Master's degree thesis

LOG950 Logistics

Lean procurement in global shipbuilding of high-end specialized vessels

- **a case study of Vard Group's global value chain with building location in Vung Tau**

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Preface

This master's degree thesis marks the end of a two-year MSc programme in Logistics, at Molde University College. This paper has been written through the spring semester 2015. The topic in this research was unknown for both authors. Hence, it has been both challenging and time-consuming to get a valid insight of the industry, but not least instructive. By accomplishing this research, we have obtained significant insight in the fields of lean philosophy, lean procurement, the ETO structure, global value chains and the Norwegian maritime cluster.

We would like to thank our supervisor, Lise Lillebrygfjeld Halse, for all the valuable advices, discussions and guidance she has given us through this semester. Her door has always been open when we experienced challenges respected to this research. Lise has provided us with helpful feedback, which has given us motivation for finishing this thesis.

Furthermore, we will especially like to thank our contact person from Vard Group, Håvard Vollen, for being of great help through this semester. Håvard has been available and provided all requested information. Accomplishment of this thesis would not have been possible without his help. Additionally, we would like to thank all the participating informants, who took their time for contributing to this research. Finally, we would like to thank all the people that have been around us through this semester, for giving us support and motivation.

Summary

The purpose of this research has been to contribute to the development of ETO literature. Based on this following research problem was formulated: *To what extent will lean procurement be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?* A case study was hence a suitable design for this research. The case organization used is Vard Group, and the unit of analysis their global value chain with foreign building location in Vung Tau.

In order to answer the given research problem, an extensive literature study was conducted for defining lean procurement. This research defined lean procurement by lean supplier selection, lean relationship management and lean supplier development. Five research questions were further formulated to answer the research problem using two different research designs. First a descriptive design was used to answer RQ1-2, and thereafter an explorative design was used to answer RQ3-RQ5. Qualitative methods were further used as main technique for data collection. Data was collected through interviews with informants within the case organization and one informant from a supplier organization.

The case study research has revealed two main findings, which proved to affect the applicability of the three defined lean procurement elements. The first main finding affecting the applicability of lean procurement is the ETO structure, which implies that shipowner has a final saying in decisions concerning components on the vessel, especially for the strategic components. The second main finding affecting the applicability of lean procurement for the case organization is the identified organizational strategic gap with respect to the lean implementation. Many decisions concerning procurement related activities are handled at the main office where lean thinking is not of concern. This will have significant impact on the applicability of lean procurement for the global value.

This research concludes that lean procurement in terms of lean supplier selection will to a very limited extent be applicable; whist lean procurement in terms of lean relationship management is to a limited extent applicable; and finally that lean procurement in terms of lean supplier development will be moderately applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country. The latter applicability is limited to joint improvement activities, knowledge sharing and dedicated assets, given that the entire organization is pursuing a lean procurement philosophy.

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LIST OF ABBREVIATIONS

ATO	Assemble-to-order
CIP	Cost insurance paid
CODP	Customer order decoupling point
DNV	Det Norske Veritas
ETO	Engineer-to-order
JIT	Just-in-time
MTO	Make-to-order
MTS	Make-to-stock
SCM	Supply chain management
TPS	Toyota production system
VVT	Vard Vung Tau

1. Introduction

1.1 Background and Motivation for the Thesis

The Norwegian shipbuilding industry is recognized as a high quality industry with significant reliability and competence in designing and building complex and highly customized vessels (Dugnas and Oterhals, 2008). Especially specialized vessels, including *offshore service vessels, seismic,* and similar, have been pointed out as one of the most important markets for the Norwegian shipbuilding industry, where the competence have developed over years. However, the high labour costs in Norway have over time created difficulties for the Norwegian shipyards to compete against low-cost countries, building standardised low-cost vessels (Nærings- og handelsdepartementet, 2005). Further, it has been revealed that the Norwegian shipbuilding industry has struggled to remain competitive and profitable, due to two main reasons. Firstly, the industry experienced a boom in shipbuilding contracts from 2000-2007. As a result, the Norwegian shipyards had problems in concluding projects due to lack of capacity, resulting in expensive delays and low profit margins (Aslesen, 2007). Secondly, the financial crisis, which began in 2007, led to less orders of new vessels. Due to this crisis, the competition from low-cost countries further increased (Dugnas and Oterhals, 2008; Hervik et al., 2012). However, a report from 2012 revealed that the Norwegian shipyards experienced an upturn the last few years, indicating that the activity has stabilized on a level giving improved number of concluded projects and improved profit margins (Hervik et al., 2012). The report stated that the Norwegian shipyards are in position to compete internationally in the sector of specialized vessels in the years up to 2020. The challenge, however, is for the Norwegian shipyards to exploit the international market in own advantage, where high focus is put on innovation, competence development, productivity improvement and smart logistical solutions to compensate for the high Norwegian cost level (Dugnas and Oterhals, 2008; Hervik et al., 2012). According to Dugnas and Uthaug (2007, in Dugnas and Oterhals, 2008), it has been proposed that adaptation of *lean principles* is an alternative for the Norwegian shipbuilding industry in order to address the challenges the industry is facing.

Lean is a central production philosophy, which receives increased attention from scholars and manufacturing companies aiming to raise effectiveness in production. The concept was first introduced by Toyota in 1940, referred to as the *Toyota Production System* (TPS).

The term lean derived from a study on TPS, which resulted in the book "*The Machine that Changed the World*", written by Womack, Jones and Roos in 1990 (Melton, 2005). The Western world was interested in the philosophy already in the beginning of 1980, as the automobile industry suffered from the Japanese competition in terms of low prices and great quality (Liker, 2004). Lean required only half the human effort, capital investment and manufacturing (Lean Enterprise Institute, 2009), in contrast to the mass production systems used in the Western world (Womack, Jones and Roos, 1990). Lean was used as a guideline for improving quality, productivity and flexibility (Womack, Jones and Roos, 1990), and received increased awareness after Toyota's success, which triggered a global transformation in other industries (Liker, 2004). The philosophy has been applied successfully in various industries, such as service industries, healthcare and governments (Bowen and Youngdahl, 1998; Larsson, 2008). According to Liker (2004) elimination of waste lie at the heart of lean. Lean thinking refers to all the non-value adding activities the customer is not willing to pay for as *muda*, which is the Japanese word for waste. Hence, lean starts with the customer and their definition of value. The aim of the philosophy is to eliminate waste in all aspects of the business, making a continuous flow of value adding activities.

The implementation of lean principles for the *Engineered-to-Order* (ETO) sector has been proposed in the literature. However, according to Gosling and Naim (2009), it has been questioned upon to which extent lean principles actually are applicable for the sector, as it initially was proposed as a philosophy applicable for mass production manufacturing systems (Melton, 2005). Thus, Gosling and Naim (2009) argue that an empirical research examining the identification of appropriate applicability of lean philosophy to the ETO sector is of high value. They further emphasize that the shipbuilding industry will contribute significantly to the development of the ETO literature (Gosling and Naim, 2009). The Norwegian shipbuilding industry has consolidated into the Norwegian maritime cluster, consisting of shipowners, shipbrokers, maritime consultants, equipment suppliers and shipbuilders (Oterhals, Hervik and Berem, 2014). According to Halse (2014), shipbuilders of specialized vessels in the Norwegian maritime cluster focus on innovation and differentiation, and can be characterized as ETO producers as they build their vessels with a high degree of customization for individual customers. Hence, this study will address the ETO literature development, by researching applicability of lean principles for a shipbuilding company from the Norwegian maritime cluster. Although

lean was pioneered as a manufacturing system, it has according to Melton (2005) expanded to become a philosophy applicable to all departments of the organization. Bashin and Burcher (2006) support this, by emphasizing that all subsystems within an organization, including procurement, will have to implement lean in order to achieve the maximum benefits. Melton (2005) further argues that lean needs to be applied in all aspects of the supply chain in order to be sustainable realized and to have the maximum benefits within an organization. This statement implies that lean thinking does not only consider an internal perspective within an organization, however it also requires the suppliers to be part of the philosophy to have the maximum benefits. The procurement department will hence be a vital department for an organization in order to link the internal with the external perspective.

Procurement was in 1985 identified by Michael Porter as a support activity in the *value chain*. A value chain is an organization's set of activities that are performed in order to deliver a valuable product to the end-customer. The purpose of a value chain is to identify and develop properties that can provide the organization a strategic competitive advantage (van Weele, 2014). However, modern literature argues that procurement no longer is seen as a support activity, but rather as a strategic activity in the organization (Tan, 2001; Barla, 2003). Procurement is linked to production, and has an important role for an organization's profitability (Larson, 2008). As a result from effective procurement, there are possibilities for obtaining a substantial competitive advantage (Langley et al., 2008). The procurement function extends into creating excellence in value streams, which includes the supplier network as a key for achieving competitive advantage (Hines, 1996). In lean, the supplier relationships are emphasized as important (Arnold and Chapman, 2004; Liker, 2004), where the buyer is dependent on the supplier for surviving in the increasingly competitive market (Bergdahl, 1996).

In order to face the challenge of the Norwegian cost-level and competition from low-cost countries, trends in the Norwegian shipbuilding industry have been to buy or build shipyards in low-cost countries (Nærings- og handelsdepartementet, 2005). The Norwegian maritime cluster has an innovative strength, which has been ascribed to the close geographical distance between the buyer and supplier (Halse, 2014). With a more geographically disperse value chain, with foreign production and innovation in the cluster, it will be interesting to detect to what extent lean principles are applicable for the

procurement function. Hence, the motivation for this research is to investigate to what extent lean procurement is applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country. The case organization for this study is Vard Group, where the unit of analysis will be their global value chain with foreign building location in Vung Tau. *Vard Vung Tau,* henceforth VVT, is recognized as an industry example of their lean philosophy, which has recently been implemented in their procurement department. The title of this mater thesis is *Lean procurement in global shipbuilding of high-end specialized vessels,* with the subtitle *a case study of Vard Group's global value chain with building location in Vung Tau.* Initial research revealed that there are limited research contributions associated with lean procurement. Hence, extensive work will be devoted for defining lean procurement through a literature study. Further, an empirical study will be conducted for investigating to what extent lean procurement is applicable for Vard Group's global value chain with building location in Vung Tau. Furthermore, it will be discussed *why* elements of lean procurement might not be applicable for this context. Based on this, this research will be a contribution for the ETO literature, identifying the applicability of lean procurement for an ETO producer, when the organization has a global value chain with production in a low-cost country.

1.2 Research Problem

Based on the background and motivation, this research will answer the following research problem:

Research Problem:
To what extent will lean procurement be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to evaluate the applicability of lean procurement, it will be necessary to divide the study into two research designs. First, two descriptive research questions will be examined. These research questions are specifically related to the case organization:

RQ1:
Where in the case organization's value chain are procurement activities conducted?
RQ2:
How is lean procurement reflected in the case organization?

Given the nature of the research problem, the aim for this research is to evaluate the applicability of *lean procurement* for a *global ETO producer,* with building location in a low-cost country. Due to the complexity related to global ETO production, it will be necessary to describe the identified value chain in order to detect where procurement activities are conducted. As stated in the introduction, VVT have recently implemented lean philosophy in their procurement department. Hence, it is necessary to describe how VVT identify lean procurement, and further describe how this is reflected in the entire case organization. A sub-conclusion will be provided for each of the research questions. The sub-conclusions will lay foundation for remaining research.

Second, three explorative and more general research questions will be examined. In order to evaluate the applicability of lean on procurement, it was necessary to define *lean procurement* for this research. The literature study presented in chapter 2, defines lean procurement by *lean supplier selection, lean relationship management* and *lean supplier development*. A detailed review of respective elements are given in the literature study, see chapter 2.3. The literature study concerning the elements of lean procurement will together with the empirical study create a foundation for discussions and an answer to the research problem.

RQ3:
What characterizes lean supplier selection, and to what extent will lean supplier selection be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to answer the third research question, literature related to lean supplier selection will be reviewed. Further, the case organization's processes related to supplier selection, when building in Vung Tau, will be identified and mapped through interviews with key informants in the value chain. Further, the processes will be analysed in order to give an evaluation of to what extent lean supplier selection is applicable for the identified value chain. In addition, it will be evaluated why this literature may not be applicable.

RQ4:
What characterizes lean relationship management, and to what extent will lean relationship management be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to answer the forth research question, literature related to lean relationship management will be reviewed. Thereafter, the case organization's processes related to relationship management, when building in Vung Tau, will be identified and mapped through interviews with key informants in the value chain. Further, the processes will be analysed in order to give an evaluation of to what extent lean relationship management is applicable for the identified value chain. In addition, it will be evaluated why this literature may not be applicable.

RQ5:
What characterizes lean supplier development, and to what extent will lean supplier development be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to answer the fifth and final research question, literature related to lean supplier development will be reviewed. Thereafter, the case organization's processes related to supplier development, when building in Vung Tau, will be identified and mapped through interviews with key informants in the value chain. Further, the processes will be analysed in order to give an evaluation of to what extent lean supplier development is applicable for the identified value chain. In addition, it will be evaluated why this literature may not be applicable.

This research aims to contribute for the development of ETO literature, where it has been questioned upon to what extent lean principles are applicable for the ETO sector (Gosling and Naim, 2009). The research has a two-folded structure. RQ1-2 are of descriptive nature, laying foundation for the remaining research. RQ3-5 are of explorative nature, where the research will examine the case organization's processes with respect to the three elements used for defining lean procurement: lean supplier selection, lean relationship management and lean supplier development. Based on the result, the research will answer the research problem by evaluating the applicability of lean procurement for a global shipbuilder, building high-end specialized vessels in a low-cost country. The research will give an evaluation of to what extent lean procurement is applicable, and *why* applicability of lean procurement might be a challenge.

1.3 Limitations of the Research Problem

Due to the limited time scope for this research, it is necessary to narrow the research down. According to Johannesen, Schjølberg and Vik (2013)[1], elements of lean procurement should be applied on products where quality, reliability and responsiveness are the most important attributes. This corresponds to Caniëls and Gelderman (2005), who propose a management strategy for strategic suppliers, where goal is to obtain improvements in quality, delivery, reliability, lead-times, product development, product design and reduction of costs. Hence, this research will explore to what extent lean procurement may be applicable based on the *strategic components* for the case organization. Literature concerning strategic components is further presented in section 2.2.2.

[1] This paper was available through the permanent link: http://hdl.handle.net/11250/266533, until May 2015. However, the paper is now marked as confidential.

