share information such as accidents and near-misses to promote a safer handling of LNG. Person D takes it one step

further and talks about the culture in the shipping cluster in west of Sweden, where the two shipping companies operates. Person D says that it is not only during this project this is applied. Instead safety solutions and emergencies and to some extent also technical solutions are shared but that the commercial part of the business are never shared.

However, some of the commercial aspects are inevitable shared with the representatives from ZVT. A representative from ZVT says that decision on what to share and what not to share is always ventilated with the partners prior to the dissemination of the projects progress. The representative says that one must be extremely careful with what to discuss and with whom since so many different people are involved in the ZVT platform. According to person B even if the partners see the material prior to the dissemination, the reporting to the funding agency are compulsory and non-negotiable.

> *"We've had the privilege of having a central position and thus receives a lot of information. We share a lot of the information, but not all of it. We always double check with the partner before distributing the information to the other partners." Person A*

One of the interviewees showed some ambiguity regarding what knowledge he wanted to share and with whom he wanted to share the knowledge with. Concerns regarding sharing some of the findings with consultancy firms was voiced. The interviewee said that he was worried that a consulting company would take the knowledge outside of the ZVT platform and into other project with competitors that was not part of ZVT platform. It was stated that it would have been preferable to have ZVT as the project manager. This is rather ambiguous since, reading between the lines, the interviewee first states that they have taken their newly created knowledge into follow up project and that the knowledge is used in their business. However, it is also said that the consultancy firm, where knowledge and soft skills are the core resources, should not bring their newly created knowledge into their other business. The consultancy firm share the findings to the other firms that was not involved in the project, but this must have been know prior to the collaboration.

> *"I would have rather preferred to have Zero Vision Tool as the leader of the project instead if the consultancy firm, since they are consultants to many other companies outside of the project. That means that our knowledge might spread outside, since the consultants bring the knowledge to other projects."*

The consultancy company does use their knowledge as a primary resource, it is important to retain and use knowledge from prior experiences. The amount of knowledge held by the company is directly tied to the trust from customers and their ability to conduct business with them. According to Person C, it is important that they differentiate between their consulting business, where the project-specific knowledge is not shared to other organisations, but used discretely, with the projects that are co-financed by the EU. The findings from those projects have to be explicitly disseminated so that they can benefit society and make it easier for followers to build upon the findings.

Communication

Three main communication channels were identified in the findings: the communication between the partners in each sub-project, the communication between the sub-projects in Pilot LNG and finally the communication with ZVT, ZVTREF and the Steering group. Two of the communication channels, between the sub-projects and Pilot LNG and within the JIP's were in aligned with the two levels of analysis in this thesis. A schematic figure of the communication channels is displayed in Figure 14.

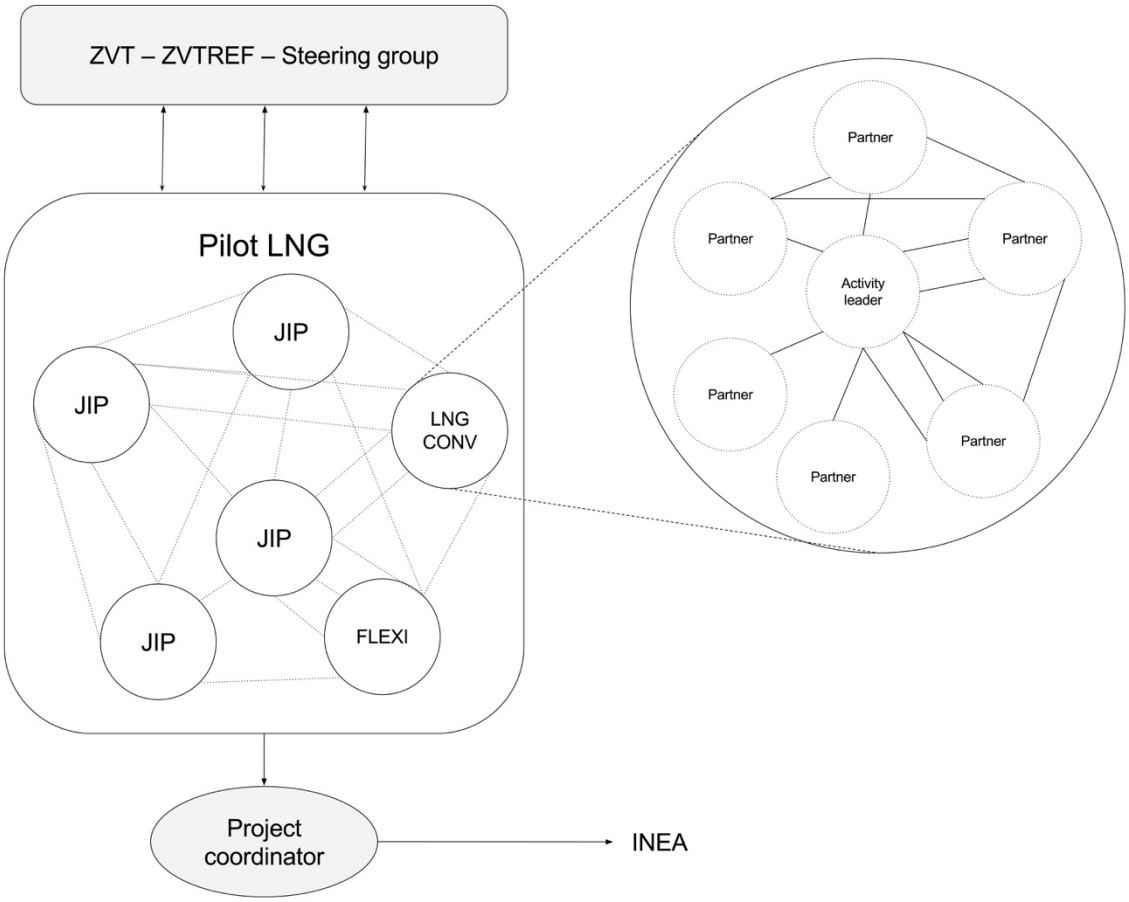


Figure 14 Schematic communication channels in sub-projects, Pilot LNG and ZVT (author illustration 2017)

PILOT LNG

The Pilot LNG group met several times per year, with the agenda to discuss issues that could concern all sub-projects. This was to encourage the inter-project knowledge flow and mitigate potential problems that could affect Pilot LNG. Person F explained that the meetings were held as an open forum where the partners from all projects were invited. An invitation was sent out and you had to confirm if you intended to participate or not. This means that not all participants attended each meeting. INEA were also invited to observe the progress. During these forums, they shared the red-yellow-green framework from all the projects and conducted open discussions about the current barriers. Apart from the more formal meetings at SSPA every second month, a few "ZVT days" was arranged were the partners could mingle and share experience among themselves. The agenda was informal and most of the time was spent

socializing with each other but sometimes there was short presentations and some organizing for future conferences says Person B. During these meetings, the primary purpose of ZVT was to listen, combine and disseminate the findings of the projects, according to person B. Person C echoes this, believing that ZVT have had an important function when it came to the dissemination of the of the findings.

As has been previously stated, multiple interviewees stated that since they know each other from before and in person, and they know whom to address when certain issues and questions arise. It is easy to contact the person within the company that holds the answer to the question, instead of going through a line of other people before reaching to the right one. This indicates a more effective communication as the partners get to know each other more deeply.

Sub-projects

Regarding the sub-projects, Person F said the they had face-to-face meetings in conjunction with the main Pilot LNG meetings every second month, but that the occurrence of these differed from project to project. Not all partners attended each meeting in the sub-project, instead there was different groups of participants involved in the project where communication relevant to the group took place. One interviewee stated that there was great value in having more than one person from the organisation attending the meetings, especially when the persons had complementary skillsets. The following discussions, between the participating persons from the organisation was very valuable for the project. It was during these discussions that the key findings from the meetings was developed and interpreted.

When they discussed the actual conversion, most of the communication occurred between the shipping company and engine provider. Most of this communication was handled via email or by telephone, but also in meetings at the designated drydock and in the facilities of the engine provider said Person E. It was also stated that the communication between the shipping company and engine provider have been open and honest. When entering the “hot phase”, it was stated that the shipping company and the ship designer had daily contact and weekly teleconferences with the rest of the project members. This was confirmed by person I, who said that they used the web-based meeting platform WebEx for the weekly prior to the “hot phase” meetings and daily face-to-face meetings during the “hot phase” of the conversion. The physical meetings with the whole project group have been held at various locations, such as Paris, Gothenburg, Rostock and Kiel depending on the current phase of the project and what task were to be done. Activity tracking software with shared questions and responsibilities for the project were used. Person I stated that a shared data storage was used to share all the common documents which all members had access to. Person F stresses the importance of these meetings and collaborating in a face-to-face environment in order understand the progression and to be able to read between the lines for a deeper level of understanding.

> *“...you learn so much more by being part of a JIP, much, much more. You notice undertones and nuances you otherwise would miss.” Person F*

Person F continued to explain that it is difficult to pinpoint the lessons learned from the project, but that it was beyond doubt that they had gained knowledge. Learning how to cooperate in a project setup and how to effectively share information was some of the lessons learned.

ZVT

The ZVT Steering Committee met on a continuous basis to organise the platform and to discuss broader organisational issues such as those concerning communication and dissemination. These meetings were communicated to all participants through meeting minutes that was sent out to the participants. Other dissemination tools used were publications on websites, news feeds and mailing lists. The ZVTREF group held meetings quarterly, and the progression and the issues of the JIPs were discussed during these meetings. Person D believes that ZVT collaboration method made the connections between the industry, government, economical systems and banks through the projects in Pilot LNG. It was an eye opener for these stakeholders what environmental benefits LNG can achieve. Person D: "*Without communicating this* [the environmental benefits of LNG], *the projects would never have been successful*. This was also confirmed in the final report of Pilot LNG where it is stated that one of ZVT's primary objectives is to share information and knowledge so other organisational could take part of it and become followers.