1.4 Structure of the Research

The following figure illustrates how the different chapters in this research are linked together for answering the research problem:

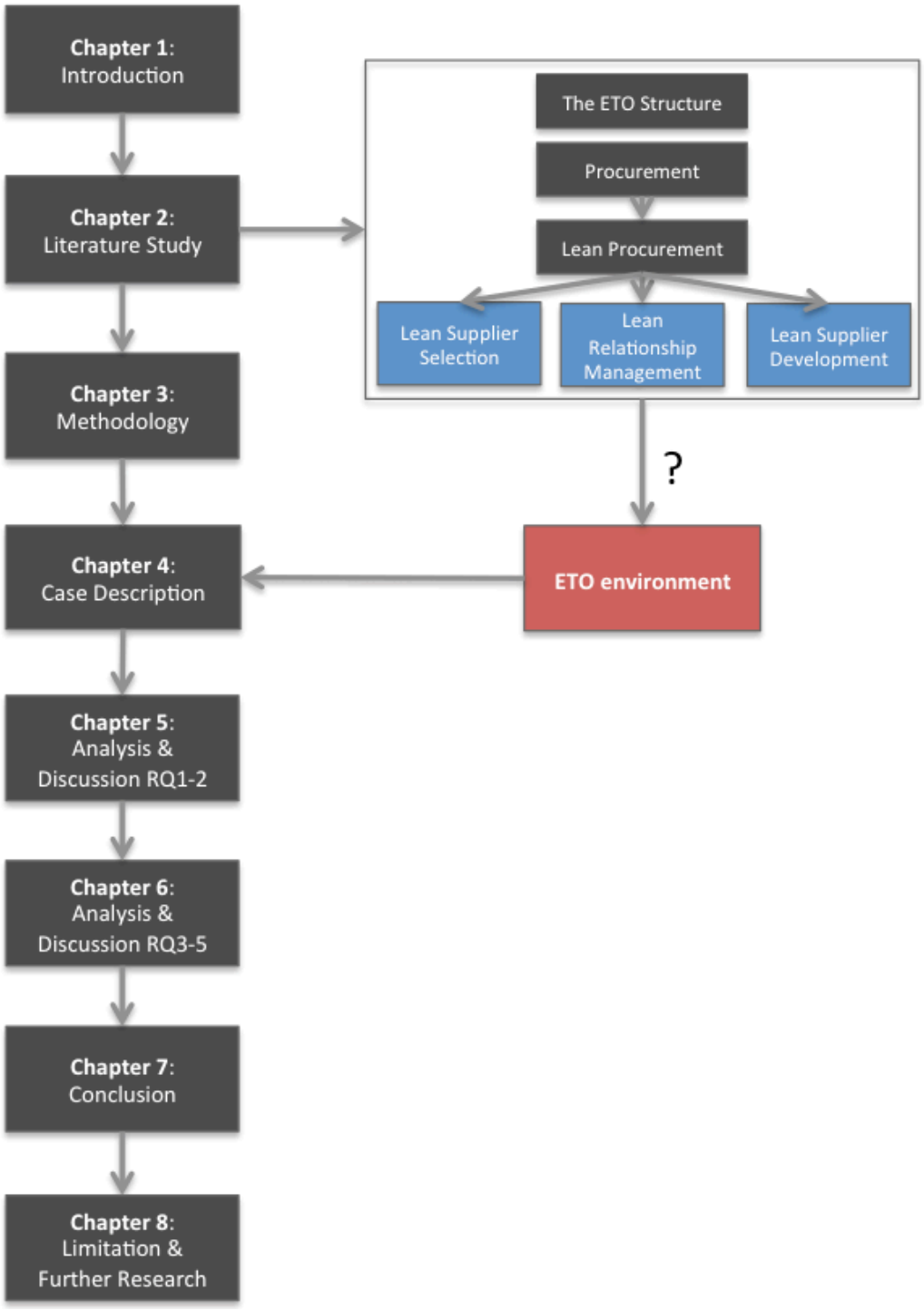

Figure 1.1: Structure of the research

The first chapter contained a motivation and background for the research, where the research problem was further formulated with associated research questions. It was identified that a literature study concerning lean procurement will lay foundation for analysis and discussion of the research question in order to answer the research problem.

Chapter 2 presents the literature study. First, ETO and procurement literature is identified. Thereafter, the elements used for defining lean procurement are reviewed. A final subchapter identifies a framework of how theoretical concepts from the literature study will be operationalized for obtaining empirical data.

Chapter 3 presents and justifies the research methods used for this research.

In chapter 4, the case is identified and a justification of why the case is relevant is given.

RQ1-2 is analysed and discussed under chapter 5, and RQ3-5 is analysed and discussed under chapter 6. The analysis and discussions are divided into two chapters, as RQ1-2 is of descriptive nature, affecting the analysis and discussion of the remaining research questions. Data obtained from the interviews is presented and analysed against relevant literature provided in subchapter 2. Further the analysis is discussed and thereafter a sub-conclusion given for each of the respective research questions.

In chapter 7, a conclusion to the research problem is given based on the analysis and discussion chapters is provided, where it lays foundation for further research, presented in chapter 8. Additionally, the latter chapter concerns limitations for this research.

2. Literature Study

2.1 Introduction

In order to answer the research problem it was necessary to conduct a literature study. This chapter presents relevant literature for this research, with a four-folded structure. The first subchapter identifies appropriate ETO literature. The following subchapter gives an introduction to procurement literature. A justification of the elements used for defining lean procurement is provided in the following subchapter. Additionally, it provides a review of respective elements. The forth and final subchapter presents a framework of how theoretical concepts from the literature study will be operationalized for obtaining empirical data.

2.2 The Engineer-to-Order Structure

As this research aims to contribute to the development of ETO literature, it is relevant to identify literature concerning the ETO structure, which is what the case organization uses. The first section in this subchapter clarifies the ETO structure by using the customer order decoupling point. As this research concerns lean *procurement*, the following section introduces literature on procurement for an ETO producer.

2.2.1 The Customer Order Decoupling Point and ETO

The *customer order decoupling point* (CODP) is recognized as an important strategic concept to distinguish different strategies and supply chains (Gosling and Naim, 2009; Semini et al., 2014). Most literature defines the four following structures: *make-to-stock* (MTS), *assemble-to-order* (ATO), *make-to-order* (MTO) and *engineer-to-order* (ETO) (Gosling and Naim, 2009; van Weele, 2014; Wikner and Rudberg, 2005). Figure 2.1 below illustrates the four different structures and at which stage the CODP is located for each of them. The ETO structure is further emphasized.

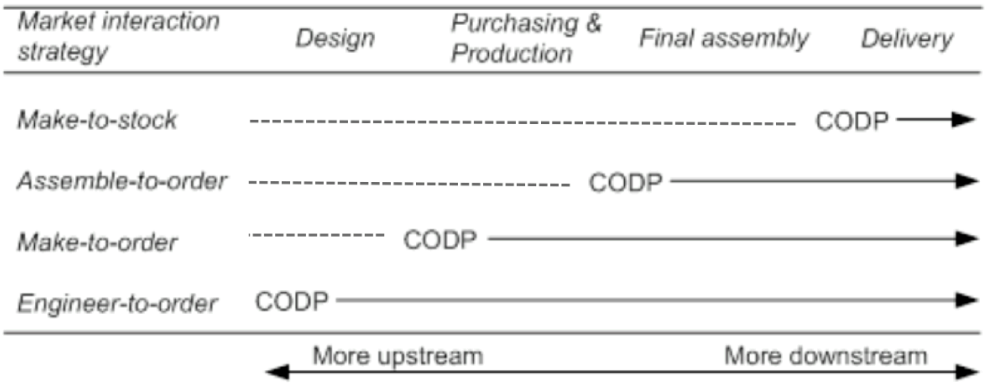

Figure 2.1: Different product delivery strategies and the customer order decoupling point (Semini et al., 2014, 365)

The CODP indicates where in the supply chain the production becomes order-specific. The activities downstream from this point are planned based upon customer orders, whilst the

activities upstream are forecast based (Gosling and Naim, 2009; van Weele, 2014). This is illustrated in figure 2.1, where the dotted line depicts the forecast based activities, whereas the straight line depicts customer-based orders. The production flow for an ETO producer is completely driven by actual customer orders with the CODP located at the design stage, illustrated in figure 2.1 above (Gosling and Naim, 2009). After the order is placed an intensive consultation between the design and engineering is necessary and often discussed in detail with suppliers. As a result this type of production structure requires long lead-times (van Weele, 2014). This indicates that the purchasing decisions must be taken at an early phase in the project. However, one of the most important characteristics of the Norwegian customized shipbuilding industry is the flexibility, which allows customers to accommodate engineering change orders late during the shipbuilding process (Semini et al., 2014).

According to Hicks, McGovern and Earl (1999) the ETO structure encompasses different types of organizations, designs and products manufactured. However, Gosling and Naim (2009) argue that the ETO structure is primarily associated with complex and highly customized project environments within the construction and capital goods sectors. In contrast to the high-volume sector there is limited research on *supply chain management*, henceforth SCM, in the ETO and low-volume sector (Hicks, McGovern and Earl, 1999). Hence, SCM in the ETO sector is considered in the context of trends in the high-volume sector. Hicks, McGovern and Earl (1999) further argue that the model applied in a high-volume context is often not appropriate for an organization with an ETO structure. Gosling and Naim (2009) supports this, but they additionally emphasize that some aspects from the high-volume sector can be applied. They argue that *just-in-time*, henceforth JIT, and supplier development initiatives, such as reduction of the supplier base and building of long-term relationships may be relevant aspects from the high-volume sector for ETO and the low-volume sector.

Hicks, McGovern and Earl (1999) argue that there has been a trend towards vertical disintegration amongst ETO producers, which is driven by financial pressure and the need for cost reduction. They further argue that a vertical disintegration may increase the flexibility and hence making alternative product configurations possible. The outsourcing approach varies from one organization to another. For some ETO producers, outsourcing is not an option due to lack of potential suppliers. At the other extreme, some ETO producers

have outsourced all manufacturing, assembly, construction and commissioning. Hicks, McGovern and Earl (1999) argue that assembly processes are considered to result in high levels of added value, and it has therefore been a common approach to focus on this activity internally. Due to the trend of increased outsourcing by ETO producers, SCM is considered as strategically important because of the reliance upon suppliers. For an ETO producer the components and services bought often represents a large share of the total contract value, therefore, McGovern and Earl (1999) emphasize the importance to develop a more collaborative approach to suppliers.

2.2.2 Procurement for an ETO Producer

According to Hicks, McGovern and Earl (1999) the effectiveness of the procurement processes within an ETO production organization will be determined by how correct and appropriate the specifications are. They distinguish between *functional specifications* and *detailed technical specifications*. Functional specifications define the requirements of what the product must do, but does not include how it should be done. This allows the suppliers to develop own design and hence introduce innovation and reduce costs. Detailed technical specification on the other hand, reduces the supplier's ability to influence the design, and hence limit innovation and result in unnecessary design and procurement activities, which may increase cost and lead-time.

The procurement decision within an ETO production organization is taken at different stages of the product development. Hicks, McGovern and Earl (1999) mention three different stages where specifications are made. Firstly, the customer may specify preferred suppliers or detailed specifications. Secondly, the specifications of components and subsystems may take place at the tendering stage. Thirdly, they argue that engineering design may specify components during the detailed design process. However, delay may be caused due to the availability of components with detailed specifications. As these require long lead-time they should be considered early in the design process. The use of standardized configurations, on the other hand, allows sourcing decisions to be taken at a later stage in the overall process (Hicks, McGovern and Earl, 1999). They further emphasize the challenge of unnecessary variety for an ETO producer, when there is only limited re-use of engineering designs amongst orders. By a high level of variety the

complexity of the procurement processes and hence greater uncertainty and risk may increase. Furthermore, they argue that the use of a lowest-price strategy may require continual supplier assessment, which may be wasteful, time consuming and expensive. In addition this strategy does not have the benefits of long-term partnerships by using fewer suppliers. Hicks, McGovern and Earl (1999) argue that the variety and range of specifications and high proportion of contract value, which is outsourced by an ETO producer suggests that procurement should be regarded as strategic.

2.3 Procurement

As this research concerns lean *procurement*, the following section introduces general procurement literature. First, a definition of purchasing and procurement is given. The following section concerns relationship management, where two classification tools are identified.

2.3.1 Purchasing and Procurement

The purchasing function involves activities to determine the purchasing needs, supplier selection, establishing suitable prices, specifying terms and conditions, issuing of contract or order, and following up delivery and payment (van Weele, 2014). Purchasing is defined as:

"The management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favourable conditions'" (van Weele, 2014, 8)

Procurement, however, is a broader term. Procurement includes all activities from getting a product from a supplier to its final destination. This means that the purchasing function is a part of the procurement, together with stores, traffic and transportation, inspections, assurance of quality and control (van Weele, 2014).

The suppliers are important for ensuring quality, functionality and for holding costs reasonable. In order to achieve a good short-term financial position, as well as a long-term competitive advantage, efficient and constructive relationship with suppliers should be of great concern (van Weele, 2014). According to Cousins et al. (2008), inter-firm relationships can be defined as a set of processes, which requires inputs in terms of resources to generate an output. The required resources are communication, culture, people, technology, time and effort. The output can be lower costs, higher quality, greater product innovation, risk reductions and enhanced market value. The inputs and outputs of a relationship may be asymmetrical depending on desired output for both the supplier and

the buyer. Moreover, the relationship will be influenced by the external environment and constrains occurring due to respective parties strategies, goals and power mechanisms.

2.3.2 Relationship Management

According to Cousins et al. (2008), a company will advantage by including relationship management as a daily routine for the procurement function. The relationship management will differ based on company strategy and the type of components that is to be purchased. The relationship may either be a transaction-based arm's length relationship, or a close cooperative relationship with a strategic focus. According to van Weele (2014), parameters like demand, value and importance of the products are relevant when forming supplier relations. For an organization providing low-cost products, the relationship management focus should be on obtaining low-cost components for production. For these organizations, the procurement is seen as a tactic operation. Vice versa, organizations aiming to provide time-to-market or innovative products will prefer to have relationship management as a part of their strategic process of procurement (Cousins et al., 2008). Cousins et al. (2008) further argue that a portfolio of supplier relations will enable the company to evaluate suitable relationship strategies. It is further argued that in order to optimally use this portfolio, the organization must analyse suitable sourcing strategies based on different components.

2.3.2.1 ABC-analysis

The ABC-analysis is a classification model used for differentiating between important and less important purchases (Gelderman and van Weele, 2005). The result from an ABC-analysis is a classification of inventory components, laying ground for establishing suitable relationships with suppliers. According to Arnold, Chapman and Clive (2008), the ABC-classification allows for different levels of control with respect to the components based on relative importance. ABC-classification is based on the principle that a small number of components often dominate the result in any situation. This tendency was observed by the Italian economist Vilfredo Pareto and is today referred to as "Pareto's law". Pareto's law

illustrates the relationship between the percentage of components and the percentage of annual dollar usage, where the pattern is divided into three groups:

- A-components: small share (approximately 20%) of the components, which stand for most (approximately 80%) of the total value.
- C-components: a large share of the components (approximately 50%), which stand for a small share of the total value (approximately 5%).
- B-components: somewhere in between, approximately 30% of the components stand for approximately 15% of the total value.

Initially, the ABC-analysis was the only tool for differentiating important and less important purchases. However, the tool does have some drawbacks. First, the ABC-analysis focus on financial value of the component, and does not consider cost of poor quality, social risk, performance risk and other components. Second, traditionally the ABC-analysis does not suggest strategic recommendations for each category classified. Thus, it was considered as a breakthrough in the development of professional purchasing when the Kraljic's purchasing portfolio was introduced in 1983 (Gelderman and van Weele, 2005).

2.3.2.2 Kraljic's Purchasing Portfolio

Kraljic's purchasing portfolio represents the most important single prescriptive and diagnostic tool available to purchasing and supply chain management (Syson, 1992, in Gelderman and van Weele, 2005). According to Kraljic (1983), the supply strategy of a company depends on the importance of the purchasing and the complexity/risk in the supply market. Kraljic (1983) developed the purchasing portfolio in order to minimize the supply risk, as well as to enable the company to make the most of their buying power. The purchasing portfolio is a matrix, where the dimensions are represented by *supply risk* and *profit impact*, running from low to high. The supply risk relates to the complexity of the supply market, and may be measured against various criteria: long-term and short-term product availability, scarcity of suppliers in the market, switching costs for changing the supplier, market structure for the supply, geographic distance, risks of inventory, and available substitutes. Profit impact is related to the impact of the purchasing for the bottom

line to the company. The profit impact may be measured against various criteria: material costs, total costs, purchase volume, percentage of total purchase costs, or impact on product quality or business growth (van Weele, 2014).

By assessing this, the organization may achieve purchasing power and an acceptable amount of risk. Based on supply risk and the purchase impact on the firm's profit Kraljic (1983) identified four categories for the components, *leverage components*, *strategic components*, *non-critical components* and *bottleneck components.* These categories are identified in the figure below.

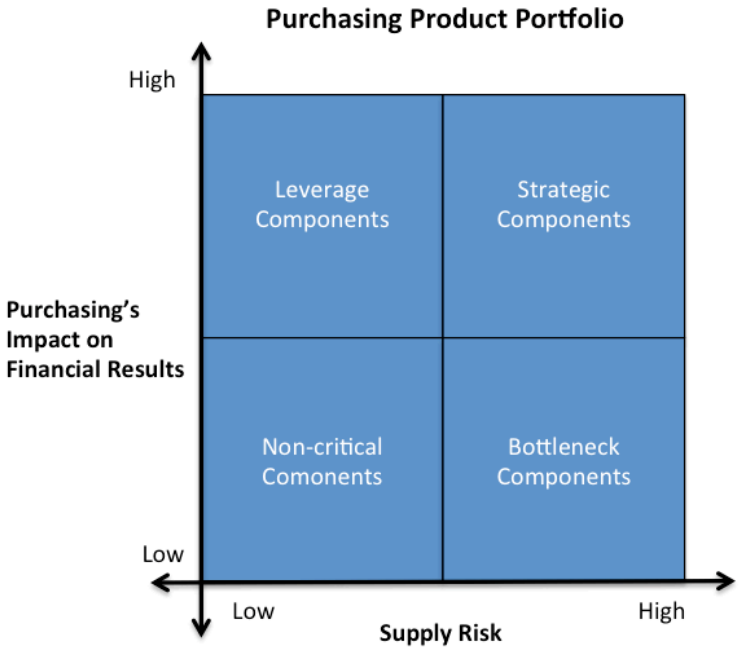

Figure 2.2: Purchasing product portfolio (modified from Gelderman and van Weele, 2002, 208)

Strategic components are often purchased from one supplier alone, leading to a significant supply risk. The components often stand for an extensive part of the product design, often supplied at customer specifications (van Weele, 2014). Van Weele (2014) argues that 20% of the components supplied will represent approximately 80% of the purchasing turnover, and can thus be classified as strategic components for the company. According to Caniëls and Gelderman (2005), it is recommended to build a long-lasting partnership with

suppliers of strategic components, with mutual trust and commitments. This may lead to improvements in quality, delivery, reliability, lead-times, product development, product design and reduction of costs. Strategic components will be the main focus for further investigations in this research, cf. 1.3

2.4 Lean Procurement

This subchapter addresses the definition of lean procurement given for this research. Johannesen, Schølberg and Vik (2013) have proposed a model for implementing lean procurement in the high-volume sector. The model includes eight elements: *value stream mapping*; *information and cost sharing*; *measure lean achievements*; *lean organization structure*; *lean thinking and kaizen*; *lean supplier selection*; *lean relationship management;* and *lean supplier development*. Lean thinking and kaizen is the key driving force in the model. This element emphasizes the importance of continuous improvements internally in the organization when implementing lean procurement. The definition of lean procurement given for this research is based on a selection of elements proposed in this model.

From the ETO literature, it was identified that the ETO structure is associated with complex and highly customized projects. The literature further revealed that the components and services bought often represents a large share of the total contract value. The production flow for ETO producers is completely based on customer orders, where the CODP is located early in the design phase. After the order is placed, an intensive consultation between design and engineering is necessary, and often discussed in detail with suppliers. Hence, the *selection of suppliers* seems relevant for lean procurement in ETO, as it is identified that this activity is conducted at an early phase in the project. Further, the ETO literature revealed that supplier development initiatives, which include a reduction of the supplier base and establishing long-terms relationships, are relevant aspects for the ETO sector. This literature corresponds with the strategy suggested for strategic suppliers in the Kraljic matrix presented in the procurement literature chapter. Based on this, *supplier development* and *relationship management* seems relevant elements for lean procurement in ETO. Torvatn (2014) emphasize the same elements based on the model proposed by Johannesen, Schølberg and Vik (2013). These elements will through this subchapter further be reviewed.

Johannesen, Schølberg and Vik (2013) claims that full benefits of lean procurement will only be achieved when all elements from the model are considered. However, they argue that benefits are possible by implementing a selection of the elements. As stated in the introduction, 1.1, initial research revealed that there are limited research contributions associated with lean procurement. Hence, extensive work was devoted for this literature

study, where the literature proposed in this subchapter is intended the high-volume sector. The purpose for this research is to evaluate the applicability of lean procurement for the ETO and low-volume sector. Literature presented in the following sections will be the foundation for analysing and discussion applicability of lean procurement, RQ3-5, in chapter 6.

This subchapter has a three-folded structure. Where a literature review is given respectively for lean supplier selection, lean relationship management and lean supplier development.

2.4.1 Lean Supplier Selection

According to Johannesen, Schølberg and Vik (2013), it is important for a company to find suppliers meeting the organization's need and demand. This will enable the organization to achieve strategic goals and top performance. Lean supplier selection is identified as one of three key elements for defining lean procurement in this research, and is further provided in this literature study with a three-folded structure. The first section focuses on possibilities, motivations and challenges for ensuring lean supply. The second section focuses on aspects related to elaboration and rationalization of components and suppliers. Thereafter, a model for lean supplier selection is presented in the third section. This part of the literature study will further be used for discussion and analysis with respect to RQ3 in chapter 6.

2.4.1.1 Ensuring Lean Supply

The introduction, given in 1.1, mentioned that the lean philosophy has expanded to become a philosophy applicable for all aspects of the supply chain. Dyer (2000) supports this by acknowledging that sustainable competitive advantage no longer is created within an organization, but in the extended lean enterprise. The foundation of lean procurement is to identify value creation for the customer, involving all actors in the value chain. Hence, requirements are put on communication between the buyer and its suppliers (Torvatn, 2014). In order to create value for the final customer, it is crucial to look at the supply

chain as a whole in order to manage both upstream and downstream relationships with suppliers and customers (Bicheno and Holweg, 2009).

It is argued that a lean customer becomes more productive when working lean suppliers meeting all requirements concerning costs, quality and reliability (MacDuffie and Helper, 1997; Simpson and Power, 2005). Further, van Weele (2014) argues that it is preferable for a lean customer to have lean supply, however most important to have suppliers able to deliver frequently in small batches with high delivery reliability. Extensive technological and organizational changes are needed for a supplier to become lean (Bashin and Burcher, 2006). In lean supplier selection, it is recommended for the lean customer to evaluate if current suppliers are lean, or if they are in position to be influenced for becoming lean (MacDuffie and Helper, 1997; Simpson and Power, 2005; Torvatn, 2014). If not, an alternative is to switch towards lean suppliers (MacDuffie and Helper, 1997; Simpson and Power, 2005).

Lean supply is associated with high degree of information sharing, single sourcing and long-term contracts. When encouraging current suppliers to become lean, challenges may be linked to these factors. Lack of supplier cooperating can create difficulties and tension. Further, resistance from the supplier and lack of communication can be a difficulty (Walters-Fuller, 1995). However, MacDuffie and Helper (1997) claim that encouraging lean supply is easier on a small company in terms of building motivation and strong dependence. Small companies have less knowledge of lean and tend to be more responsive to both expectations and suggestions. When encouraging a small company to become lean, the customer must allow for short-term disrupts in performance and understand the initial focus for them is to acquire new skills.

Challenges are also related towards switching to lean supply. Advantages gained from relationships with current suppliers will be lost. Trust in the market is a factor for achieving success, which might be jeopardized when other suppliers notice the event. Further, already lean suppliers might have advantages and commitments towards other companies, making them less responsive for a new buying company. The switching costs of selecting new suppliers, which are lean, might be economical, political and reputational. Hence, the customer must evaluate and detect the best option between switching towards lean supply or encouraging existing supplies to become lean (MacDuffie and Helper, 1997).

As mentioned above, less responsiveness is a challenge related to switching towards lean supply. However, coping with this challenge is generally relevant in lean supplier selection. In a network perspective, it is recommended for the buying company to evaluate if the supplier acknowledges their shared supply chain as the most important one (Torvatn, 2014). The customer should identify the supplier's other customers, what demands they put on that supplier, and evaluate if these demands are conflicting with own demands they put on the supplier (Johannesen, Schølberg and Vik, 2013). Torvatn (2014) support this statement by arguing that it is important to identify if the supplier is willing to contribute for development of a shared value chain, and that they are not too busy coordinating another. Further, he argues that it is important to identify if the supplier is a part of a conflicting supply chain, where the collaboration between the supplier and buyer is in conflict with what the supplier aims to develop with another buying company.

2.4.1.2 Rationalizing Components and Suppliers

According to Bicheno and Holweg (2009), lean practice is to work with a few suppliers that are reliable and able to provide a large range of different components. Torvatn (2014) supports this by emphasizing that the buyer should evaluate how many products the supplier deliver that is important for own production in lean selection. Furthermore, it is important that the organization identified all non-value adding components used in production, since *supplier selection, relationship management* and *supplier development* is waste if the organization have components in production which does not create value (Bicheno and Holweg, 2009). Bicheno and Holweg (2009), suggest a team approach for supplier selection, where the purchasing officer should coordinate the selection with help from the R&D-, quality- and production departments.

2.4.1.3 The Supplier Selection Model

Cousins et al. (2008) suggest that a company should use a strategic supplier selection model for rationalizing the suppliers. The first step is to reduce the potential suppliers to a number, which is easier to control and manage if there are many suppliers available in the market. This may be done by putting requirements on available suppliers with respect to

standards and components the supplier have available. The next step is to identify and evaluate measurement criteria of which the company will base their supplier selection decision. The third step is to collect relevant data from the supplier based on the measurement criteria, and then evaluate the supplier. The forth and final step is to make a decision on which suppliers to work with. Cousins et al. (2008) suggest to use a linear selection model where each criterion has a scored assigned, based on importance for the buying company. The total score will provide the company to evaluate the suppliers on best score based on the different criteria.

Cousins et al. (2008) emphasize the second and forth step in the supplier selection model. The company should use an existing, or develop a, model for supplier selection. Under the second step, it is necessary to find criteria that will be compatible with requirements of lean suppliers (Johannesen, Schølberg and Vik, 2013). Lean literature suggests various criteria that should be included. For instance, Wilson and Roy (2009) are suggesting a combination of *quality, reliability, culture, behaviours, delivery performance* and *price.* According to Torvatn and van Weele (2014; 2014), a company aiming to select lean suppliers should use JIT principles for defining criteria. In similarity with lean criteria, JIT put emphasis on both *flawless products* and *process quality,* which in combination puts standards for delivery with zero defects. Further, *delivery reliability* is emphasised (van Weele, 2014). Lean literature does not specifically argue how the criteria should be measured, as it will differ for various companies. In addition, Torvatn (2014) argues that lean supplier selection is about selecting a supplier suitable for close relationship with a long-term perspective. With respect to this, the buying company should consider if the supplier has competencies that contributes to own product development, and if the supplier is willing to cooperate closely with a long-term perspective.

According to Bashin and Burcher (2006), a requirement for achieving desired performance level from suppliers is to have them geographically close. When the supplier is located close to the buying company, it generates for information sharing, quality levels and cost reduction at facilities. It might be a challenge to enable lean procurement in a global supply chain, as the long distance creates a challenge in terms of incorporating design and volume changes. With respect to the ETO literature, this can be considered as highly relevant, as the long distance leads to less flexibility in an environment where late change orders are common. Further, Bashin and Burcher (2006) argues that it generally makes the

supply chain more complex, which entails higher level of buffering. In order to arrange for frequent and small batches, it gets difficult when international vendors are involved and multi-modal transport links might be necessary. This will affect the lead-time variability and uncertainty in the supply, which can be a barrier for implementing lean procurement (Wilson and Roy, 2009). Based on this, it can be implied that lean literature is suggesting a lean criterion in terms of geographical proximity with suppliers.

2.4.2 Lean Relationship Management

It is important for a company to evaluate how many supplier relationships that should be managed as partnership or arm's length relationships. In line with lean procurement, the focus should be on value creation. Hence, suppliers generating for a large share of the value creation should be managed with close relationships. It is important for the buyer to acknowledge the importance of a supplier in order to exploit all benefits possible in a buyer-supplier relationship. Lean relationship management is identified as one of three key elements for defining lean procurement in this research, and is thus provided in this literature study with a three-folded structure. The first section discuss the rationalizing of the extent of supplier relationships, including cost-benefit analysis and ABC-classification. The following section discusses governance of the supplier relations. Thereafter, the importance of cost and information sharing in lean procurement is reviewed. This part of the literature study will further be used for discussion and analysis with respect to RQ4 in chapter 6.