Implications of Pilot LNG

Three follow up project from Pilot LNG crystalized during the interviews. First a project called ENVISWITCH, the six new vessels already mentioned and a solution for ship-to-ship bunkering.

ENVISWITCH

After the LNG CONV project, another project called ENVISWITCH was initiated to identify the gaps in the rules and regulations that emerged during LNG CONV. Person H said that there were possibilities to interpret the rules and regulations in many ways, and the shipping community wanted to implement an industry standard. Person C states that this project was much easier to get going and one reason for this is because the previous collaboration in LNG CONV. Most of the partners from LNG CONV where also involved in ENVISWITCH. Person H said that the drydock had previous experiences with the organisations involved, whether they are competitors, clients or suppliers. The main purpose of the project was to study the conversion of conventionally fueled vessels to LNG powered, where the result would act as support for shipping company, dry docks, manufacturers, decision makers and other stakeholders in conversion from conventional fuels to LNG.

In the same manner as LNG CONV, the communication in ENVISWICH has been very open and partners have been willing to share information. Person H said that a shared goal had been developed throughout workshops, where targets and frameworks had been discussed with the involved parties. The experience has been very positive experience. Most of the communications have been through telephone meetings, but there have also been a few

workshops. Many of the interviewees mentioned the three-day hazard identification study (HAZID) in Paris, which was one of the activities in ENVISWITCH. According to Person E the intensive meeting was held by the classification society and 15-20 people with different knowledge and functions participated. Person E, expressed that the meeting was very interesting to attend and that they learned a lot from it. This addition to LNG CONV was a necessary step to identify other obstacles that followers – shipping company that also wants to convert an existing vessel – could encounter, thus a vital step to lower the barrier for entering.

New vessels

The LNGCONV project have led to ordering of six new LNG fueled vessels by the shipping company. Without the knowledge gained from LNG CONV, they would never have made the decisions of having the six new vessels equipped with dual fuel engines which can operate on both LNG and conventional fuels.

> *"We would never have dared to build six new vessels without the learnings we gained from the conversion of Fure West [LNG CONV]. We might have had one vessel built, but never six of them." Person F*

The interviewee argues that they would never have been built if it was not for the collaboration though ZVT and the knowledge transfer between the companies was established. The knowledge accumulated during LNG CONV has been valuable during the production and has generated know-how on how to proceed with the building of the new vessels. The interviewee continues to say that there is a lot of technical knowledge tied to LNG and the regulation of it that will be of use for the six new vessels. However, Person F says that they would be unsure to commit to a similar project in the future, due to the lack of support from authorities and the public, that was mentioned in the case study.

Internalizing knowledge

Person G explained how the new knowledge gained from LNG CONV will be shared to the six new vessels. One of the two engine officers, either the First Engineer and Chief Engineer that work onboard Fure West, and has experience from operation of the LNG propelled vessel will be transferred to the vessel that is first delivered. In practice, the Chief Engineer onboard Fure West will now act as an inspector at the shipyard where the new vessels are built. A new officer without LNG experience will be tough person-to-person for a few months before the next new vessels is delivered. Then the same procedure is repeated. This means that the vessels always will have at least one officer that is familiar with the new procedures and can teach the new officer through face-to-face interactions. This is done to both share the knowledge but also to make the vessels homogenous. There are differences in how the participating organisations communicate the findings and takes from the collaborations back to the core organisation. Some of them use databases, which is part of a quality management system, others held workshops and internal meetings and some had no such processes in place. One of the cornerstones for saving and sharing knowledge at the consultancy firm is continuous communication on a personal level, according to Person C. The JIP-leaders from the consultancy firm held internal meetings where they shared experiences so that they could then bring the knowledge to a

company-wide level. Person E said that the knowledge gained from the project was implemented to the rest of the organisations through an informative session, but there was no training or workshop session with the rest of the organisation. It was also planned to make a matrix with knowledge gained for future projects, which has not yet been done. Person H said that the knowledge that they have gained during projects are written down and inserted to a web based quality database which all employees have access to. Workshops have also been held to tech the employees of the new working processes.

SHIP-TO-SHIP bunkering

Another project that sprung out of Pilot LNG was a solution to ship-to-ship bunkering for LNG, where there had not been any standard practice or standardised regulations. Person B says the shared vision and goal can sometime lead to the acknowledgement and solving of other obstacles that appear along the way. One of the obstacles in Pilot LNG was the lack of standardization of the hose-connection during a ship-to-ship bunkering. This solution sprung out of the projects and was solved by the combined skills and knowledge of the partners. A suggestion on how this is to be solved have been presented. It could have not been done without the involvement of many project members according to Person B. It was said that the most the standardisation of the hoses could be done by the industry. But without the regulatory development of the standardisation must also be developed, with cannot be done solely by the industry.

6 Discussion

This chapter will first discuss the three parameters and contextualise the analysis with the theoretical framework. It will further highlight the implications of pilot LNG, discuss the research questions and end with a discussion regarding the method used and how the results can be applied in a larger perspective.

6.1 Leadership & organisation

During the literature review of the research fields of IOC and KC, special attention was paid to themes and phrases that connected the two fields. It was found that the influential researchers in the areas of KC and IOC, such as Nonaka, von Krogh, Huxham and Vangen, discusses the concepts of *leadership & organisation, trust between partners* and *communication* in their major works. After much deliberation, these were deemed to be fitting parameters for investigating KC in IOC in the planned case study. There were other common themes found, such as the selection of partners or the management of risk. However, the three parameters found and chosen were found to be interacting with each other and therefore suitable for the study.

It was found that the organisational leadership of Pilot LNG was broadly divided into administrative and operative roles. The administrative roles of the project leader and the project specific JIP leaders were organised and designated by a consultancy company. In both of the studied projects, the roles of operative activity leaders were found to be held by the shipping companies as well as owners of the vessels. Both the project documentation and the interviews indicate that the activity leaders in Pilot LNG were not individuals but rather the companies. Lynch (1993) argues that leadership in a collaboration is not necessarily held by a person but can be an organisation. Huxham and Vangen (2000) claim that leadership can be seen from the perspective of the participating organisation, and that the leading role can be held by the most competent or involved member. In LNG CONV, it was observed that even though the activity leaders of the projects were responsible, the project had a loosely hierarchal formation and in reality, it was the project member with the most knowledge of the current phase in the project that had a leadership role. In other words, the informal leadership role changed along the way. It also helps to distribute the power between the participants, in order to accommodate a more equal relationship. It is this type of informal organisation that promotes the creation of ‘ba’ within an organisation (Nonaka & Konno 1998) and helps the project utilise the knowledge from the individual organisations.

Role of the JIP-leader

The role of the JIP-leader was found to be a source of uncertainty. While the documentation clearly states that the JIP-leader is responsible for administrative duties, several of the interviewees expressed the desire for increased support in other areas. Huxham and Vangen

(2000) states that external consultants, such as the JIP leader in this case, can be to the benefit of a project as they provide a helicopter perspective of the project and acts in an unbiased manner. The personal drive and values of the leader will have a profound effect on the direction of the project. In addition, knowledge creation theory (von Krogh et al. 1997) states that leaders in projects with strong KC capabilities should not be creating knowledge themselves, but should focus on enabling and promoting the activities and in creating the 'ba', something that an external leader is more disposed to do. As it were, the companies serving as activity leaders were deeply involved on an operational level, which can lead to a loss of focus on long-term objectives such as KC. Interviewees stated that they thought that the effort and interest of the JIP leaders varied from project to project as the JIP leaders were changed during the ongoing project. It seems like the LNG CONV project has not benefitted from the positive effect that an external consultant can have on a project. With exception of the final JIP leader, there was an overall lack of interest, time and energy from the assigned JIP leaders. However, since the organisational leadership of the project was divided in an administrative and an operational part, the absence of a strong JIP leader was remedied by the motivated activity leader. Because of this, it can be argued that the project lost some of the outside perspective mentioned by Huxham and Vangen (2000), and risked an increased focus on the interests of the activity leader. In addition, being a strong leader might not have been the purpose of the JIP leader in the first place, but if this is the case, it is worth mentioning that this was not understood by the activity leader. Another finding that indicate a lack of leadership capabilities from the JIP leader, was the difficulties in understanding the rigidity of the EU reporting structure. It can be argued that it was the JIP leader's responsibility to inform the participants on a deeper level prior, throughout and in the reporting stage of the project. These types of disagreements on who is responsible for different parts of the project can easily turn in to a dispute (Panteli & Sockalingam 2005). Since many of the participants experienced problems with correctly applying for the financing from INEA, the leader responsible for this should have identified possible solutions to this problem to alleviate the participants. According to Huxham and Vangen (2000), a possible solution to help simplify the process could be workshops, to build a better understanding for the necessity and process of the mandatory reporting to INEA. The findings are inconclusive of what measures has been taken to inform the project participants, but the general dissatisfaction of the process indicates that it has not been enough. A concrete example of this was the failure in estimating the hours needed to complete the projects. This might have been avoided if the participants were better informed and prepared at the start of the project.