2.4.2.1 Rationalizing the Extent of Supplier Relationships

In lean supply, relationship management should be emphasized where commitment, mutual trust and long-term relationships are important (Bashin and Burcher, 2006; Bicheno and Holweg, 2009). The rationalization behind the partnership philosophy is to create benefits through cooperation, not confrontation. This philosophy does not put emphasis on the product price, but the total cost. Total cost includes quality (defects), delivery reliability, simplification of transactions, and future potential for price reductions (Bicheno and Holweg, 2009). Further, Bicheno and Holweg, (2009) argues that a long-

term relationship lasting through both good and difficult times will give motivation and confidence for the supplier to invest and improve.

However, not even Toyota had strategic collaborative relationships with all their suppliers (Liker and Choi, 2004). Arm's length relationship is common from traditional purchasing theory, where the buyer has multiple suppliers available and at all time use the suppliers providing the best prices. According to McIvor (2001), benefits from lean supply might be achieved without having close relationships with all suppliers. He further argues that close relationships require a great extent of resources from both the supplier and buyer. Thus, McIvor (2001) recommends that price should be of concern when deciding on a sourcing strategy for standardized products where the quality is somewhat the same from all suppliers available. He further argues that it will be more beneficial with multiple suppliers and an arm's length relationship for these components. In lean, a combination between arm's length relationships and close cooperation should be sufficient to achieve sustainable competitive advantage (McIvor, 2001). This statement will be in line with Kraljic's purchasing portfolio, see section 2.3.2.2.

Cost-Benefit Analysis

In order to evaluate how many close relationships an organization should have a cost-benefit analysis can be conducted. According to Cousins et al. (2008), the cost-benefit analysis enables the organization to understand the cost structure occurring when following a strategy. It is important that the advantages are greater than the costs. According to Johannesen, Schølberg and Vik (2013), a supplier generating great value for the end company should be in a relationship built on strategic cooperation.

The ABC-Classification

Subchapter 2.3.2.1 identified limitations with the ABC-analysis, which made the Kraljic's purchasing portfolio a favourable tool for an organization establishing suitable supplier relationships. Despite these limitations, lean literature does not recognize Kraljic's purchasing portfolio, but instead the ABC-classification as a tool for lean relationship

management. From subchapter 2.3.2.1, it was further identified that one limitation respected to the ABC-analysis was the lack of providing a recommendation for each category classified. Lean literature however, presented by Bicheno and Holweg (2009), argue that the ABC-classification is a suitable tool for establishing lean relationship management. The lean literature further identifies strategic recommendations for each category classified.

For A-components, high priority is important. It is necessary with tight control, which includes accurate records with close follow-up and expediting to reduce lead-time. A-components should have regular and frequent review by management and frequent review of demand forecast. Suppliers of A-components are suitable for close relationship, and partnership may be considered. Suppliers of C-components should have the lowest priority with simple control and modest or no records at all. C-components are suitable for an arm's length relationship. Suppliers of B-components should be handled somewhat in between, but one may consider collaborative long-term partnership for B-components as well (Bicheno and Holweg, 2009). According to Bicheno and Holweg (2009), criticality of the components and risk should be considered when deciding on type of relationship, in order to avoid partnership with a company having poor industrial relations, weak finance or poor quality assurance.

2.4.2.2 Relationship Governance

Another aspect of lean relationship management is the governance of the relationship. According to van Weele (2014), the balance of power between the parties may differentiate by a being buyer-dominated segment, a supplier-dominated segment or a balanced relationship. The degree of dependence might be a challenge for the relationship. Lack of bargaining power on either the supplier or buyer side will affect the power-balance in the collaboration. In a supplier-dominated relationship, the buyer might experience a "lock in" with the supplier, where they have bought (too expensive) strategic components or solutions they cannot change later on (van Weele 2014).

In a buyer-dominated segment, the supplier might experience a rather one-sided relationship, where the buyer is dictating their demands to the supplier. The supplier's

investments for ensuring lean supply is likely to involve great technological and organizational changes, including pull systems, multi-skilled workers, high degree of continuous improvements, reduced batches and lead-times, and high demand of quality and innovations (van Weele, 2014; MacDuffie and Helper, 1997). Due to the investment, the supplier will get dependent on the buyer, as they might not have resources for producing with zero defects for more than one customer. It is not guaranteed that the supplier will have the contract extended. Hence, it might be difficult for the supplier to regain lost territory after termination of the contract with the buyer (van Weele, 2014). Again, there is a lock-in situation, this time for the supplier.

According Lamming (1993), the customer and supplier needs to be equal parts in a lean relationship, where the relationship is built on mutual trust and openness. This is in clear contravention to McIvor (2001), who implies that Lamming's requirement of complete equality in a relationship is too rigorous. McIvor (2001) argue that it is difficult to obtain complete equality, as the benefits accrued often is obtained by the customer. Further, he argues that it is possible for organizations to achieve some of the benefits associated with lean supply without pursuing a relationship based on complete equality. In lean relationship management, the customer has a *paternalistic position* in the relationship, where the customer has more power, influence and responsibility (MacDuffie and Helper, 1997; McIvor, 2001;Womack, Jones and Roos, 1990). It is important for the customer to get an insight in the supplier's resources and competences. In a lean supply strategy where the customer has a paternalistic position, the customer must acknowledge the important position the supplier have in the relationship. However, the customer must evaluate whether the resources and competences are sufficient for further supplier improvements and development processes (Johannesen, Schølberg and Vik, 2013).

2.4.2.3 Information and Cost Sharing

Lamming (1996) emphasizes the importance of information and cost sharing between customer and supplier in order to achieve benefits of lean supply, such as mutual improvements and cost reductions. The improvements may be handed over to the final customer in terms of reduced prices. For some products, the price reduction may increase the value of the product for the final customer (Johannesen, Schølberg and Vik, 2013).

Lamming (1996) further implies that both customer and supplier can benefit from this sharing. The supplier can benefit from reduced administrative effort and continuous improvement within quality, reliability and service, which may increase their competitive advantage (Lamming, 1996). However, McIvor (2001) argues that the benefits acquired through equal information and costs sharing, will mostly be obtained by the customer. According to McIvor (2001), it is a common practice for customers to exploit the supplier, in terms of pushing down prices when cost information is shared as the supplier has shared more information than the customer. Asymmetric sharing of costs and information between supplier and buyer is hence a challenge for information and cost sharing. Further, apportionment of fault might be a challenge linked to cost sharing. This can also be seen as a waste in the value creation as no resources is used in order to detect cause and solve the occurring problem. Mutuality is hence important in order to achieve the intended benefits of lean procurement (Johannesen, Schølberg and Vik, 2013).

2.4.3 Lean Supplier Development

Sustainable competitive advantage is no longer only created within an organization, but in the supply chain as whole (MacDuffie and Helper, 1997). In order to be successful, Liker and Choi (2004) argue that the extended lean enterprise requires partnership between buyer and suppliers, a culture of continuous improvement and joint learning among the actors in the supplier network. This makes supplier development an important element within lean procurement and supply theory (Johannesen, Schølberg and Vik, 2013). This part of the literature study consists of three sections. The first section will describe kaizen events with suppliers. The following section will describe joint improvement activities. Lastly characteristics for competitive partnerships are highlighted in the third and final section. This part of the literature study will further be used for discussion and analysis with respect to RQ5 in chapter 6.

2.4.3.1 Kaizen Events with Suppliers

According to MacDuffie and Helper (1997) an important element of lean supplier development is to encourage the suppliers to implement continuous improvement as part

of their identity. Liker and Choi (2004) emphasize the importance of understanding the supplier's work and their capabilities in order to initiate kaizen events with them. Instead of making several radical changes at the same time, lean supplier development focuses on many small kaizen events by doing small specific improvements one by one to eliminate waste. This may give rather fast results, which MacDuffie and Helper (1997) argue will give motivation for further improvement and development events. The focus in the supplier development process should be on the activities, which a *value stream mapping* finds to be the most value adding ones (Marks and Barkman, 2007; Stark, 2004). Value stream mapping is a process identifying value adding and non-value adding activities in the supply chain for the final product. This may give the actors an overview of prioritizing the activities having the greatest potential for improvement, and to eliminate the activities not adding value (Stark, 2004).

2.4.3.2 Conducting Joint Improvement Activities

In their case study MacDuffie and Helper (1997) argue that the customer has a paternalistic position in the supplier development arrangement, by being the initiator and having the knowledge and resources to develop suppliers. This is in line with Simpson and Power (2005) who define *supplier development* as any activity the customer undertakes to improve the performance and/or capabilities of the supplier. Yet, MacDuffie and Helper (1997) acknowledge that the suppliers can have their own ideas for further development as well, which may lead to innovation and contribute to develop the customer's products. This is not in line with Liker and Choi (2004) who argue that the customer is the party knowing how the supplier best can develop. However, Liker and Choi (2004) argue that the lean supplier development is a process contributing to build good and long-term relationships between buyers and suppliers, which are valuable for both parties. According to Lamming (1996), *relational development* is a more appropriate term for supplier development. He considers the development of the supply chain as a joint effort between buyer and supplier where both contribute to reveal the opportunity for improvement and elimination of waste in the supply chain.

However, with respect to the review given in subchapter 2.4.1.1, MacDuffie and Helper (1997) argue that lean supplier development may be a challenge if the supplier serves

several customers who have different or even conflicting demands. The supplier may then be pulled in different directions, which will make it difficult for the supplier to develop and satisfy both customer relationships. Moreover, MacDuffie and Helper (1997) argue that supplier development can be a challenge when the supplier organizations have very strong identity with their own mind-set of developed knowledge and routines. Radical changes such a lean implementation may then be met by resistance from larger suppliers with strong identity. This can make the knowledge transfer process longer and more time consuming. As mentioned in section 2.4.1.1, smaller suppliers may be more responsive to the customer's suggestions compared to larger suppliers (MacDuffie and Helper, 1997). A challenge with the small responsive suppliers is however, that they may become too dependent on the customer during the hands-on knowledge transfer process, and when the customer is no longer physically present the supplier will fall back into old habits. According to MacDuffie and Helper (1997) a supplier with moderate degree of both dependency and identification with the customer is the most optimal supplier. They argue that if these are too high, the customer will be tempted to continue relying on assistance from the customer. However, if they are too low, there is a chance the supplier will think the customer has nothing to teach them. MacDuffie and Helper (1997) argue that tension between supplier and customer during the learning period is not necessarily bad. They argue that this can motivate the supplier to become self-reliant.

2.4.3.3 Three Key Characteristics for Competitive Partnerships

According to Dyer (2000) value is not automatically created within a partnership. He identifies three following key characteristics, which create competitive advantage for partnerships: *dedicated asset, knowledge sharing* and *trust.* Each of these will be further described below.

Dedicated asset

The first factor, dedicated asset refers to investments customized to a specific customer or supplier in factories, equipment, processes or people (Dyer, 2000). Simpson and Power (2005) argue that supplier development for performance improvement requires all

organizations involved to commit financial, capital and personnel resources to the development task and to share timely and sensitive information. The investments may improve the efficiency of the network and the network's ability to develop unique products. However, the advantage of dedicated assets is of much greater importance in complex industries compared to arm's length relationships (Dyer, 2000). Simpson and Power (2005) acknowledge that the commitment in dedicated assets such as financial, capital and personnel resources can be a challenge for the parties involved. The customer must be convinced that the risk of investing these resources in a supplier is worth taking. On the other hand the supplier must be convinced that it is in their best interest to accept direction and assistance from their customer.

Knowledge sharing

The second factor is knowledge sharing, and refers to the network's ability to exchange valuable knowledge concerning market, processes, quality, design or anything that can help the partnership learning to be more efficient and effective (Dyer, 2000). MacDuffie and Helper (1997) argue that both suppliers and customers can benefit from entering into a knowledge transfer arrangement. However, they recognize that knowledge can be difficult to transfer. This aspect is highly relevant with respect to the ETO literature. Halse (2014) emphasizes that knowledge sharing can especially be a challenge for a shipbuilding company with a global value chain as a lot of the information and knowledge flowing between supplier and yard is tacit. She acknowledges that shipbuilding groups to a little extent take advantage of knowledge from their foreign production sites and that the innovation process primarily takes place in Norway. Halse (2014) questions upon whether increased global sourcing of production may hamper future innovativeness for the industry, and argues that this should be subject for further research. The aim for this research is not to investigate this further. However, the aspect will be relevant in order to detect whether the knowledge sharing literature presented is applicable for the identified value chain for this research.

MacDuffie and Helper (1997) emphasize two key factors affecting the knowledge transfer process from customer to supplier. The first one is the supplier's *absorptive capacity*. Prior knowledge already existing within an organization will affect its ability to absorb new

related knowledge. The absorptive capacity for an organization is related to its *organizational identity*, which is the second factor affecting the knowledge transfer process. The individuals being member of the organization will determine this factor as identity affects the organization's ability to embrace changes. However, MacDuffie and Helper (1997) argue that even having a highly absorptive and responsive supplier and using the best knowledge transfer techniques will not guarantee successful knowledge transfer. Having a customer-supplier relationship with high motivation for learning and high trust between the parties is however, crucial for transferring the knowledge of a complicated system such as lean (MacDuffie and Helper, 1997).

Trust

The final and maybe the most important factor is trust. Trust is critical for partner success. Trust facilitates both investments in dedicated assets and knowledge sharing (Dyer, 2000). According to MacDuffie and Helper (1997) an important part of the trust-building process can be a knowledge transfer program where the customer invests in the relationship by providing the supplier with training. However, MacDuffie and Helper (1997) argue that some knowledge transfer programs can be undesirable, due to imbalance of the risk taking between the buyer and supplier. If the knowledge transfer program requires highly customer-specific investments of either time or capital and no long-term commitment from the buyer, the supplier may take most of the risk.

2.5 From Theoretical Concepts to Empirical Data

With respect to the research problem, relevant literature has been presented in this chapter. First, appropriate ETO literature was given in order to enhance the understanding of the ETO structure. This was relevant, as the aim for this research is to contribute to development of ETO literature, where the case organization in this research uses such structure. As this research is concerning lean *procurement*, it was further relevant to include procurement literature for the ETO structure, and additionally one subchapter introducing relevant procurement literature. The latter subchapter presented a definition of purchasing and procurement, and additionally two classification tools used for relationship management. The third subchapter presented lean procurement literature. A justification of how this research defines lean procurement was given. The subchapter mentioned a proposed model for implementing lean procurement in the high-volume sector. Based on this model and literature identified in the previous subchapters, it was revealed justifiable to define lean procurement by lean *supplier selection, lean relationship management* and *lean supplier development*. Initial research in this study revealed that there are limited research contributions associated with lean procurement. Hence, the sections under lean procurement, chapter 2.3, concerns literature intended the high-volume sector. The purpose for this research is to evaluate the applicability of lean procurement for the ETO low-volume sector. The case organization in this study is a global shipbuilder, building high-end specialized vessels in a low-cost country. RQ3-5 concerns applicability of respective elements used for defining lean procurement: lean supplier selection, lean relationship management and lean supplier development. Hence RQ3-5 will be emphasized for answering the research problem. The following sections aims to describe how these three theoretical concepts can be operationalized into empirical data.

To answer RQ3, literature concerning lean supplier selection has been reviewed in this literature study. The literature argues that a lean producer will become more productive when working with lean suppliers. Hence, it is recommended to ensure lean supply by either evaluate if current suppliers are lean, if they are in position to be influenced for becoming lean, and if not - change to lean suppliers. Lean supply will further be referred to as suppliers operating under lean philosophy. In order to obtain data concerning this aspect, the interview guides (see appendices 1-4 and 6) include questions related to the case organization's frequently selected suppliers. The informants will be asked if their

frequently selected suppliers are lean, if they are in position to become lean, or if lean supply is a criterion they use for selecting suppliers to their projects. Same relevant questions will be asked to one informant from the supplier side (see appendix 5). This interview guide contains questions related to their production philosophy, and their potential for being influenced by their customers. Further, the literature identifies the lack of responsiveness as a challenge of concern in lean supplier selection. The literature recommends the buying organization to identify the supplier's customers, and further identify the requirements other customers puts on that supplier. This is in order to detect if there are any conflicting demands that will affect the lean collaboration with the supplier. In order to obtain data concerning this aspect, the informants will be asked about their awareness of other customers the suppliers have, and additionally questions related to demands they put on that supplier. Further, the informants will be asked if they experience lack of responsiveness from their suppliers, which can be related to conflicting demands. Same relevant questions will be asked to one informant from the supplier side (see appendix 5). This interview guide contains questions related to the suppliers' other customers and the requirements these customers put towards them. Further, the informant will be asked questions related to their responsiveness towards their customers. The literature further suggests that lean practise is to work with a few reliable suppliers, able to provide a large range of components. Moreover, the literature suggests identifying all non-value adding components used in production. In order to obtain data concerning these aspects, the informants from the case organization's value chain will be asked questions related to the supplier selection process. The interview guides contain questions related to how suppliers are selected, how many components the suppliers deliver, and who participates and have influence in the process of selecting the suppliers. The lean literature suggests using a supplier selection model with lean criteria for selecting lean suppliers. The informants will be asked questions in order to detect if the case organization uses such model. Additionally, the informant will be asked to emphasize the criteria they use for selecting suppliers. In the ETO literature provided in subchapter 2.2, it was commented upon the recognized high flexibility of the ETO producers in the Norwegian maritime cluster, allowing for late change orders. Hence, it is interesting to investigate whether the flexibility in the Norwegian maritime cluster is be designated the geographical proximity in the maritime cluster. The lean literature emphasized geographical proximity as criterion for lean supplier selection. With respect to what was stated in the ETO literature, this seems as a relevant aspect. In order to evaluate the importance of geographical proximity,

questions will first of all be asked if it is a criterion for supplier selection to select suppliers with geographical proximity. Furthermore, the informants will be asked questions related to how the relationship with suppliers is handled when the yard is located in Vietnam compared to when the yard is located in the maritime cluster. Same relevant questions will be asked the to the informant from the supplier side. This interview guide concerns questions related to their relationship with a buying shipyard located in a low-cost country compared to one located in the maritime cluster. By asking questions related to the theoretical concepts presented under lean supplier selection, it is possible to evaluate to what extent lean supplier selection will be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country.

To answer RQ4, literature concerning lean relationship management has been reviewed in this literature study. The literature provided a discussion of the recommended extent of supplier relationships, where it was concluded that benefits from lean supply can be achieved through a combination of arm's length and long-term relationships with suppliers. The literature further suggested using ABC-classification and cost benefit analysis for determining the extent of supplier relationships with suppliers of various components. In order to obtain data concerning this aspect, questions will be asked in order to detect the case organization's extent of supplier relationships. Questions related to total value of their strategic components will be asked. Furthermore, questions related to the long-term perspective of the collaboration with suppliers of these components will be provided the informants. Further, the literature provided a discussion related to the relationship governance. The literature argued that the degree of dependence could be a challenge in the relationship, where two different lock-in situations were identified. Hence, questions related to specific investments and dedicated assets will be asked to the informants. Further, the literature provided a discussion concerning governance in the supplier relationship, where complete equality was identified as difficult. However, literature emphasized a paternalistic position in the relation, where the buyer acknowledges the supplier's important position in the relationship. In order to obtain data concerning the governance of the supplier relationships, informants from the case organization will be asked question related to dependency. The informant from the supplier side will be asked same relevant questions. Lastly, the literature concerned importance of information and cost sharing between supplier and buyer, where the importance of mutuality was emphasized for achieving benefits of lean procurement. In

order to obtain data concerning this aspect, the interview contains questions related to the case organization's extent of information sharing. The informant from the supplier side will be asked same relevant questions. By asking questions related to the theoretical concepts presented under lean relationship management, it is possible to evaluate to what extent lean relationship management will be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country.

To answer RQ5, literature concerning lean supplier development has been reviewed in this literature study. The literature emphasized the importance of continuous improvements and joint learning amongst the actors in the supply chain. In order to obtain data concerning these aspects, the informants will be asked questions related to development activities with suppliers in the value chain. Conducting Kaizen events with suppliers have been emphasized as important for creating a culture of continuous improvement. Hence, the interview guides include questions for revealing if the identified value chain have proposed lean thinking to their suppliers to develop the total value of the vessel. Moreover, conducting joint improvement activities in the supplier network where both customer and supplier contribute with mutual benefits is found to be important. Thus, the interview guides include questions regarding their development projects with suppliers, if they cooperate to develop the products together and the importance of the competencies the supplier holds in order to contribute to development of the vessels. Thereafter, investing in dedicated assets, knowledge sharing with suppliers and building a trust worthy relationship are identified as key characteristics for creating a successful partnership. In order to obtain data concerning these aspects, the informants will be asked if the case organization or their suppliers are investing in development projects in terms of financial, capital or personnel resources. Literature in this chapter acknowledged knowledge sharing as a challenge for global ETO shipbuilders. It is therefore highly relevant to investigate in this research if there are any challenges regarding this global value chain with respect to lean procurement and knowledge sharing. Lastly, to map the trust in the relationship between the case organization and their suppliers, the informants will be asked to describe the trust in the relationships and to find if they trust some suppliers more than others, and if so, why. By asking questions related to the theoretical concepts presented under lean supplier development, it is possible to evaluate to what extent lean supplier development will be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country.

3. Methodology

3.1 Introduction

Methodology describes a systematically method used for gathering data contributing to answer a given research problem. The choice of methodology depends on the situation, purpose and resources available (Gripsrud, Olsson and Silkoset 2006). This chapter will describe the methodological approach for this research. The first subchapter concerns the *research design*. Empirical data were collected for this research, through a descriptive-explorative design using a single case study. In the following subchapter, methods for *data collection* are introduced. Qualitative methods were used as main technique of data collection, using unstructured and semi-structured interviews, e-mail correspondences and group interviews. *Choice of informants* is discussed in the following subchapter. Thereafter, the *practical implementation of the research* is stated. Following subchapters presents the *data analysis* and the *quality of the research*.

3.2 Research Design

A research design should be closely linked with the purpose of the research. It should specify relevant data, the process of data collection, and how data collected will be analysed (Gripsrud, Olsson and Silkoset, 2006). The research methodologies can be classified depended on the type of data and the type of analysis. The type of data can either be *modelled data* or empirical data (Ellram, 1996). For this research, empirical data were gathered for analysis from a real world context through a case study. According to Ellram (1996), empirical methods have received increasingly attention due to possibilities of incorporating real world data for improving the relevance of business research.

The objectives of the research design may either be of *exploratory*, *explanatory*, *descriptive* or *predictive* purpose (Ellram, 1996; Yin, 2003). For this study, a descriptive-exploratory research was conducted. The rationale for this decision is further presented in the following section. The purpose of a descriptive research is to provide an accurate description of a given phenomenon. A descriptive case study is used when it is necessary to describe the phenomenon and the context, which the phenomenon exits (Yin, 2012). Exploratory research is used when the issue is concerning *how* and *why* something is done (Ellram, 1996). Exploratory case studies are used to illustrate a phenomenon within a context, or to illustrate a situation where the phenomenon that is being studied has no clear outcome (Yin, 2012).

3.2.1 Case Study Research

According to Yin (2012), a case study research can be defined as *"an empirical inquiry about a contemporary phenomenon (e.g., a "case"), set within its real-world context – especially when the boundaries between phenomenon and context are not clearly evident"* (Yin 2012, 4). A case study will be a beneficial approach when the variables are vague and the researcher has little or no control over the events while investigating a contemporary phenomenon. The case study provides an in-depth understanding of a single or a small number of cases where they are set in real-world context. Case studies can be a good tool for investigating "how" and "why" questions, and a good tool for developing new theories and ideas used for theory testing and refinement (Voss, Tsikriktsis and Frohlich, 2002).

In the introduction, see subchapter 1.1, it was identified that it has been questioned upon to which extent lean principles are applicable for the ETO sector. The subchapter further revealed that the shipbuilding industry would contribute significantly to the development of ETO literature (Gosling and Naim, 2009). A case study was a suitable design for this research, as the aim was to develop ETO literature by researching the applicability of lean procurement for a global shipbuilder, building high-end specialized vessels in a low-cost country. Vard Group were the case organization for this research, and the unit of analysis their global value chain with building location in Vung Tau, as this was considered as a typical unit within this context. According to Gripsrud, Olsson and Silkoset (2006) the traditional research process suggests to first use an explorative design in order to enhance the understanding and knowledge of the research area. Thereafter a descriptive or explanatory design is suggested in order to understand which aspects that need to be included in the research. Due to the purpose of this research, it was beneficial to breach with the traditional research process. In order to answer the research problem, five research questions were provided. For RQ1-2, a descriptive design was used. Given the nature of the research problem, the aim for this research was to evaluate the applicability of *lean procurement* for a *global ETO producer,* with building location in a low-cost country. Due to the complexity related to global ETO production, it was necessary to describe the identified value chain for detecting *where* procurement activities are conducted. As stated in the introduction, see 1.1, VVT have recently implemented lean philosophy in their procurement department. Hence, it was necessary to describe how VVT identify lean procurement, and further describe how this was reflected in the entire case organization. A sub-conclusion was provided for each of the research questions, which laid basis for the remaining research. An exploratory research design was used for exploring to what extent lean procurement may be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country. This was investigated by answering RQ3-5.

A case study takes form either as *single* or *multiple*. In advance of the data collection, the researcher must decide whether a single case or multiple cases will be used for addressing the research questions (Yin, 2013). According to Yin (2003), multiple and single case studies are variants within the same methodological framework, where no broad distinction is made between the two case study designs. However, multiple case studies have a distinct advantage of being more robust than a single case study. According to

Ellram (1996), the case in a single case study will be a self-contained experience, with a unique context that is part of the experiment. The single case study design will hence be suitable when the case represents a critical case to test well-formulated theory, a unique or extreme case, or a case where previously inaccessible phenomenon are revealed. The goal for a multiple case study is to develop a rich theoretical framework, where for instance multiple cases are used for predicting similar results among replications. If a multiple case study is used as research design, the researcher must evaluate how many cases are necessary to achieve desired generalizability of the results. Six to ten cases do in most situations provide compelling evidence to support or reject initial propositions (Ellram, 1996). As this research had a limited time scope, it was necessary to narrow the case study research into a single case study. The case used for this study can to some degree be considered as a critical case, where the aim is to evaluate the applicability of literature concerning lean procurement in a global ETO context. This is for developing and extending the ETO literature, which is in line with justifications given for selecting a single case research design (Yin, 2003).

3.2.2 The Research Methodology

This research will consist of an empirical study and a literature study, illustrated in figure 3.1. After the formulation of the research problem, a great amount of the literature studies were conducted in the initial phases of the research. Some aspects of the literature study have not further been presented in this research, as it was not directly used in analysis and discussion of the research problem. However, the initial research established a framework for the research and further literature studies. According to Yin (2003), a case study is always to some degree explorative, where the researcher does not know what the results will be. Hence, the researcher may discover new interesting research problems that can be of value, but is not themed in the project description. The initial literature study was helpful for the researchers to specify what was being studied in the research. The literature study relevant for analysis and discussion of the research problem, presented in chapter 2, established a definition of lean procurement used for this research. Based on this definition, the five research questions were developed. For this research, lean procurement were defined by lean supplier selection, lean relationship management and lean supplier development. Due to the extensive work with the literature study, the empirical study was

to some degree conducted simultaneously. This is illustrated by figure 3.1. The literature study supported the empirical study, where it helped defining what data needed to be collected. By conducting the empirical study and literature study simultaneously, it enabled procedures, knowledge and experiences from the informants to be exploited, and to organize and direct important aspects of the literature.

The literature study of this research is complied in chapter 2. Chapter 5 and 6 presents an analysis and discussion of the empirical study, where findings from the case study are seen in light of the respective theories. The analysis and discussion are given in two chapters, where chapter 5 concerns the descriptive RQ1-2, and chapter 6 concerns the explorative RQ3-5. It was necessary to divide the analysis and discussion chapters into two separate chapters, as findings from the descriptive research laid foundation for the analysis and discussion in the explorative research. The conclusion of this research is presented in chapter 7.