Leadership and knowledge creation

From a KC perspective, the organisation of Pilot LNG, with the open forum meetings and social gatherings can be connected to the SECI model and the corresponding *'ba'* of the phases (Nonaka & Konno 1998). There has been an emphasis on the externalisation and combination processes, as the different JIP's would use the meetings to raise awareness on issues and discuss topics that they needed assistance with, or findings that Pilot LNG could use. This corresponds with Nonaka's description of externalisation, where tacit knowledge about a subject, or in this case, findings or problem, is described and expressed so that it becomes tacit. The meetings

also included more practical exchanges of information or knowledge, for example when energy and gas companies shared trading patterns that could be of use to the LNG vessels in the JIP's. This knowledge transaction corresponds with Nonaka's combination process, as the shipping companies would take the data and, with the knowledge of their own capabilities, use it to make informed decisions. After the meetings, this knowledge would be brought back and internalised into their own organisation, in accordance with Nonaka et al. (1994). However, it is difficult to demonstrate Nonaka's socialisation process in Pilot LNG. This phase, when individuals work side-by-side and exchange tacit knowledge, is not represented on this level, but can rather be found in the sub-projects, such as LNG CONV, where the project members worked closely together during the conversion of Fure West. Interviewees from the project asserts the significance of close relations and continuous communication during the "hot phase" of the project. This leads back to the discussion of the question of Pilot LNG and if it is a collaboration or not. While it is not possible to draw any final conclusions, it seems as if the socialisation process is lacking in the Pilot LNG level, and that it is stronger, along with the rest of the phases, in the JIPs, suggests that the true IOC for KC lies in the sub-projects. The collaboration was focused during the "hot phase". Another reason for this could have been the tight deadline to receive funding. The vessel was completed with just a few days before the funding's would have been withdrawn. In accordance with Huxham and Vangen (2000), this deadline may have had a positive leadership functions since it helps the participants to stay focused on the task, in order to reach completion.

Stages of partnership

Regarding the organisational part of leadership, ZVT's role in Pilot LNG is multifaceted and complicated. ZVT goes under many different epithets, such as collaboration platform, collaboration method or tool for collaboration. ZVT was the initiator and organiser when structuring Pilot LNG in the early stage, and call the Pilot LNG a collaboration between organisations. It corresponds to the definition by Himmelman (1996) that "Collaboration is defined as exchanging information, altering activities, sharing resources and enhancing the capacity of another for mutual benefit and to achieve a common purpose". Information is exchanged between the partners and they are sharing some resources between each other. Since the projects are interdependent, there is also incentives to enhance the other partners for mutual gains. The common goal is, on a higher level, to widen the use of LNG as a marine fuel in the SECA-area, which is also fulfilled. However, when including the arguments by Järrehult (2011) that, for it to be a collaboration the partners should not only share resources, but the resources should complementary. If the partners have similar resources it is a co-operation (Järrehult 2011). For example, in Pilot LNG, there are for example multiple shipping companies sharing similar knowledge and resources. Another argument from Thomson and Perry (2006) is that a collaboration has a more involved interaction than in co-operation. Since the Pilot LNG had an open structure meeting every second month, it cannot be seen as a deeper interaction. Adding that some of the partners did not even identify themselves as being part of Pilot LNG, but only involved in each of the sub-projects is also a factor that makes it less of a collaboration. Here, it seems as if the activity leaders may have acted in the phronesis leadership role, serving as a driving force for the collaboration and for KC (Nonaka et al. 2014). One can also say that Pilot

LNG fits Himmelmans (1996) definition of co-ordination: “Co-ordination is defined as exchanging information and altering activities for mutual benefit and to achieve a common purpose”. But, since some resources are also shared, which they are in co-operation, it is more of a co-operation. However, there might have been some of the partners that entered Pilot LNG with the purpose to network with the other partners and only contributing with the bar minimum. But according to Kaats and Opheij (2014) not everyone has to go into the collaboration with exactly the same interests. It is expected that there are some differences in the involvement between the partners. To conclude, it can be argued that Pilot LNG is not a collaboration but is instead placed somewhere in between co-ordination and co-operation. LNG CONV on the other hand may be defined as a collaboration. In this sub-project, each of the partners contributed with resources and knowledge that was vital for the outcome of the project which corresponds to the notion mentioned by Järrehult (2011). The interactions were also at a much deeper level with weekly meetings and multiple meetings in person throughout the project. This was intensified during the project’s “hot phase” with daily face-to-face meetings and hands-on completion of the conversion of the vessel. Although, it was argued that LNG CONV reached a collaboration, it was not found that it reached an even higher level of partnership, such as co-creation (Ollila and Yström (2016) or open innovation (Chesbrough 2003). The partners must open up even more for such a collaboration to develop. For the sake of simplicity, the thesis will cluster co-ordination and co-operation into collaboration from now on.

Common goals and values

In the start-up of Pilot LNG and the individual JIPs, meetings were conducted in order for the vision and objectives to be discussed and aligned. This is, according to both Järrehult (2011) and Ring and van de Ven (1996), a critical step in the collaboration process. It is in this discussion that it is decided what the resources and knowledge that are to be shared, making it imperative for the continuing project. The commitment expected by the participants is also clarified in this stage. These shared objectives and goals can overcome inherent differences and values, according to one of the interviewees. Huxham and Vangen (2000) asserts that the leadership of the collaboration plays a role in the establishment of these common values, even if it is natural that they are not in place at the beginning of the project. In Pilot LNG, it was expressed by interviewees that while the final objectives held fast for the underlying JIPs, the path and scope of the projects could change due to unforeseen circumstances. LNG CONV, for example, had an offspring, the ENVISWITCH project, with new objectives that emerged during the initial project. It can be argued that during this initial alignment of the participants, the leadership should set the vision of knowledge creation, as described by Nonaka et al. (2000). In Pilot LNG, this leadership role is suggested to have been played by ZVT, as they were heavily involved in the start-up meetings and claim that they should preserve the knowledge that has sprung from the projects. However, several of the interviewees suggest that their contact with ZVT has been nominal points to the fact that the development of a knowledge vision has not been entirely successful, as it has not been sufficiently communicated throughout the Pilot LNG structure.

6.2 Trust

Many interviewees point out that they had previous contact with most of their partners in the JIP. It was therefore found that the foundation of the collaborations in Pilot LNG and its sub-projects were built on trust that had previously been established between a majority of the involved parties. The companies in the Swedish shipping cluster have had the opportunity to prove their capabilities regarding the dimensions of trust (Mishra 1996) towards each other. For example, partners must trust in each other's competences. This can be connected to an interviewee's comment that one of the reasons why they felt comfortable joining the project in the first place was that they knew that the activity leader only initiate "serious" projects. Regarding the dimension of openness, there was already an established culture of sharing technical solutions in the Swedish west coast shipping cluster, prior to the project. Finally, the high reliability in many of the partners was also established after many years of conducting business together. One of the interviewees, who represents a company who has not been connected to the shipping before, comments on this, and how different it is to other industries. As Darabi and Clark (2012) states, trust is fundamental in any partnership. For an IOC, as large as Pilot LNG, trust is even more central, as the partners of the different sub-projects must work towards Pilot LNG objectives that might only be loosely tied to their specific project. The high base-level of trust may have played an important role in enabling the Pilot LNG in the first place. Panteli and Sockalingam (2005) argues that trust should be established quickly in order for the sharing of competence and resources. As the JIPs all had a tight deadline set by INEA, it is possible that the projects would face severe delays if this is not achieved. Because of the trust established between participants beforehand, this need for haste might not have played such a large role in Pilot LNG.

Personal & organisational trust

Both Dodgson (1993) and Zaheer et al. (1998) states that there are two types of trust, inter-personal and inter-organisational trust. Both are of interest in Pilot LNG and the sub-projects, as the development of trust happens on a both levels during the project. Dodgson (1993) claims that the inter-organisational trust is primary, as it ensures the collaborations long term success, even though the inter-personal trust is essential for effective communication and mutual learning during when the project is running. Zaheer et al. (1998) echoes this claim. Interestingly, the interviewees from Pilot LNG claims otherwise, some going as far as stating that "...inter-personal trust is much more important than inter-organisational trust." There are a few possible reasons for the contradiction between the theoretical framework and the empirical findings. First, the Swedish shipping industry is small and as has been stated before, tightly connected. Competitors and suppliers alike are often on a first-name basis. Interviewees state that they equate the top management with the companies, meaning that there is no differentiation between dealing with the person or the company. Secondly, since the persons involved in the JIP's are to work closely together during the project duration, the personal trust between project members takes precedence over the trust between organisations.

There were a few projects that was canceled prior to completion of Pilot LNG. This was due to various reasons, but in the end the participants of the projects failed to commit to their obligations and did not deliver what they had promised. One of interviewees stated that it was much easier to contact someone involved in Pilot LNG that had finished their projects to discuss matters regarding issues or challenges or opportunities regarding LNG. It was found that the sub-projects in Pilot LNG are interdependent and that the failure of one project could, in some ways, impact the others. This indicates a confirmation of Newell and Swan's (2000) findings regarding commitment trust, where organisations that fail to commit to the obligations in the contracts, will probably not be picked for future collaborations. The trust will not be reinforced from the previous collaboration but possible weakened. The consequence from a canceled project weakening trust can also be viewed from the process framework of collaboration by Ring and Van de Ven (1994). The process framework, starting with negotiations, then commitment and finally an implementation phase and if the partners are satisfied with each other, the process framework can start over again, possibly with a greater level of partnership. Ring and Van de Ven (1994) says that the collaboration will end if the partners have not delivered what they have promised. In other words, no renegotiation or initiation of new projects will happen in the implementation phase fails. One interviewee stated that they would be reluctant to partner with those that had cancelled projects. On the other hand, LNG CONV, which was successful, almost immediately had a spin-off project, ENVISWITCH, with a majority of the old project members. This indicates that organisations should be careful of what projects they undertake, as the commitment must be followed by actions. Failure to follow-through can have a negative impact on future collaborations.

Trust and building psychological contracts

Another example from LNG CONV was that the shipping company and the ship designer had an extraordinary long relationship with a lot of trust embedded between them. However, a minor dispute between two partners surfaced during the "hot phase" in LNG CONV. When the project approached deadline, it was acknowledged that the ship designer did some extra work outside their scope to get the vessel ready before deadline. Instead of rewriting the contracts in the middle of the "hot phase" the ship designer prioritised to get the work done and believed that the extra hours would be solved afterwards. The level of trust in the shipping company can according to this gesture, along with other similar findings, indicate that they have come very far in the trust-building loop presented by Vangen & Huxham's (2003b) and in the process of collaboration by Ring and Van de Ven (1994). Instead of stopping and writing new physical contracts, they trusted the shipping company that this would be solved afterwards and instead a psychological contract was "signed". The ship designer indicated that they would not have acted like this with any company and that the long personal relationship with the shipping company was the reason for relying on what Newell and Swan (2000) reference to as companion trust, instead of renegotiating a legal contract. The dispute has, according to the findings, not affected the long-term relationship since they are continuing doing business in a major project after the completion of LNG CONV. The theory regarding physical contra psychological contracts drawn from Van de Ven (1994) can be connected to the findings that an interviewee believed that the importance of trust varied throughout the project. It was perceived that the

importance of trust between partners were less during the later phase of the JIP, when the project members signed contracts for the project work. After this, the participants were legally protected and the project was more akin to a normal operation. When looking at LNG CONV from Vangen and Huxham's (2008) trust-building loop, the partners should aim towards a realistic goal for the first project they do together, and if they complete it, they can continue and enter a more ambitious collaboration. Since many of the partners have done business, collaborated or been has been a part of the same small shipping community before LNG CONV, a foundation of trust was already in place. If they had not known each other, they would, according to Vangen and Huxham, have had to start with a simpler project. It can be argued that the LNG CONV project's first stage would not have been initiated, due to its complexity and high risk, if there was no prior trust between the partners. The rest of the sub-projects in Pilot LNG was of various complexity, with a few that were very ambitious and innovative and one of the reasons why some of they were not completed could be because the partners aimed too unrealistically compared to the prior established foundation of trust.

Lack of trust

Lack of trust can lead to conflict. It was stated that there were no major conflicts in LNG CONV. The reason for this could have been that the common goal was concrete and crystal clear from the start of the project to the end of the project. However, the path towards the goal changed along the way. Inkpen and Tsang (2005) argues that a clear and common goal among the partners reduces inter-organisational conflicts and that if conflict surface, they should be negotiated. There could have been more conflicts but according to one of the interviewees, the small disputes that surfaces throughout the project was solved by *"effective communication*" There was no indication that the partners forced their solutions onto the other project partners. If this would have been the case, it can be a source of conflict (Inkpen & Tsang 2005). In pilot LNG, it was stated that many of the involved personnel was changed along the course of the project. Newell and Swan (2000) argues that companion trust, which can be related to inter-personal trust is developed over time as the people interact and get to know each other. The high turnover of individuals in Pilot LNG could have undermined the establishment of inter-personal trust and personal friendship and in the long run, harm the partnership. But since the project spanned over 3-4 years it can be argued that these types of changes are inevitable.

It was found that there were differences in company culture in the FLEXI project. These were the result of two shipping companies with different modus operandi that were tasked with working together in a joint-venture. An interviewee stated that this was challenging for the inter-project relationships, but were necessary for the project to continue. Not only were there cultural differences between the parties, but also a geographical distance which hindered them, which is a restricting factor for knowledge flow (Mowery et. Al 1996). According to Knoben and Oerlemans (2006), such barriers can be overcome if there is a mutual understanding and shared culture between parties. It was perceived that the two shipping companies had not been able to adequately fulfill these criteria. It can be discerned from the theory of the knowledge spiral (Nonaka et al. 1996) that physical distance matters less in the combination phase, as it can be overcome by IT systems such as file sharing or email. However, as has been pointed out,

mutual respect and trust is built by working together closely (Nonaka & Konno 1998). As one of the shipping companies only joined the project after the initial study, this might have hampered their opportunity to build a relationship in a close vicinity during the start-up of Pilot LNG. While there were similar geographical distances and cultural differences in the LNG CONV project, partners worked together from the outset of Pilot LNG. They also had prior business conducted between parties in the JIP. They had thus built relationships and trust before the project even started, in other words come far in the process of collaboration (Ring & Van de Ven 1994) which enabled them to work efficiently despite the differences in distance.

Trust and knowledge creation

Trust is an important part of the KC process according to Nonaka et al. (2000). As Nonaka's theories regarding IOC mostly are written on an intra-organisational level, the translation to an IOC may affect the required level of trust, as there may exist barriers between organisations that you would not find between different departments within an organisation. Even if KC in an IOC is one a level farther in Nonaka's knowledge spiral (1996), with knowledge flowing between organisations, the personal exchange of tacit knowledge between individuals is still the cornerstone for KC. In the case of Pilot LNG, it is suggested that knowledge was created continuously throughout the project process, but likely started with the pooling of resources on a group level and thus started in the externalisation phase rather than the socialisation phase. However, the actual use and creation of new knowledge most likely happened in the "hot phase" of JIPs such as LNG CONV, when the project team worked intensely along each other during the actual conversion of Fure West. This "hot phase" shares many similarities to the socialisation phase described by Nonaka et al. (1996).

In knowledge theory, it is possible for knowledge to be created even in an environment with a low level of care, a concept which includes trust (von Krogh 1998). However, such an environment puts a limit on the creation of new knowledge, as the involved parties are characterized by a reluctance to share knowledge if there are no clear benefit or gain for themselves. When mutual trust is high and the environment of the project is supportive and caring, von Krogh (1998) argues that increased levels of KC is observed, as the knowledge bearers are more willing to share their knowledge, because it is encouraged by the environment and KC often is one of the explicit objectives in the project. In the case study of Pilot LNG and its sub-project, there were several instances when interviewees described the importance of feeling that you gain as much as you give, even by the project members who are most enthusiastic about the KC component of the project. This indicates that there are still reservations to how open partners should be in an IOC and how much trust can be put in partners outside of your organisation. The literature stipulates that this can have an adverse effect on KC. During the case study, it was found that the reservations to sharing existed more on the level of Pilot LNG than between the project partners in the JIP's. This is natural, as the members of a JIP work together and share information and knowledge on a more intimate level. Thus, the originating *'ba'* which can only emerge organically, is much stronger within the JIP than outside in Pilot LNG. According to Nonaka and Konno (1998), it is in this space that the care and trust between members emerge. In Pilot LNG, where knowledge creation transitions mainly

exist on an externalisation or combination level, the corresponding *'ba'* should be created by the project members and leaders of the organisations. The reservation to sharing by members indicate that these *'ba'* were not as developed as they could be, in accordance with Nonaka and Konno (1998). However, there is an important distinction to note here, as the fact that there are fundamental and inherent difference between an IOC and a collaboration inside an organisation regarding the required levels of trust and shared values.

Reciprocity

It was found that there exists an ambiguity regarding the subject of sharing the knowledge that is created in the sub-projects of Pilot LNG. While it is acknowledged on a JIP-wide level that the sharing of the knowledge is an important part of the process, in accordance with the theory of Nonaka et al. (1996), some reservations were found regarding about the sharing of findings on a Pilot LNG level. There were concerns regarding the fact that consultancy firms would take the tacit knowledge from the projects and bringing and transferring the tacit knowledge from Pilot LNG into other projects with competitors, thereby diminishing the competitiveness of the participants. This phenomenon has been observed by Baldwin and von Hippel (2011) and is a valid concern. This is a possible future scenario, but it is also one of the explicitly stated objectives of ZVT, which the participating organisations. As some interviewees point out, for the projects to be profitable, the infrastructure and market for LNG as a maritime fuel must grow. It seems as if those that raises the concerns are aware of this, but that it is difficult to balance the risk of short-term losses with the hypothetical long-term gains. One interviewee would have preferred ZVT as the project leader, even though they have the previously stated intent of sharing the findings from the project, in form of written reports, conventions and websites. This strengthens the finding that the participant thinks that tacit knowledge is more potent than explicit, as the consultancy firm was more involved in the projects than ZVT, who only disseminates the findings reported by the projects.

If was found that the companies in the shipping industry on the west coast of Sweden are willing to share technical solutions regarding safety. It was also stated that technical solutions were shared in Pilot LNG in accordance with the written contract from INEA. However, none of the commercial aspects of vessel converted and the LNG bunker vessel built were not discussed or shared in Pilot LNG. This practice has been applied in the west coast shipping cluster for many years. It can be argued that the borders between the technical solutions created and the commercial aspect of the technical solutions created are not distinct but instead diffused and unclear. If it would have been an intra-organisational collaboration, it is probable that there would be less restrictions regarding the sharing of commercial aspects of the knowledge creation. The fact that commercial aspects of the solutions are withheld may have been a contributing factor to less knowledge creation in Pilot LNG and the sub-projects. Nonaka and Konno (1998) withholds that one of the most essential aspects for creating a *'ba'* where knowledge can be articulated is an open and progressive environment. As information is withheld during the meetings in Pilot LNG, it is possible that the KC shit is inhibited.