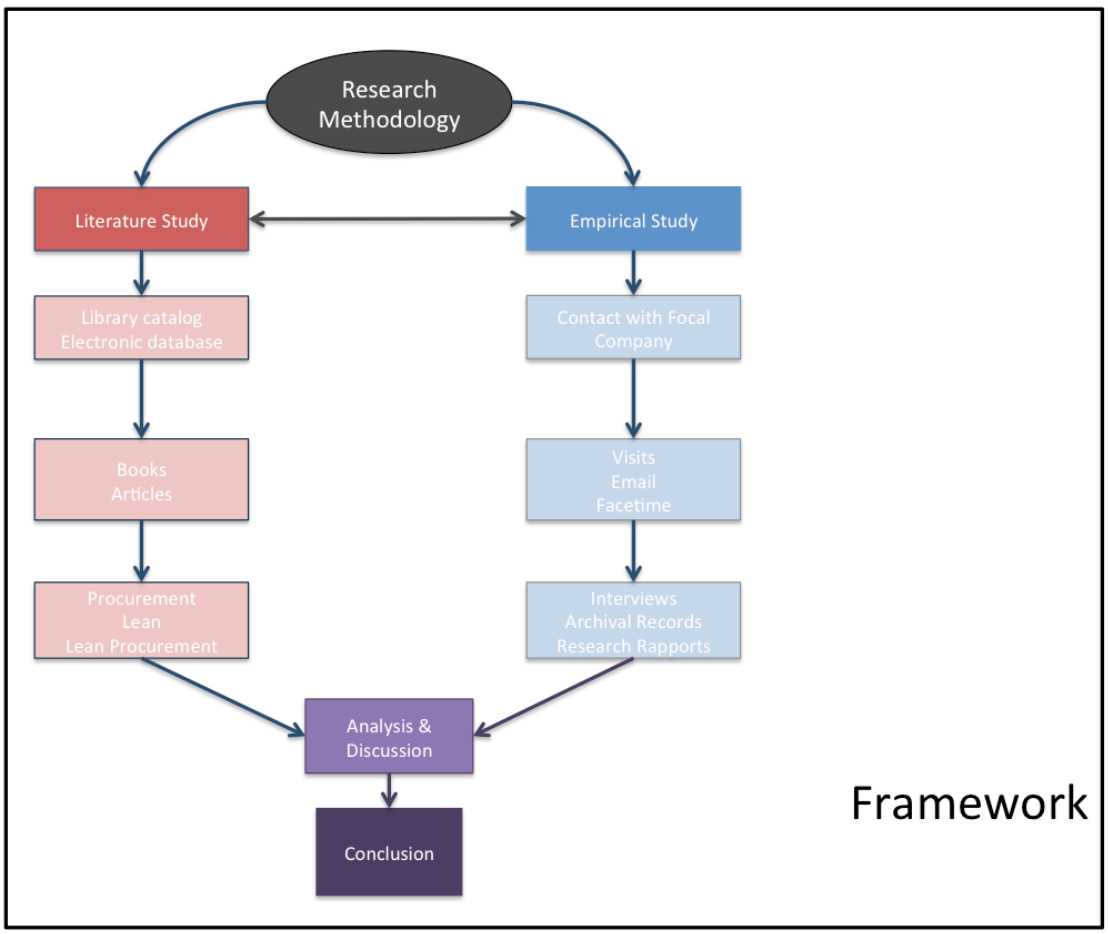

Figure 3.1: Research methodology

3.3 Data Collection

In data collection, it is distinguished between *primary data* and *secondary data*. Secondary data is used for secondary purposes, and is effective when gathering information on the areas where it can be difficult to obtain primary data. Already existing data are called secondary data, where researchers have implemented them for other purposes. All secondary data has once been the primary data for a given problem. The secondary data is used for both exploratory and descriptive research design. Since secondary data is collected for other purposes of analysis, the validity of these that are lower than for primary data. In the absence of adequate secondary data on a given topic, it will be appropriate to obtain primary data in order to get a broader understanding of the research problem. As shown in table 3.1, the literature study is conducted by secondary data. Further, secondary data in terms of research reports and archival records was used as support material for analysis and discussion of the empirical data. Primary data may be obtained by *qualitative* or *quantitative* methods, or a combination of both (Gripsrud, Olsson and Silkoset, 2006).

According to Yin (2012), a case study may be a pure qualitative or quantitative study, or a study that looks at a mix of both qualitative and quantitative data. Yin (2012), further argues that there are six key sources of evidence applicable to case studies; *archival records, documentation, interviews, direct observation, participant observation* and *physical artefacts*. The data collection methods will depend on the research problem. Quantitative methods merely provide a systematic understanding of human expression. By using quantitative methods, the researcher gain a quantifiable size analysed using various form of statistics and methodology (Gripsrud, Olsson and Silkoset, 2006). According to Ellram (1996), quantitative data are expressed through numerical, quantifiable terms. Qualitative methods, however, will provide an in-depth study of a phenomenon. This will be described further in the next subchapter. Given the nature of the research problem in this study, qualitative methods were mainly used for collecting relevant primary data. However, some data obtained from the research reports and archival records was secondary quantitative data. The distribution of data collected in terms of primary, secondary, qualitative and quantitative data is illustrated in table 3.1.

	Primary Data	Secondary Data
Qualitative Data	Interviews	Literature Study Research Reports Archival Records
Quantitative Data	#	Research Reports Archival Records

Table 3.1: Distribution of Collected Data

3.3.1 Qualitative methods

Qualitative methods are used for collecting data through texts, sounds and pictures. *Direct observations* and *interviews* are the main methods, where the data materialize in the form of text. The analysis will be based around these texts. However, data may also exist in form of audio and video recordings. The advantage audio and video recording is that it detects conditions that may be difficult to interpret from a text such as meta-communication. Meta-communication is non-verbal expressions including intonations, pauses, gestures and facial expression (Johannessen, Christoffersen and Tufte, 2011; Gripsrud, Olsson and Silkoset, 2006).

Data collected through interviews are based on expressions of the informant in conversations with the researcher. The information is dependent on the research problem the researchers aims to answer. According to Johannessen, Christoffersen and Tufte (2011), interviews are a suitable method for collecting data if the research problem is descriptive in terms of specific actions or events. Further, it is a suitable method for collecting data if the research problem is theoretical, where the aim is to elucidate, understand or explain specific actions and events. Based on the purpose of this research, data collection through interviews was suitable. In addition, e-mail correspondences were additionally methods for collecting qualitative data for this research.

3.3.1.1 Interviews

The purpose of the interview is to understand or describe a certain area or phenomenon (Johannessen, Christoffersen and Tufte, 2011). According to Kvale and Brinkmann (2009), qualitative interviews is characterized as a conversation with a certain structure and purpose. The interviews are more or less structured. For this study, *unstructured* and *semi-structured* interviews were used. Semi-structured interviews provide a good balance between standardizing and flexibility in the interview process. Unstructured interviews give an informal atmosphere, where it will be easier for the informants to express themselves (Johannessen, Christoffersen and Tufte, 2011). In advance of the data collection for this study, various research strategies for qualitative data collection was evaluated. It was decided to conduct both unstructured and semi-structured interviews with a selection of central people contributing in the defined value chain. The purpose of the interviews was to obtain descriptions of the informant's everyday world, allowing the researchers to interpret the meaning of the phenomena described. In this process, the respondents are seen as informants of knowledge and life experiences that the researchers want insight into. The answers provided by the informant are recorded as data in the qualitative interviews (Johannessen, Christoffersen and Tufte, 2011).

With qualitative methods it is possible to go in-depth in the area of study and get a more detailed description. This enables close relationship between the researcher, the environment and the informants (Repstad, 2009). The structure of interviews is connected to the division of roles between researcher and informant. In semi-structured interviews, the researcher provides topics and questions, which are to be answered by the informant. Since the researcher leads the conversations, it is her role to control the situation (Johannessen, Christoffersen and Tufte, 2011). This enables flexibility, where the researcher easily can make adjustments that may contribute to better results and quality (Ringdal, 2007). Further, it is argued that the informants more easily will express their experiences and opinions if they are involved in determining the content of the interview (Johannessen, Christoffersen and Tufte, 2011). In unstructured interviews, the questions and topics are not prepared in advance of the interview. This study categorizes the unstructured interviews as the interviews where no interview guide was provided. However, the researchers had prepared topics for the conversations, and conducted the interview as a conversation. This enabled flexibility. These benefits underlie the choice of

using unstructured and semi-structured interviews as methods for collecting qualitative data for this research.

However, there are some drawbacks. The less structured the interviews are, the higher the chance is that the relationship between the researcher and the informant will be decisive for the information collected (Johannessen, Christoffersen and Tufte, 2011). The researcher can inhibit the informant by asking leading questions or not being able to interpret and understand the meta-communication occurring in the interview (Briggs, 1986). The cost and time scope of interviews may be very demanding. The verifiability in interviews might also be a challenge (Gripsrud, Olsson and Silkoset, 2006).

3.3.1.2 Group Interviews

Group interviews may be a supplementary element to a research project in order to answer the research problem. The advantages of conducting group interviews are that it is time saving and efficient. It can be a good method for collecting data in harmless and actual circumstances. In some cases, the group interviews might detect actual attitudes and opinions easier if they are done in circumstances where the informants are comfortable. Additional information may be added and the interview might turn out to be a conversation between the informants, providing a more sufficient and complete evidence for the researcher (Repstad, 2009).

During the period of data collection for this research, an opportunity arose for conducting two separate group interviews. First, one interview was conducted with two informants from respectively Vard Brattvåg and Vard Søviknes. Secondly, one interview was conducted with three informants from VVT. An interview guide was used when conducting the group interviews. The informants were discussing the topics and questions they were provided. If one informant had trouble answering the question, the other informant assisted. Moreover, when one informant had answered a question, the other informant supplemented with additional information where they found it necessary. For some topics, discussions between the informants occurred, which led to interesting findings for the researchers.

Group interviews are most beneficial if they are conducted with a group of informants that are homogenous, with some variation. This increases the chance of detecting different opinions. The informants of the group interview conducted at Brattvåg had both the same position in the organization. They had both been in the organization for about the same time period, and had both previously the same experience from the organization. However, at present they were working at different sites, respectively Brattvåg and Søviknes, with different responsibilities. By conducting a group interview with only two informants, the informants could more easily discuss sensitive topics where they might have been emotionally attached (Johannessen, Christoffersen and Tufte, 2011). The informants of the group interview from VVT, however, had different responsibilities in the organization. However, the informants were somewhat homogenous, as they all had key positions in the same organization, where all were central people with respect to the lean implementation. A potential drawback associated with group interviews is that one only gets opinions that can be presented public (Repstad, 2009).

3.3.2 Interview Guides

In this research, lean procurement is defined by lean supplier selection, lean relationship management and lean supplier development. These elements were further described under the literature study concerning lean procurement, given in subchapter 2.4. The discussion of RQ3-5 in this research will mainly be structured around these elements. Based on the aim for this research, it was necessary to construct the interview guides in a manner where the theoretical concepts could be operationalized into empirical data. This was thoroughly elaborated under subchapter 2.5. The interview guides are given in appendix 1-6. Based on the research problem, the interview guides consist of different themes and questions. The bold blue headlines indicates the topic that were to be discussed, whilst the black questions indicates what the researchers asked the informants. The grey questions underneath were additional questions the researchers used for leading the informant into the right direction to ensure that desired data was obtained. To illustrate how the theoretical concepts will be reflected in the empirical data, the questions were marked in red with elements from the literature study; respectively lean supplier selection *(SS)*, lean relationship management *(RM)* and lean supplier development *(SD)*.

After the interview guides were developed, they were sent for feedback and approval to the supervisor. Depending on the purpose of the interview and the position of the informant, the interview guide was adjusted. Different interview guides used on different informants are illustrated in table 3.2. As seen in the interview guides, projective techniques of word associations were used to identify the informant's thoughts and knowledge of different theoretical concepts.

3.4 Choice of Informants

A characteristic of qualitative methods is that much information is wanted from a limited number of informants. Thus, the recruitment of informants in qualitative research has a distinct purpose. According to Patton (1990, in Johannessen, Christoffersen and Tufte, 2011), this is called purposeful sampling. In purposeful sampling, the researcher defines the target population for collecting relevant data. From this population, the researcher chooses informants that will contribute to the research (Johannessen, Christoffersen and Tufte, 2011). The choice of informants for this research was based on purposeful sampling. In collaboration with the researchers' supervisor and the researchers' contact person at VVT, informants were selected. Seven informants from Vard Group, two informants from Møreforskning, and one informant from Brunvoll contributed to the data collection. Some informants for this study were selected at initial stages of the research. Other informants were selected based on findings and the direction of the research while it was conducted.

In the table below, all contact with various informants are listed. The informants are presented by their job title and organization. The pilot interviews are further elaborated under subchapter 3.5. Information gained through various e-mail correspondences is also included in the table. Further the table indicates the length of the interviews, the purpose of the interviews, and which interview guide that was used (if any). For this research, it were conducted five unstructured interviews and six semi-structured interviews. Of the semi-structure interviews, two of them were conducted as group interviews.

Date	Informant	Method	Purpose	Dur	IG
31.10.14	General Director, VVT	E-mail	Request for master thesis	#	#
04.11.14-11.11.14	Procurement Manager, VVT	E-mail	Request for master thesis: discussed terms and requirements	#	#
11.11.14	Procurement Manager, VVT	FaceTime: conversation	Confirmation: confirmed the collaboration for the research	8 min	#
17.11.14	Procurement Manager, VVT	E-mail	Pilot studies: investigated interesting research areas	#	#
19.11.14	Lean Scholar, Møreforskning	Unstructured interview	Pilot studies: introduction to the lean concept as a research area	1h	#
27.11.14	Procurement Manager, VVT	E-mail	Mapping the value chain	#	#
14.01.15	Procurement Manager, VVT	FaceTime: unstructured interview	Mapping value chain	41 min	#
22.01.15	Procurement Manager, VVT	FaceTime: unstructured interview	Mapping the value chain: continued	1h, 4 min	#
03.02.15	Procurement Manager, VVT	FaceTime: unstructured interview	Mapping details for specific project – NB838	25 min	#
04.02.15	General Manager, Møreforskning	Unstructured interview	Obtained information of the maritime cluster and Vard Group's position	53 min	#
3.03.15	Vice President Sales and Marketing Dep., Vard Group	Semi-structured interview	Details around the sales of NB838, mapping activities for the first steps in the value chain, supplier selection, relationship management, supplier development	58 min	1-B1
04.03.14	Management Trainee Management Trainee, Vard Group	Group interview, semi-structured	Shipbuilding in Norway, shipbuilding in Vietnam, value chain, supplier selection, relationship management, supplier development	3h	2-C1
10.03.15	Procurement Manager, VVT	Semi-structured interview	Procurement process VVT, NB838 specific procurement, value chain, supplier selection, relationship management, supplier development	2h	3-A4
25.03.15	Production Director Planning Manager Procurement Manager, VVT	Group interview, semi-structured	Lean implementation at VVT	24 min	4-D1
16.04.15	Procurement Manager, VVT	E-mail	Follow-up from 10.03.15	#	#
17.04.15	Executive Sales Manager, Brunvoll	Semi-structured interview	Description of Brunvoll's relation to Vard Group, Brunvoll's perception of Vard Group's supplier selection, relationship management, supplier development	1h, 1min	5-E1
20.04.15	Senior Vice President Procurement, Vard Group	Semi-structured interview	Procurement process Vard Group's, value chain, supplier selection, relationship management, supplier development	44 min	6-F1

Table 3.2: List of informants

The number of informants needed for a research depends on the research problem. It is difficult to know the number of interviews needed, however recommended to conduct interviews until no new information is provided (Johannessen, Christoffersen and Tufte, 2011). This will be the saturation point for the data collection. In qualitative research, different informants have different status for the study. Hence, some informants may be interviewed several timed during a research. For this research, it was necessary to interview the procurement manager at VVT several times, as he was identified as a central informant for data collection. The general manager at Møreforskning was selected as informant, as it was known that he had conducted several research reports on the maritime cluster, including Vard Group as unit of analysis. In addition, a lean scholar from Møreforskning was selected as informant, in order to an introduction to the lean concept as a research area. The vice president in the sales and marketing department at Vard Group was selected as informant, as the informant was responsible for the sale of NB838. It was believed that the informant could contribute with information regarding accomplishment of procurement activities in the early phases of a project, and further information of how responsibility is acquired by VVT. The two management trainees working at respectively Brattvåg and Søviknes were selected as informants, as they both had experience from both VVT and Vard Group's sites in Norway. It was believed that they could provide information of how the shipbuilding process differs from different locations, and how the value chain is connected. The production director and the planning director at VVT were selected as informants, as they had been in charge of implementing the lean philosophy at VVT. It was believed that they could provide information of how the philosophy is implemented at various departments in the organization. The executive sales manager at Brunvoll was selected as informant, as Brunvoll is one supplier that is frequently selected in Vard Group's projects. Brunvoll were however not a supplier at NB838. However, as Brunvoll have been selected as a supplier for other projects, both for Norwegian sites and for VVT, it was believed to be interesting to interview them in order to get their perspective on how Vard Group works with supplier selection, relationship management and supplier development. The senior vice president of procurement at Vard Group was selected as informant, as it was revealed through the interviews that supplier selection, relationship management and supplier development are activities that often are conducted in Norway, where this informant will have much responsibility. This aspect is thoroughly highlighted in the analysis and discussion, found in chapter 5.