6.3 Communication

The group meetings for Pilot LNG was held several times per year, approximately every second month. An invitation was sent out to all the participants, and the organisations could decide for themselves if they wanted to attend or not. According to Huxham and Vangen (2000) this open structure has some disadvantages. In this case, it can be somewhat problematic to coordinate and implement actions if the meetings contain different individuals from time to time. For the communication to be efficient, the IOC structures needs to be established early in the collaboration. The IOC structure is something that needs to be coordinated early in the collaboration to enable efficient communication throughout the whole project phase (Hardy et al. 2003). This means that the open structure could have inhibited the development of the communication structures. Instead a tighter structure would preferably have been used early in project to build a foundation for all the upcoming communication throughout the project. On the other hand, within the JIP LNG CONV it was more a tight structure (Huxham & Vangen 2000) where all participates attended the group meetings. One can argue that the Pilot LNG meetings held ones every second month should have been of a tight structure to enable communication and indirectly an efficient IOC and KC. Viewed from another angle, it can be said that at least some communication channels was already established prior the start Pilot LNG since many interviewees stated that they already knew who in an organisation to contact if an issue raised. But this could not have been the case for all partners in Pilot LNG. The number of JIP leader changes throughout the project might also have had an impact on the efficiency of the communication (Hardy et al. 2003), since the succeeding JIP leader have missed the early stage during the IOC structure developments. The open structure and the "ZVT days", where the participants socialised in informal settings can however have helped to create the aforementioned *'ba'* where the tacit knowledge of the participants is voiced and made explicit (Nonaka & Konno 1998). As ZVT was present and gathered the knowledge from these events, the findings could be disseminated effectively and conveyed to the industry, authorities and the public. As had been previously mentioned, this was an important objective for Pilot LNG, in order to show that LNG is a viable alternative fuel source. An central part of a project is the final evaluation, where the outcome and learnings can be discussed. It was found that this had not been done in the case of Pilot LNG, partially because the sub-projects continued due to delays after Pilot LNG was officially finished. The evaluation is valuable because it presents an opportunity for participants to voice their feedback and possible improvements for the next collaboration, which is of value from a KC standpoint as it can be brought into the next iteration of the knowledge spiral (Nonaka, 1996).

Communication channels

The sub-projects of Pilot LNG were found to have several communication channels. Unlike Pilot LNG, the communication was of a more closed structure in accordance with Huxham and Vangen (2000), with regular meetings held in connection the larger Pilot LNG meetings, and also regular communication, both through face-to-face meetings and via telephone and email. LNG CONV followed the line of recommendation by Panteli and Sockalingam (2005) that, even if there are various technological substitutes and alternatives to conventional face-to-face

interactions, the participants in a project should meet in person in the beginning of a project. It is in this initial phase where the participants set a structure for communication to be able to meet the common objectives (Gray 1989). These initial meetings laid ground for the continuation of the project. The structures and means that was set for the LNG CONV was the use of Webex, a video conference tool for meetings, the usage of phone for urgent discussions, a file sharing platform and other data and email. As Panteli and Sockalingam (2005) argues, these types of IT substitutes instead of conventional interactions will be more efficient after the first meetings, were the project framework is set. However, in accordance with Ansell and Gash (2008), there should be continuation face-to-face meetings throughout the whole collaboration, something which LNG CONV have managed to fulfill by meeting in person at different locations relevant to the project at a regular interval. Panteli and Sockalingam (2005) also say that the communication should revert to face-to-face communication at the end of a project. LNG also did this during the so-called "hot phase", where they had daily meetings in person on the conversion site. Since the frequency of how often the partners interact and meet have an obvious effect on the overall process and result of the collaboration (Vangen et al. 2015), one can argue that the line of communication has been well structured in the LNG CONV project, and that it gave opportunity for KC between the project members. It is argued that the project followed the knowledge spiral presented by Nonaka et al. (1996) when engaging in close discussion during the initial phase of the project, which not only gave birth to knowledge about the project proceedings, but also helped to build the previously mentioned *'ba'* that incorporates the mutual trust (von Krogh 1998) to be able to substitute some of the close proximity interaction with the use of technology-mediated communication. It is unclear whether it was intentional or not, but it can be argued that the initial and the "hot phase" were the phases when most of the KC was created. This is because the possible future issues and solutions were presented and discussed in the initial phase, and during the "hot phase" of the conversion, issues were continuously encountered and dealt with by the project team. As the team reverted to mainly face-to-face communication, potential issues with a lack of communication were avoided.

There has been various takes on what role ZVT has played in the projects. In accordance with Huxham (1996), a collaboration can achieve a result of a greater magnitude, for not just the partners in the collaboration, but also for the society. ZVT might have been the function to communicate and disseminate the knowledge created by converting it into a more comprehensible material which the public can understand. The public interests of LNG might have acted as a driver for other companies to invest and contributing to the LNG infrastructure, which is better for the health of the inhabitants of coastal cities. When looking at the communication of ZVT from a KC perspective, ZVT plays the role of combinator (Nonaka et al. 1996), gathering as much as of the knowledge as possible from the projects and spreading it through their channels to the public and industry. However, the act of assimilating the knowledge created in the Pilot LNG has to be done by the industry. At that point, it can be argued that the scope of ZVT has been fulfilled. Without this type of communication to the public, the outcomes from Pilot LNG might not transform from an invention to an innovation that fits the market.

6.4 Implications of Pilot LNG

In the projects and undertakings that followed LNG CONV, it was found that it was easier and quicker to start-up new projects due to the trust that was built and continued from LNG CONV, something that is supported by Vangen and Huxham (2003b). One of the reasons for the continuation project ENVISWITCH was that some new objectives crystallised throughout the project that was found to be important for the advancement of LNG as an alternative to fuel. It was to be done not only for LNG CONV but for Pilot LNG and for the industry, hopefully providing a benefit that is greater than just for the collaborative partners, much as Huxham et al. (1996) proclaims. Indeed, the combination of findings from JIPs, with FLEXI in the lead, gave rise to new solutions such as a suggestion for a new industry-wide standard for hoses when bunkering LNG from ship-to-ship. Additionally, in the HAZID conducted during the ENVISWITCH, there were participants and observers from EU countries, which indicates that there is a greater interest for the projects connected to Pilot LNG from a societal sustainability perspective. As mentioned before, SO_x, NO_x and particle emissions are basically eliminated when using LNG as a fuel (Bengtsson et al. 2011). As has been mentioned, ZVT has had an important role to play when it comes to disseminating the findings on a wider level, but as one interviewee pointed out, the knowledge spread is not comparable to what you get by participating in the actual collaboration. This can be seen through the order of six new LNG fueled vessels by the shipping company in LNG CONV, where the knowledge gained from LNG CONV and Fure West is absorbed into the company and internalised. The findings will be useful for the coming vessels and is an excellent example of the SECI-model (Nonaka et al. 1996), with close collaboration and face-to-face interaction between participants in LNG CONV, and a conversion from tacit to explicit when solutions to found issues where voiced. These were then discussed and brought into a greater context in Pilot LNG. Finally, the matured knowledge is brought back into the company.

During the thesis work, changes of scope and orientation alterations were made as new knowledge about the thesis subject were found. The progress of the thesis was monitored by the supervisor during the thesis work, helping the authors stay within the scope. It was first intended to use a multiple-case study design, but this was changed to a single case study design with two embedded units of analysis. This might have had an impact on the quality of the study since Yin (2009) argues that findings from a single case design is weaker than from a multi-case design. A reason for the choice include another level of analysis is that one of the cases, FLEXI, is lacking enough data to make a full analysis and discussion. Instead a lot of data emerged from the Pilot LNG level of analysis. Due to this change, more data was available to support the analysis and discussion of Pilot LNG and the two sub-projects. In the end, this thesis only investigates one case, instead of two, which was first intended. Therefore, the results from this study cannot be generalized and applied to another setting. To increase the robustness of this this thesis, the authors should have investigated a project similar to Pilot LNG, also containing multiple sub-projects. For example, the sister projects, Pilot Methanol and Pilot Scrubber which are also included in the ZVT portfolio. However, investigating one of them would include investigating two more sub-projects like LNG CONV and FLEXI which would be too time consuming for the scope of this thesis.

The intension was to use three different sources of evidence in the case study. Unfortunately, it was not possible to conduct any direct observations in the two sub-projects of Pilot LNG. LNG CONV was completed in 2016 prior to the initiation of this thesis and factors such as timing, time restraints and limited access hindered its conduction in the other sub-project. This will affect the quality of the data triangulation since one less source of evidence is used to confirm the findings and facts from the interviews and documentation (Yin 2009). It would have provided a greater practical understanding of how the meetings and communication functioned within the projects. However, most of the documentation used in the case study was not separate sub-studies but instead confirms and strengthen many of the findings from the interview. The data have still, so some extent, been triangulated but not as intended prior to the data collection. The interviews and documentation used is to be considered highly relevant for the case study, as the interviewees had senior positions and were directly involved in the projects and the documentation was officially recorded.

6.5 Research question discussion

In the previous discussion, the three parameters that were found has been examined and the findings have been connected to the theoretical framework. What follows is a brief discussion of how the presented research questions can be answered, by considering the data and the previous research in the areas of IOC and KC.

What parameters exist within inter-organisational collaboration for knowledge creation and what factors of these parameters affect the success of these collaborations?

It was found that there is a strong indication that new knowledge and innovation was created in the Pilot LNG project. It has been shown that there are steep barriers for KC to take place in an IOC than within an organisation, and that there is a greater demand on the partners involved in the collaboration. Three parameters have been found that are especially important for the successful creation of knowledge in an IOC, found in the intersection of IOC and KC. These are *leadership & organisation, trust* and *communication.* Within these parameters, a few key factors were found to be of extra importance for the projects of the conducted case study. These have been discussed earlier in this chapter, and is summarised in Figure 15, together with an illustration of how the results fits with the identified theoretical gap. It was found, that setting clear objectives in an early stage helped to facilitate the required *'ba'* for knowledge creation. It was also found that the emphasis on a looser leadership style in LNG CONV helped to promote the flow of knowledge between the participants. Overall, there were a closer sense of understanding and mutual trust found in the JIPs, not just between the organisations but also between the project members. This was found to a lesser degree in Pilot LNG, which reinforces the theory that the main collaboration and KC happens in the JIPs or the so called sub-projects. This is further strengthened by the open and honest environment that was described by the interviewees. It was described that the phases were most knowledge were created was characterised by personal meetings and face-to-face communication, which is in-line with the theoretical frameworks. The three parameters were found to be linked, as they all were found to be factors that fed on each other and were interdependent. For example, the looser leadership

roles were only possible because of the mutual trust between participants, and the flat leadership organisation helped build trust between the partners.

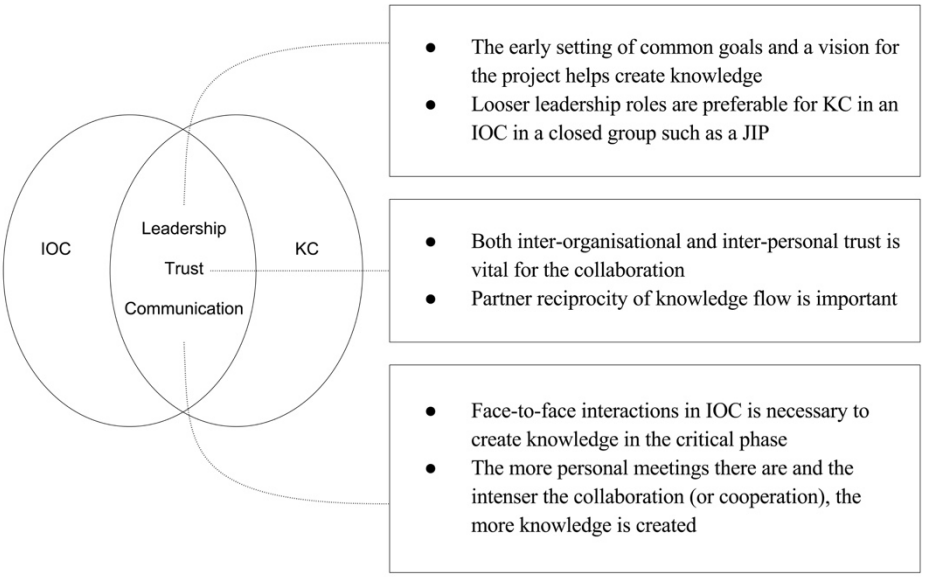


Figure 15 Interactions between IOC and KC (author illustration 2017)

How has the Zero Vision Tool collaboration platform enabled the creation of new knowledge in the Swedish shipping industry?

The conducted case study suggests that the ZVT platform has driven the development towards a more sustainable practice in the Swedish shipping industry. As has been mentioned previously in this chapter, the knowledge has, in accordance with Nonaka et al. (1996) and Huxham et al. (1996), for the most part been created in the sub-projects and not on the level of Pilot LNG. It is in the sub-projects where the above stated factors of the parameters were most prominent. However, it has been argued by the interviewed participants that the ZVT platform has played an important role as supporters and enablers, for example in LNG CONV, to support for knowledge creation, that otherwise would not have been created. First of all, it was found that the funding from INEA would probably not have been granted if ZVT had not brought together all sub-projects and have labelled them Pilot LNG before presenting them to the INEA in the first place. In accordance with Huxham and Vangen (2000), the structure of Pilot LNG and the workshops and meetings have functioned as a forum where the difficult issues in LNG CONV collaboration was ventilated with other industry professionals. According to the interviewees, LNG CONV could also ventilate issues that they could not solve by themselves with a reference group, put together by ZVT, containing prominent stakeholder from both the government, non-governmental organisations and industry. It was found that this reference group could take the issues further up to Swedish maritime authorities which in turn can raise awareness on an international level. This is suitable for an international industry such as shipping. Another important function of ZVT is to disseminate the findings to followers, stakeholders and the public in a graspable format. Since the completed products in Pilot LNG are part of and dependent on the continued development for a sustainable LNG infrastructure, it is very important that the LNG in general attracts more stakeholders and investors to get the synergy

of a network effect. In other words, the finished products of Pilot LNG will need followers to be considered innovations. Figure 16 below attempts to visualise this.

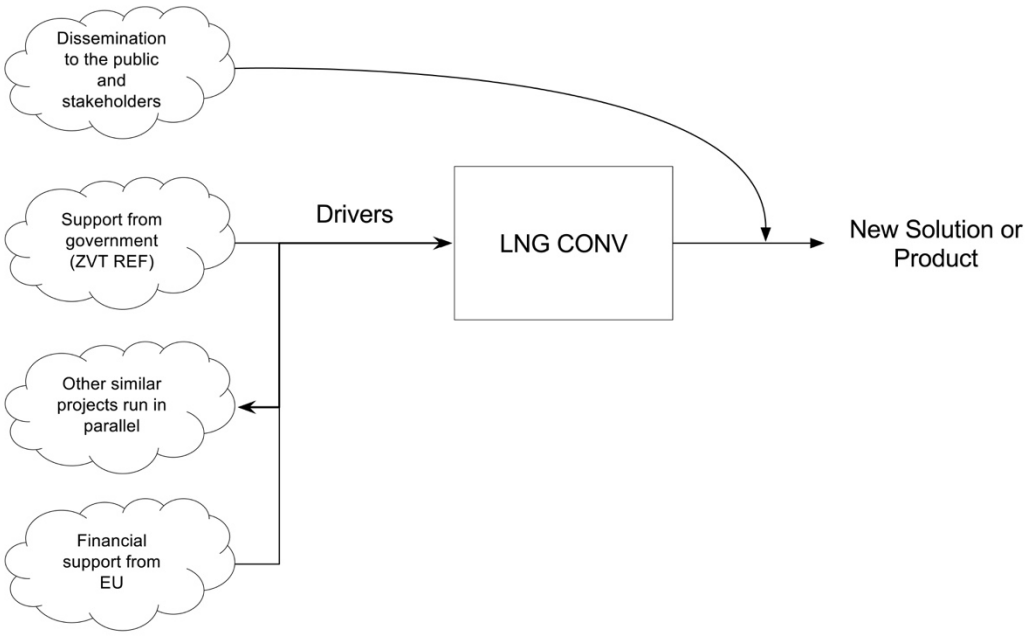


Figure 16 How ZVT has driven KC and innovation in the Swedish shipping Industry (author illustration 2017)

The ZVT platform have acted as a supportive platform for Swedish shipping companies. It has in some ways helped them to stay or become more ambidextrous in accordance with O'Reilly and Tushman (2004), and focus on exploring for new solutions and at the same time exploiting their core business. With this line of argument, ZVT platform has played an important role in the development of a more sustainable shipping.

7 Conclusion

The purpose of this thesis was to investigate how an inter-organisational collaboration for innovation works, by conducting a case study on Pilot LNG, a collaboration for LNG fuel in the Swedish shipping cluster. Pilot LNG was initiated by Zero Vision Tool, a Swedish platform with the purpose of promoting sustainable shipping initiatives. A theoretical gap regarding what aspects influence such a collaboration was found by the thesis authors. Three parameters that connects the two research fields were identified; *leadership & organisation, trust* and *communication*.

The study concludes that the Zero Vision Tool platform has had a positive effect on the development and creation of new knowledge in the Swedish shipping industry to help find new solutions to meet the stricter sulfur regulations. Zero Vision Tool strives to be a collaborative platform for knowledge creation and sharing in joint industry projects. However, in Pilot LNG, it may not have operated as it is intended to. The findings show that the knowledge creation is found inside the joint industry projects themselves, and especially in the "hot phase" and not in the structure of Zero Vision Tool. Their role has instead been to disseminate information from the joint industry projects, and to act as a supporting function to the joint industry projects. The information that Zero Vision Tool have disseminated through conferences, webpages, videos and printed material cannot be seen as knowledge creating activities in themselves, but instead knowledge and information sharing activities that may be part of a knowledge creating process. Zero Vision Tool can on the other hand be seen as an incubator for many of the successful projects, an initiator making the projects possible. But in the end, the new knowledge has been created in the collaborating sub-projects that has shown elevated levels of trust between partners as well as effective communication and an organised leadership structure.

Knowledge creation, especially in an environment with multiple stakeholders from different organisations, is a complex process. Knowledge is continuously created throughout the collaboration process, on different levels, between project members and between organisations. It is therefore difficult to observe or even describe the knowledge creation process, and models of it should be used as approximations and guidelines. It is more practical to discuss the internal and external environment needed for knowledge creation, in this thesis called *'ba'*. The found *parameters leadership & organisation, trust* and *communication* are all important for the creation of knowledge, more so in an inter-organisational collaboration than its intra-organisational counterpart, as inherent differences between organisations in general places a higher demand on the organisation of the collaboration, with regards to the parameters. In the case study, there were perceived issues regarding some of the leadership, but this was somewhat mitigated by very high levels of trust and effective communication. A successful collaboration for innovation relies on openness, something that were present to some extent in Pilot LNG. However, if you share your knowledge and resources, it is expected that you should also be returned in kind.