3.5 Practical Implementation of the Research

As initial preparation for this research, pilot studies were conducted. In case study research, the purpose of a pilot study is to further refine the research, which regards content and procedures. The case study may be modified, not only for the specific case study, but also for later case studies (Ellram, 1996). The pilot study in this research was conducted in order to reveal existing decisions alternatives and data that needed to be collected and analysed in this regard. The pilot study emphasised unstructured interviews and e-mail correspondence with the contact person at VVT, the procurement manager, in order to detect their field of interest for this research. Additional unstructured interviews with the scholars at Møreforskning were conducted in order to get insight of the lean literature and the industry of which Vard Group is operating. Based on this pilot study, interesting findings for further research arose. However, the pilot study was of special importance for improving the research plan before investing further time in the field.

E-mail correspondences were a method used for data collection in this research. Questions were written down and sent to the procurement manager, as shown in table 3.2. It was conducted semi-structured interviews of seven people in Vard Group. Three located at the site in Vung Tau, one located at the site in Brattvåg, one located at the site in Søviknes, and two located at the head office in Ålesund. The data collected from Vung Tau was done through interviews over FaceTime, Skype and e-mail correspondences. In addition, one interview with an informant from the site in Vung Tau was conducted at Molde University College, during his visit to Norway. One experience the researchers got by conducting interviews over FaceTime and Skype was that it was more difficult due to connection errors. However, this was coped with by devoting extra time for the interviews, and by sending follow-up e-mails when necessary. Hence, these difficulties were not further seen as limitations for this research. The respective interviews with informants located in Norway were either conducted at their work location, or through telephone. Both researchers were present at all interviews for this research to ensure consistency. Further, the interviews with Norwegian informants were conducted in Norwegian. This was done, as it was believed to be less sources of error by translating the data material into English, than to conduct the interviews in English. It was believed that the informants more easily could express themselves on their native language. However, this decision can be as a limitation to the research, as the informants initial expressions might have been lost in

translation when the researchers translated the data material used for citations in the analysis.

The majority of the pilot studies were conducted in November. Additionally, one interview was conducted early in February. The majority of the interviews for the main data collection were conducted from January through the end of April. A great amount of the empirical studies were conducted simultaneously as the literature study. After the interviews were conducted, the researchers wrote transcripts and an individual summarizing report of each interview. Through the interview process, the researchers gained experience and were more confident for each interview conducted. Hence, enriched information was obtained at the limited time the informant had available. Interviews were conducted until the researchers felt they met a saturation point. As the informants were interviewed with different purposes at various times in the research, the interview guides got more specific through the time of data collection. This was because it got clearer what data was needed later in the project for answering the research problem.

Recorders were used for interviews in this research. This enabled the researchers to concentrate on the answer provided by the informant. However, some notes were taken as it got more structured asking follow-up questions. Additionally, by recording the interviews, the researchers were able to pay more attention towards the meta-communication in the interview. When analysing the data collected, it was a great advantage to have done transcripts of the interviews recorded. The researchers had literal renderings from the interview, not filtered citations presented based on notes and the researchers' memory.

In addition to the topics and questions in the interview guide, a formal introduction was provided where the researchers presented themselves, the case study, the purpose of the interview, and general information of how the interview would be conducted. All informants were asked if they wanted to be anonymous, and if the conversation could be recorded. The informants were also informed about why the interview would be relevant for the research, and how the material would be handled at termination of the research. The informants was told when the interview approached completion, where they got a chance to add whatever they wanted to the conversation, as well as ask questions to the researchers if they had any. The different interview guides used on respective informants in the semi-structured interviews are presented in table 3.2. The interview guides

contributed as guidance for the conversations with the informants. However, the interview guides were not directly followed, as the aim for the interviews was to establish a conversation where the informants were free to add topics and additional information.

3.6 Data Analysis

In order to analyse, it is necessary to break up the data material into smaller pieces, then synthesize by building it up and put the pieces together with interpretations and coding. The goal is to create an overview of the material that enables the researcher to see new relationships that were not visible at first. Sometimes this will happen in the reverse order in which the result of the analysis is not new contexts, but rather a new look for contradictions and discontinuities (Brinkmann and Tanggaard, 2012).

It is necessary to encode data material collected from interviews by reducing the amount of text into meaningful units. This will also help in creating an overview. The codes are keywords that can either be data-driven or concept-driven (Brinkmann and Tanggaard, 2012). For this research, it was appropriate to use concept-driven coding based on the literature presented in chapter 2.

After the interviews were completed, the data was analysed. Transcripts were written for each interview, and additional reports summarizing reflection the researchers had of the interview. The reflections were based on meta-communication and answers provided by the informant. Before the data analysis started, each interview was reviewed in detail. Thereafter, it was made a comparison of the answer provided in the interviews. The data were categorized based on different topics. To easier compare the data, the information related to each topic was placed in columns for each informant. Additional information from e-mail correspondences and unstructured interviews were then included under each topic. The results from this analysis will be further analysed against the relevant literature with respect to defined research questions. This is followed by a discussion of these analysis with respect to the given research questions. This analysis and discussion is disclosed in chapter 5 and 6.

3.7 Quality of the Research

Grønmo (2004) suggests that quality in a research may be evaluated based on reliability and validity. Reliability should be evaluated in terms of stability, equivalence, internal consistence, and external consistence. Validity should be evaluated based on competence validity, communicative validity and pragmatic validity. In addition, Ellram (1996) and Yin (2003) suggests tactics that should be used for ensuring validity and reliability. In this subchapter, the quality of this research will be discussed, based on the issues and tactics suggested.

3.7.1 Reliability

Reliability is a fundamental question in all research. Reliability is linked to the accuracy of survey data, which data is used, the way data is collected, and how the data are processed (Johannessen, Christoffersen and Tufte, 2011). Ellram (1996) argues that the reliability also addresses the repeatability of the experiment, indicating that quality in the research is present if replication is possible where the same results are achieved.

According to Grønmo (2004), it is difficult to estimate the reliability for qualitative studies, as standardized method will not apply. This is due to the lack of structure in qualitative studies, as well as data collection and analyses often are overlapping processes. Further, the result of a qualitative research is very much dependent on the role of the researcher. The research approach is often developed under execution of the data collection, and is somewhat depended on the researchers analysis and interpretations of data before new data is collected. Moreover, the data collected is associated to the context of where and when the research is done. Thus, it is impossible to conduct another research based on the exact research approach (Grønmo, 2004). However, some reviews of the reliability of qualitative data may be done, where Grønmo (2004), suggests evaluating the stability and equivalence of the research.

3.7.1.1 Stability

An empirical baseline is established by repeatedly collecting data that is considered as stable from the same source in the same context. The empirical baseline is used for evaluating the stability of the research. For interviews, the researcher may ask the same questions to the same informants. Another method is to critically review the data at various times after collection. The purpose is to detect the stability of the researchers descriptions of the conditions that is studied. The stability is evaluated based on compliance between descriptions based on collection or reviews of data at various times (Grønmo, 2004).

The data collected for this research was at all times recorded. Immediately after the interviews, the researchers wrote a transcription, as well as a report indicating vital findings and impressions from the conversation. As shown in table 3.2, the interviews were conducted over a period of five months. Before analysing the interviews, the transcripts and reports were evaluated to make sure that reflections of the interviews were consistent with impressions the researchers got from reading the transcripts. This procedure was done two times for each interview before it was used for analysis. Furthermore, it was necessary to collect data from the same informant as the research approach developed. As a control, same topics were discussed in order to check for stability in the answers.

3.7.1.2 Equivalence

By comparing different research descriptions of the same conditions, one is able to check for equivalence as reliability in the research. These descriptions may be based on separate data collections from each researcher, where in interviews the same informant is questioned about the same topics at various times (Grønmo, 2004). Due to time limitations for this research, this was not done for this data collection. However, Grønmo (2004) suggests that equivalence is based on descriptions the researcher separately develops after data collection. The equivalence of the research is then evaluated based on comparisons of this material. Both researchers conducted the reports of the interviews individually. Afterwards the results were compared. In most cases the researchers had the same

reflections of the interview. Due to time limitations, both researchers did not write the transcripts from the interview individually.

3.7.1.3 Internal Consistence

The internal consistence is about the relationship between different elements of the collected data. The internal consistence is decent if the different data elements are plausible relative to each other and the data material as whole. This indicates that the different parts of the data collected fits well into an overall picture of what is to be studied. When reliability is evaluated for a research by comparing parts of the data collection, it is the consistence that is considered (Grønmo, 2004). For this study, the answers from the interviews could give an indication of the internal consistence. Different informants provided similar information independently on questions and topics. Moreover, the information was provided consistent with each other, and offered an overview that seemed reasonable in reliance to literature on the topic. This indicated that the internal consistence of this research have been decent.

3.7.1.4 External Consistence

External consistence is the relationship between the collected data and other relevant information. The external consistence is decent if the different data are plausible relative to other available information regarding the field that is to be studied. This indicates that the material fits well into the context that is being studied, and is perceived reasonable relative to this context (Grønmo, 2004). To support the external consistence in this research, procurement plans, contractual documents and project specific data were provided. It was of the researchers impression that the external sources of material supported the data collected through the interviews.

3.7.1.5 Case Study Tactics

In case studies, *case study protocols* and development of *case study base* are two fundamental keys to reliability (Ellram, 1996; Yin, 2003). A case study protocol often includes an interview guide and procedures followed in using the test instrument (Ellram, 1996; Yin, 2003). The intention of a protocol is to guide the researcher in carrying out the data collection from a single case study (Yin, 2003). A research plan was developed for this research, introduced in subchapter 3.2.2. The development of a case study base is conducted to verify the evidence, as well as provide a formal assembly of evidence independently of the research purpose (Ellram, 1996). For this study, the case study base consisted of interview guides, makers-list for NB838, purchase plan for NB838, contractual documents, additional notes taken outside of interview, e-mail correspondences, transcriptions and interview reports.

3.7.2 Validity

According to Kvale and Brinkmann (2009), validity is the extent to which there is credibility in the data collected in reliance to the research problem the study aims to answer. There might be high reliability in a research, however this does not necessarily indicate that the data is relevant for the purpose of the study (Grønmo, 2004). Since the validity of the data includes more aspects than the reliability, the evaluation of validity is more complex and less precise. Hence, different criteria apply for different measurement of validity. What is most accurate for evaluating the research quality will depend on the research structure. With respect to qualitative research, Grønmo (2004) argues that there are three types of validities that are common for evaluation data: *competence validity*, *communicative validity and pragmatic validity*. Moreover, research quality in terms of *external validity, internal validity* and *construct validity* are identified as four issues addressed by Ellram and Yin (1996; 2003). This will be discussed further in this subchapter.

3.7.2.1 Competence Validity

Competence validity refers to which extent the researcher has competencies in the field for collecting qualitative data. The competencies are connected to the researchers experiences, assumptions and qualifications related to this type of data collection. If the researcher has high competencies, the quality of the data collected tends to be better, as the data is more likely to be relevant for answering a research problem. Hence, the quality of the data is connected to the researchers competencies. Again, this is associated with the role the researcher has in qualitative data collection. The competencies is not only related to the methodological approach of the research, but also to the researcher's ability to develop relations to the informants and the researcher's ability to develop a theoretical interpretation of the data collected. Based on this, it is more likely to find the most relevant information for answering a research problem, easier to collect data, and it gets possible to assess the relevance of how aptly the data are for concepts that are central in the study (Grønmo, 2004).

The researchers in this study had some experience with qualitative methods. Both researchers had qualitative methods as main method for collecting data when writing the bachelor thesis. The researchers had written the bachelor thesis for different purposes, and the individual experience obtained from this process was seen as strength during preparations for data collection for this study. However, the scope of data collection method is somewhat broader for a master thesis compared to a bachelor thesis. Thus, the researchers still had much to learn about qualitative methods when preparing for data collection for this research. As a preparation for the interviews, the researcher had to devote time to build theoretical knowledge of qualitative methods to compensate the lack of experience in the field. Methodological literature and conversations with the supervisor was of significant help in this phase of the study. Further, the researchers' personal qualifications became advantageous during data collection, as it enabled them to communicate well with the informants. The focus was to have conversations with the informants, not formal interviews. With this focus, a good dialogue with informants was easily developed through the interviews. With a good dialogue, there is less risk of misunderstandings and misinterpretations. Based on previous experiences, formal and informal competencies in qualitative methods, it is believed that the researchers have been capable of interpret the data collected in light of theoretical perspective in this field.