Looking at Pilot LNG from a broader perspective, and comparing it to other industries joint projects it can be argued that the timeframe from start to finish have been too tight. The project lasted for a total of four years, which can be compared to the automobile industry's competence center SAFER. It is also a collaboration center including partners from academia, industry and public organisation. That organisation have been established for more than ten years, which is a suitable timeframe to be able to build trust, communication structures and leadership. Pilot LNG on the other hand started in 2011 and Pilot LNG spanned over a four-year period, which is very short compared to the scope of the project. As has been mentioned, Zero Vision Tool lost their financial support from the Swedish maritime administration in 2017. Since this type collaboration structure seldom can bear its own costs, the future of the Zero Vision Tool platform is uncertain. The authors believe that this withdrawal of financial support will, in one way or another, hamper the development of sustainable shipping in the Swedish maritime sector.

7.1 Concluding remarks and further research

It is difficult to place initial value on new knowledge. It may come into fruition and become a new, valuable asset for the company, or it may be a waste of time and resources. Because of this, there will always be a certain risk associated with being an innovator or leader of an industry, which means that commitment becomes important. It must be mentioned that the Swedish west coast shipping cluster have been endorsed with several entrepreneurial, next generation and innovative rewards awards, both locally and internationally. Although the Swedish shipping industry have internationally been viewed as one of the progressive leaders when it comes to energy efficiency, sustainability and more environmentally sustainable solutions, the industry needs to look for new means to continue on that path. It can be suggested that the actors in the Swedish shipping industry should open up even more, and move away from the belief that to give, you must get something in return. If they dare to move further away from the organisational borders, there might be unknown opportunities. As for now, shipping companies go into collaborations with a clear picture of what they will achieve at the end of the projects. Maybe move into the waters of open innovation in an industry where it is not commonly used or initiate collaborations where the outcome is unknown, making something up as the collaboration moves along.

The findings from this thesis can, as previously mentioned, not be generalized, therefore the authors suggest that more case studies should be conducted in a similar setting. It is suggested that investigating Pilot Methanol and Pilot Scrubber which are two sister projects to Pilot LNG, and investigate if similar interaction between the three parameters: leadership, trust and communication are present there. Extended studies of how these interact with each other in other industries should also be conducted if the findings in this thesis are to be generalized.

Personal reflections

This thesis has been both demanding and challenging for the authors, both from an endurance and a cognitive perspective. The thesis has allowed the authors to widen their understanding on

the theory of inter-organisational collaboration and knowledge creation. Although the authors have encountered inter-organisational collaboration and knowledge creation in multiple courses throughout their master studies, the understanding of the two fields was limited prior to the start of this thesis. Writing this thesis has defiantly helped the authors to increase their theoretical skills which they can hopefully will bring into their future career.

References

Alavi, M. & Leidner, D.E., 2001. Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *MIS Quarterly*, 25(1), pp.107–136.

Alter, C. & Hage, J., 1993. *Organizations working together*, Newbury Park, CA: Sage Publications.

Ansell, C. & Gash, A., 2008. Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory*, 18(4), pp.543–571.

Baldwin, C. & von Hippel, E., 2011. Modeling a Paradigm Shift: From Producer Innovation to User and Open Collaborative Innovation. *Organization Science*, 22(6), pp.1399–1417.

Bartolacci, C. et al., 2016. Ba virtual and inter-organizational evolution: a case study from a EU research project. *Journal of Knowledge Management*, 20(4), pp.793–811.

Beckman, S.L.S. & Barry, M., 2007. Innovation as a Learning Process: embedding design thinking. *California Management Review*, 50(1), pp.25–56.

Bengtsson, S., Andersson, K. & Fridell, E., 2011. A comparative life cycle assessment of marine fuels: liquefied natural gas and three other fossil fuels. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, 225, pp.97–110.

Bryman, A. & Bell, E., 2015. *Business research methods* 4th ed., Oxford: Oxford Univ. Press.

BSP, 2009. Baltic Sea Position – Zero system co-operations! Available at: http://balticseaposition.eu/ [Accessed January 31, 2017].

Chesbrough, H., 2003. The Era of Open Innovation. *MIT Sloan Management Review*, 44(3), pp.35–41.

Cohen, W.M. & Levinthal, D.A., 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35(1), pp.128–152.

Darabi, F. & Clark, M., 2012. Developing business school/SMEs collaboration: The role of trust. *International Journal of Entrepreneurial Behaviour & Research*, 18(4), pp.477–493.

Dodgson, M., 1993. Learning, Trust, and Technological Collaboration. *Human Relations*, 46(1), pp.77–94.

Drucker, P.F., 2007. *Innovation and entrepreneurship: practice and principles* 2nd ed., Oxford: Butterworth-Heinemann.

Easterby-Smith, M., Thorpe, R. & Jackson, P.R., 2015. *Management and Business Research* 5th ed., London: SAGE.

European Commission, 2014. *LNG Bunkering Infrastructure Solution and Pilot actions for*

Ships operating on the Motorway of the Baltic Sea,

Gallaud, D., 2013. Collaborative Innovation and Open Innovation. In *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship*. pp. 236–241.

Gomes-Casseres, B., 2003. Competitive advantage in alliance constellations. , 1(3), pp.327–335.

Gray, B., 1989. *Collaborating: Finding common ground for multiparty problems* Jossey-Bass, ed., San Francisco.

Hamel, G., Doz, Y.L. & Prahalad, C.K., 1989. Collaborate with your competitors and win. *Harvard Business Review*, pp.133–137.

Hardy, C., Phillips, N. & Lawrence, T.B., 2003. Resources, Knowledge and Influence: The organizational effects of interorganizational collaboration. *Journal of Management Studies*, 40(2), pp.321–347.

Herriott, R.E. & Firestone, W.A., 1983. Multisite Qualitative Policy Research: Optimizing Description and Generalizability. *Educational Researcher*, 12(2), pp.14–19.

Herzog, P., 2008. *Open and Closed Innovation* 1st ed. D. T. Gabler, ed., Wiesbaden: Betriebswirtschaftlicher Verlag.

Hislop, D., 2010. Knowledge management as an ephemeral management fashion? *Journal of Knowledge Management*, 14(6), pp.779–790.

Hocker, J.L. & Wilmot, W.W., 1985. *Interpresonal Conflict* secound. W. C. Brown, ed., Dubuque: IA.

Holzner, B. & Marx, J.H., 1979. *Knowledge application: The knowledge system in society*, Boston: Allyn and Bacon.

Huxham, C. et al., 1996. *Creating collaborative advantage* 1st ed., London: Sage Publications.

Huxham, C. & Vangen, S., 2000. Leadership in the Shaping and Implementation of Collaboration Agendas : How Things Happen in a (Not Quite) Joined-up World. , 43(6), pp.1159–1175.

INEA, 2017. Innovation and Networks Executive Agency. Available at: Innovation and Networks Executive Agency [Accessed May 2, 2017].

Inkpen, A.C. & Tsang, E.W.K., 2005. Social Capital, Networks, and Knowledge Transfer. *The Academy of Management Review*, 30(1), pp.146–165.

Järrehult, B., 2011. Open Innovation: To Cooperate or Collaborate –That is the Question. *Innovation Managment*. Available at: http://www.innovationmanagement.se/2011/08/08/open-innovation-to-cooperate-or-collaborate-that-is-the-question/ [Accessed April 6, 2017].

Kalantari, J. et al., 2015. *LNG Bunkering Infrastructure Soultion and Pilot actions for Ships*

operating on the Motorway of the Baltic Sea, Göteborg. Available at: http://www.zerovisiontool.com/sites/www.zerovisiontool.com/files/pilotlng_report_ac07_revwebaccept.pdf.

Knoben, J. & Oerlemans, L.A.G., 2006. Proximity and inter-organizational collaboration: A literature review. *International Journal of Management Reviews*, 8(2), pp.71–89.

von Krogh, G., 1998. Care in Knowledge Creation. *California Management Review*, 40(3), pp.133–153.

Von Krogh, G., Nonaka, I. & Ichijo, K., 1997. Develop knowledge activists! *European Management Journal*, 15(5), pp.475–483.

Levin, D.Z. & Cross, R., 2004. The Strength of Weak Ties You Can Trust: The Mediating Role of Trust in Effective Knowledge Transfer. *Management science*, 50(11), pp.1477–1490.

Li, M. & Gao, F., 2003. Journal of Knowledge Management Why Nonaka highlights tacit knowledge: a critical review Why Nonaka highlights tacit knowledge: a critical review. *Journal of Knowledge Management*, 7(3), pp.357–365.

Lynch, R.P., 1993. Business alliances guide: The hidden competitive weapon. *Wiley*.

Mayer, R.C., Davis, J.H. & Schoorman, D.F., 1995. An Integrative Model of Organizational Trust. *The Academy of Management Review*, 20(3), pp.709–734.

Mishra, A.K., 1996. Organizational responses to crisis: The centrality of trust. In *Trust In Organizations*. Newbury Park, CA: SAGE, pp. 261–287.

Mowery, D.C.., Oxley, J.E.. & Silverman, B.S., 1996. Strategic Alliances and Interfirm Knowledge Transfer. , 17, pp.77–91.

Newell, S. & Swan, J., 2000. Trust and inter-organizational networking. *Human relations*, 53(10), pp.1287–1328.

Nonaka, I. et al., 2014. Dynamic fractal organizations for promoting knowledge-based transformation - A new paradigm for organizational theory. *European Management Journal*, 32(1), pp.137–146.

Nonaka, I., 1991. The knowledge-creating company. *Harvard Business Review*, (November-December), pp.96–104.

Nonaka, I. & Konno, N., 1998. The Concept of "Ba": Building a foundation for knowledge creation. *California Management Review*, 40(3), pp.40–54.

Nonaka, I., Takeuchi, H. & Umemoto, K., 1996. A theory of organizational knowledge creation lkujiro Nonaka and Hirotaka Takeuchi Katsu hiro Umemoto. *IJTM, Special Publication on Unlearning and Learning*, 11.

Nonaka, I., Toyama, R. & Konno, N., 2000. SECI, Ba and Leadership: A Unified Model of Dynamic Knowledge Creation. *Long Range Planning*, 33(1), pp.5–34.

O'Reilly, C.A. & Tushman, M.L., 2004. The ambidextrous organization. *Harvard Business Review*, 82(4), p.74.

Ollila, S. & Yström, A., 2016. Anything goes? Conceptualizing different interaction strategies in open innovation. In *EEURAM conference*. Paris.

Opdenakker, R., 2006. Advantages and Disadvantages of Four Interview Techniques in Qualitative Research 2 . Advantages and Disadvantages of the Four Interview Techniques. *Forum: Qualitative Social Research*, 7(4), pp.1–9.

Panteli, N. & Sockalingam, S., 2005. Trust and conflict within virtual inter-organizational alliances: A framework for facilitating knowledge sharing. *Decision Support Systems*, 39(4), pp.599–617.

Du Plessis, M., 2007. The role of knowledge management in innovation. *Journal of knowledge management*, 11, pp.20–29.

Polanyi, M., 1966. *The Tacit Dimension* 1st ed., London: Routledge & Kegan Paul.

Popadiuk, S. & Choo, C.W., 2006. Innovation and knowledge creation: How are these concepts related? *International Journal of Information Management*, 26(4), pp.302–312.

Powell, W.W., Koput, K.W. & Smith-doerr, L., 1996. Interorganizational Collaboration and the Locus of Innovation : Networks of Learning in Biotechnology. *Administrative Science Quarterly*, 41(1), pp.116–145.

Quinn, J.B., 1992. The Intelligent Enterprise a New Paradigm. , 6(4), p.48.

Rice, J.L. & Rice, B.S., 2005. The application of the SECI model to multi-organizational endeavors; an integrative review. *International Journal of Organizational Behavior*, 9(8), pp.671–682.

Ring, P.S. & Van de Ven, A.H., 1994. Developmental processes of cooperative interorganizational relationsship. *Avademy of Management Review*, 19(1), pp.90–118.

Saunders, M., Lewis, P. & Thornhill, A., 2009. *Research Methods for Business Students* 5th ed., Edinburgh: Pearson Education Limited.

Seppänen, R., Blomqvist, K. & Sundqvist, S., 2005. Measuring inter-organizational trust-a critical review of the empirical research in 1990-2003. *Industrial Marketing Management*, 36(2), pp.249–265.

TEN-T, 2014. European Comission TEN-T. Available at: http://ec.europa.eu/inea/en/ten-t [Accessed May 2, 2017].

Thomson, A.M. & Perry, J.L., 2006. Collaborative Collaboration Processes : Inside the Black Box. *Public Administration Review*, 66(1), pp.20–32.

Toikka, S., 2007. ICT Supported Interorganizational Knowledge- creation: Application of Change Laboratory. *Creating New Learning Experiences on a Global Scale*, pp.337–348.

Vangen, S., Hayes, J.P. & Cornforth, C., 2015. Governing Cross-Sector, Inter-Organizational Collaborations. *Public Management Review*, 17(9), pp.1237–1260.

Vangen, S. & Huxham, C., 2003a. Enacting Leadership for Collaborative Advantage: Dilemmas of Ideology and Pragmatism in the Activities of Partnership Managers. *British Journal of Management*, 14(.).

Vangen, S. & Huxham, C., 2003b. Nurturing collaborative relations: Building trust in interorganizational collaboration. *The Journal of Applied Behavioral Science*, 39(3), pp.490–504.

Wallin, M.W. & Von Krogh, G., 2010. Organizing for open innovation: Focus on the integration of knowledge. *Organizational Dynamics*, 39(2), pp.145–154.

Yin, R.K., 2009. *Case Study Reseach: Design and Methods* 4.th edn., London: SAGE.

Zaheer, A., McEvily, B. & Perrone, V., 1998. Does Trust Matter? Exploring the Effects of Interorganizational and Interpersonal Trust on Performance. *Organization Science*, 9(2), pp.141–159.

ZVT, 2016. *Zero Vision Tool White Paper*, Available at: http://www.zerovisiontool.com/sites/www.zerovisiontool.com/files/attachments/zvt_whitepaper_dec2016_web.pdf.

Appendices

Appendix A – Interview guide

Introduction of interviewee

Can you please make a short introduction of yourself and the organisation that you represent?

Do you have any previous experience with collaborations over organisational borders?

The project

What is the role of your organisation in the project?

Why is your organisation invested or involved in the project?

What was the expected result from the project collaboration? What do you hope the project will generate?

How far have the project come to this day?

The collaboration

Can you please the describe the collaboration process with the other partners within the project?

What is your thoughts on using the Zero Vision Tool platform during this project?

What are your thoughts about the communication between yourself and the other organisations during the project?

How often do you meet in person during the project?

Are you meeting in any other setting outside of the project?

Are there any differences in values and norms between your organisations and the partners?

Please describe the greatest challenge in the project.

What role does trust between organisations have in the project?

Can you describe how the leadership is structured in the project?

Are you satisfied with the leadership in the collaboration?

Have there been any disputes during the project? If so, how were this handled?

Knowledge

What have you personally learned by being involved in this project and is it applicable for your position?

What has your organisation learned from this collaboration so far? Please provide examples.

Do you have any strategy for retain the knowledge that you have acquired from the project?

How do you document the findings from the project?

What is your organisations opinion regarding the sharing of information and knowledge with other organisations?

Closing thoughts

If you would have been the organiser and leader of the project, how you have structured it?

Are you satisfied with the project?

Do you have anything else to add regarding the project that you would like to share?

Appendix B – References and the fields of theory

	Authors	Year	IOC	KC	Leadership	Trust	Communication
1	Alavi, M. & Leidner, D. E	2001		o			
2	Alter, C. & Hage, J.	1993	o				
3	Ansell, C. & Gash, A.	2008	o		o		o
4	Baldwin, C. & von Hippel, E.	2011	o	o	o		
5	Bartolacci, C. et al.	2016	o	o			
6	Beckman, S.L.S. & Barry, M.	2007		o			
7	Chesbrough, H.	2003	o	o			
8	Cohen, W.M. & Levinthal, D.A.	1990	o	o			
9	Darabi, F. & Clark, M.	2012	o	o		o	
10	Dodgson, M.	1993	o	o		o	
11	Drucker, P.F.	2007		o			
12	Gallaud, D.	2013	o	o			
13	Gomes-Casseres, B.	2003	o				
14	Gray, B.	1989	o		o	o	o
15	Hamel, G., Doz, Y.L. & Prahalad, C.K.	1989	o				
16	Hardy et al.	2003	o	o			o
17	Herzog, P.	2008	o			o	
18	Himmelman, I	1996					
19	Hislop, D.	2010		o			
20	Huxham et al.	1996					
21	Huxham, C. & Vangen, S.	2000	o		o		
22	Hocker, J.L. & Wilmot, W.W.	1985	o			o	

23	Inkpen, A.C. & Tsang, E.W.K.	2005		o		o	
24	Jones, G.R. & George, J.M.	1998	o			o	
25	Järrehult, B.	2011	o	o		o	
26	Kaats, E. & Opheij, W	2014	o		o	o	o
27	Knoben, J. & Oerlemans, L.A.G.	2006	o				o
28	Kramer	1996					
29	von Krogh, G	1998		o		o	
30	Von Krogh, G., Nonaka, I. & Ichijo, K.	1997		o	o		
31	Levin, D.Z. & Cross, R.	2004	o	o		o	
32	Li, M. & Gao, F.	2003		o			
33	Lynch, R.P.	1993	o		o		o
34	Mayer, R.C., Davis, J.H. & Schoorman, D.F.	1995	o			o	
35	Mishra, A.K., 1996	1996	o			o	o
36	Mowery, D.C.., Oxley, J.E. & Silverman, B.S.	1996	o	o			
37	Newell, S. & Swan, J.	2000	o			o	
38	Nonaka, I.	1991		o		o	
39	Nonaka, I. & Konno, N.	1998		o			o
40	Nonaka, I., Takeuchi, H. & Umemoto, K.	1996		o			
41	Nonaka, I. et al.	2014	o	o			
42	Nonaka, I., Toyama, R. & Konno, N.	2000		o	o	o	
43	Ollila and Yström	2016					
44	O'Reilly, C.A. & Tushman, M.L.	2004			o		
45	Panteli, N. & Sockalingam, S	2005	o			o	o
46	Du Plessis, M.	2007		o			

47	Polanyi, M.	1966		o			
48	Popadiuk, S. & Choo, C.W.	2006		o			
49	Powell, W.W., Koput, K.W. & Smith-Doerr, L.	1996	o	o			
50	Quinn, J.B.	1992		o			
51	Ring and Van de Ven	1994	o	o			o
52	Rice, J.L. & Rice, B.S.	2005	o	o			
53	Ring, P.S. & Van de Ven, A.H.	1994	o				o
54	Seppänen, R., Blomqvist, K. & Sundqvist, S.	2005	o			o	
55	Thomson, A.M. & Perry, J.L.	2006	o		o	o	o
56	Toikka, S.	2007	o	o			
57	Vangen, S., Hayes, J.P. & Cornforth, C.	2015	o		o		o
58	Vangen, S. & Huxham, C.	2003a	o		o		
59	Vangen, S. & Huxham, C.	2003b	o			o	
60	Wallin, M.W. & Von Krogh, G.	2010	o	o			
61	Zaheer, A., McEvily, B. & Perrone, V.	1998	o			o	