3.7.2.2 Communicative Validity

The communicative validity builds on dialogues and discussions between the researcher and others. Accuracy of the material is evaluated with respect to the research problem of the study. The discussion partner may be the source itself, or other researchers. This kind of discussion is beneficial for detecting possible challenges and weaknesses in the data material. The validity can be evaluated to be high if the discussion results in agreement or consensus in that there is not any specific problems or weaknesses relative to the intentions of the study (Grønmo, 2004). For this study, the only validity discussion of the data material was conducted between the two researchers. It was not facilitated for discussions with other parties in this research, which might be a limitation of the validity. However, the supervisor was sometimes participating in discussions of implementation of the interviews and the results, before and after the interviews.

3.7.2.3 Pragmatic Validity

The pragmatic validity refers to the extent the data material and the results in a study create a baseline for certain actions. The validity may be considered high if the study constitutes a good basis for developing a plan of actions. This is a question of whether or not the results and knowledge obtained through the study is applicable in a real life context (Grønmo, 2004). The aim for this study was to describe Vard Group's global vale chain with building location in Vung Tau. Based on this, the aim was to *evaluate* and *understand* to what extent lean procurement would be applicable. Hence, the result of this research will not suggest a plan of actions for improvement of lean procurement in this area. However, it was necessary to detect opportunity areas and challenges of lean procurement within this context. These results may be used as a foundation for further work with lean procurement in an ETO production organization with a global value chain. This is discussed under further research, chapter 8.

3.7.2.4 Case Study Tactics

According to Grønmo (2004), internal and external validity is often used in experimental testing of causal hypothesis. However, in case studies, Ellram and Yin (1996; 2003) argues that internal and external validity is two of four issues that should be addressed when evaluating the quality of a research. Internal validity for case study research is only a concern in causal (explanatory) case studies, and will be irrelevant for exploratory and descriptive case studies. Based on the research design for this research, internal validity will not further be discussed in this section. Ellram and Yin (1996; 2003) emphasize construct validity as an issue that should be addressed when evaluating the quality of a research. External validity and construct validity for this research is discussed below.

External Validity

The external validity is a reflection of how accurately a result represents the actual phenomenon studied. This indicates the generalizability of the results. One major criticism of case studies is that there is a lack of generalization of the data (Ellram, 1996). External validity is one of the major barriers in case studies, as criticism are put towards poor basis for generalization when having a single case. However, case studies rely on analytical generalization, where the researcher aims to generalize a particular set of results to some broader theory. This generalization is not automatic, and should be tested by *replicating* the findings in various cases. For this research, a single case design was selected. According to Yin (2003) a case study that includes multiple cases will be seen as more robust, as evidence from multiple cases often is considered to be more compelling. In order to follow the replication logic mentioned, multiple cases are necessary. Thus, in this research the external validity is limited due to the research design consisting of a single case study.

Construct Validity

According to Yin (2003), construct validity is to establish correct operational measures for the concepts being studied. Thus, this part of the data collection will be closely linked to

the reliability. According to Ellram and Yin (1996; 2003), three case study tactics are associated with the establishment of construct validity; to *use multiple sources of evidence,* to *establish chain of evidence* and to *have key informants review draft case study reports.*

Triangulation is a common term in case study design, which is the use of multiple sources of data to support evidence. Triangulation will help overcome the information bias that might occur when interviewing human subjects (Ellram, 1996). The additional sources of evidence may be documentation, archival records, direct observations, participant observations and physical artefacts (Yin, 2003). By using multiple indicators, more stable and reliable results are achieved (Ellram, 1996). A major strength for data collection in case studies is to use many different sources of evidence where it is possible (Yin, 2003). Since multiple sources of evidence are not used on all findings for this research, it will lower the validity of the results. However, in addition to the data collected through interviews in this research, exchange of documents was done on areas where it was necessary for further insights. Further, to clarify issues and corroborate data, discussions and follow-up emails were sent to informants when necessary.

Establishing a chain of evidence is done so the reader of the thesis will be able to follow the case study and analysis from initial formulation of the research question to its final conclusion (Ellram, 1996). For this thesis, various external researchers could have reviewed the thesis in terms of the research question, the research plan, the protocol for interviews, the analysis and the discussion of the results. Further, various external researchers could have reviewed this research for logic, clarity, flow and content of the paper. This would have given external verification, which could have been used for identifying a logical flow and a chain of evidence. For this paper, the supervisor was individually reading parts of the paper to give feedbacks on these areas during the period where the research was conducted. In addition, several drafts were sent to the supervisor close to due date for delivery on order to obtain such feedback.

The last element to support the construct validity of a research is to have it reviewed by key informants of the case. The notes the key informant takes during the review may be valuable for the case, as well as the researcher has the chance to publish them as a part of the case study (Yin, 2003). For this research, key informants did not read the finished paper due to time limitations. However, as a part of the descriptive research, one key

informant reviewed the description of the value chain and the description concerning VVT's implementation of lean in the organization.

4. Case Description

4.1 Introduction

The purpose of this chapter is to identify the case, and to rationalize why this case is suitable for this research. In addition to published literature, this chapter includes background information presented by informants from Vard Group. This chapter has a three-folded structure, where the first subchapter provide a description of the shipbuilding industry in Midwest Norway. Further, background information of the case organization, Vard Group, will be given followed by a subchapter presenting background information of the shipyard in Vung Tau.

4.2 The Maritime Cluster in Midwest Norway

The shipbuilding industry in Midwest Norway has through a long tradition built a versatile and highly competent maritime industry (Nærings- og handelsdepartementet, 2005). The figure below illustrates that the total turnover in the maritime cluster during the 25 past years have increased from approximately NOK10 billion to nearly NOK 50 billion in 2009 (Guvåg et al., 2012).

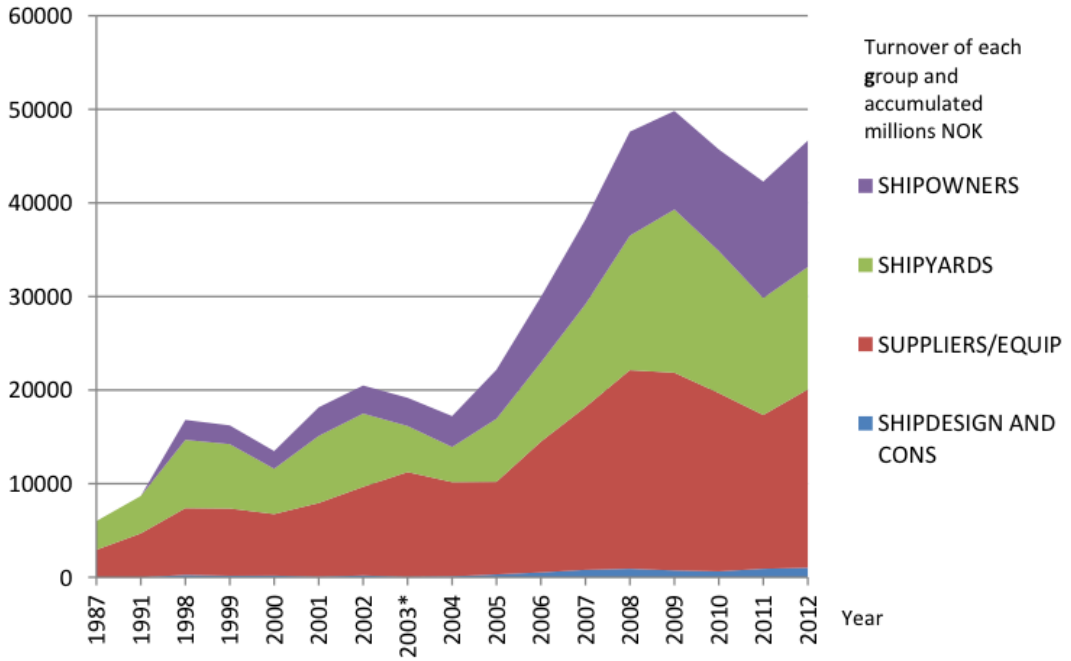

Figure 4.1: Turnover of different actors in the maritime cluster in Midwest Norway (Guvåg et al., 2012, 14)

Based on a report from 2014, The Norwegian Maritime Cluster consists of 13 shipping consultants, 14 shipyards, 20 shipowners and 169 suppliers of equipment and services. In 2014 the cluster had a calculated turnover of around 55 billion NOK, about 22 000 employees, and 1 400 hired labour (Oterhals, Hervik and Bergum, 2014). The interaction effect between the actors is vital and develops the competitive power for the Norwegian maritime cluster. This is further very important for the innovative capacity and adaptability of the cluster in an international competitive market (Hervik et al. 2012).

For a long time the shipyards performed most of the value-adding activities internally, before many of these activities were outsourced during the 1980s and 1990s. This laid basis for the highly competitive and specialized supplier industry in Norway, which exist today (Guvåg et al., 2012). Figure 4.1 illustrates that during the period the suppliers as a group gained competitive strength, and become highly competitive globally within the high-end segment of specialized vessels. The Norwegian supplier industry of maritime equipment exports approximately 67% of their production (Nærings- og handelsdepartementet, 2005).

A research was conducted in 2011 on the ripple effect of the maritime cluster, where STX OSV (now Vard Group) was the case unit. The research found that Norwegian suppliers represented 66% of equipment and services supplied to the shipyard. The suppliers in Midwest Norway represented 42% of this share (Guvåg et al., 2012). This indicates that the supplier industry in Midwest Norway is highly important for the shipyards, as the ripple effects are strong.

Vard Group are one of the 14 shipyards in the Norwegian Maritime Cluster, and were used as case organization for this study. Some background information will be presented in the following sections.

4.3 Vard Group

Vard Group are a major designer and shipbuilder of specialized vessels for the oil and gas industry, such as exploration-, production- and offshore service vessels. They are operating on a global scale with ten modern shipyards located in four different countries: five in Norway, two in Romania, one in Vietnam and two in Brazil, with the headquarter based in Norway. In total the group has 11 779 employees worldwide (Vard Group, 2015a). Their long tradition within shipbuilding, skilled employees and innovative design combined with experienced suppliers enable them to provide their customers with advanced and customized vessels and solutions, which ensures access to the fast growing oil exploration markets (Vard Group, 2015b).

The ownership structure is illustrated in the figure below where Vard Group were listed on the Main Board of the Singapore Exchange in 2010. In January 2013 Fincantieri Oil and Gas S.p.A., a wholly owned subsidiary of Fincantieri S.p.A., acquired Vard Group and now owns 55.63%. Fincantieri are headquartered in Triste, Italy and is one of the largest shipbuilding groups in the world with over 200 years of maritime experience and 7.000 built vessels. Fincantieri improved the competitive position of Vard Group in the offshore industry, which is now becoming a major leader within the sector (Vard Group, 2015b).

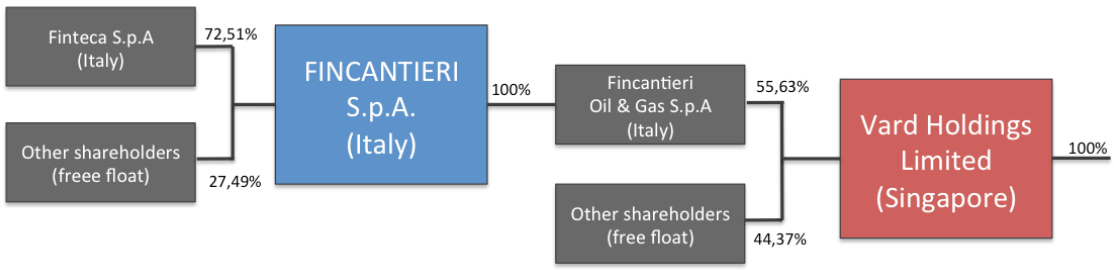

Figure 4.2: Ownership structure (Vard, 2015, 18)

Vard Group delivered 18 vessels during 2014: 14 from Norway, one from Romania, two from Brazil and one from Vietnam (Vard Group, 2015a). Of these were 7 platform supply vessels, 3 anchor handling tug supply vessels, 5 offshore subsea construction vessels and 3

other specialized vessels. The order intake early 2014 was record high, and by the end of the year the order book consisted of 45 vessels. Further, the annual report from 2014 shows consolidated revenues of NOK 12.92 billion for the financial year 2014, which is an increase by NOK 1.76 billion compared to 2013 with revenue of NOK 11.16 billion. The procurement function is central throughout Vard Group's value chain. Major equipment represents a high share of the total cost of a vessel. The main vessel specific equipment, such as engines, propellers, generators, thrusters and powerful winches on an anchor handler, represents more than 50% of the total costs of the vessel (Vard Group, 2015a).

The core market for Vard Group is the North Sea with a dominance of Norwegian clients. However, the proportion of customers located in Norway has decreased from more than 50% of the contracts in 2013 to 40% in 2014. Moreover, the number of customers based in Europe and North America has increased significantly during the same period (Vard Group, 2015a).

As stated in the introduction, see chapter 1.1, the actors in the Norwegian maritime cluster is influenced by a globalization, where their challenge is linked to exploiting the international market in own advantage. This is difficult as innovation, competence development, productivity improvement and smart logistical solutions must compensate for the high Norwegian cost-level, as competition from low-cost countries increases. Vard Group are an interesting case organization for this research, as they have followed the trend in the Norwegian Maritime Cluster by building shipyards in low-cost countries. Informants revealed initially in this research, that the advantage of building vessels in low-cost countries is linked to the low cost-structure, compared to Norway. It has further been proposed that adaptation of lean principles is an alternative for the Norwegian shipbuilding industry of specialized vessels in order to address the challenges the industry is facing, see chapter 1.1. The VVT shipyard claims to have implemented lean principles in the procurement function. Vard Group's value chain with production in Vung Tau is an interesting unit of analysis where the shipyard in Vung Tau is already familiar with the lean philosophy. In the following section, background information of VVT will be presented.

4.4 Vard Vung Tau

VVT are a fully integrated shipyard owned by Vard Group. VVT are one of the eight major shipyards located in Vietnam with 882 employees in 2014 (Vard Group, 2015a). The shipyard takes projects from hull construction to delivery of the vessels. The first vessel was delivered in 2010 and was built simultaneously as the yard was raised. During the following years, nine vessels have been delivered from this yard (Vard Group, 2015a). In the annual report presenting 3Q results it is stated that the yard has currently six projects in the order book, of which five are under construction and one in the planning phase (Vard Group, 2015a). This ensures sustainable yard utilization and extending order book visibility to 2016. Since the shipyard was established in 2007 it has been operated by Norwegian management with years of experience from the maritime industry in Norway. The following figure illustrates the organizational structure for VVT.

VVT's customers are Norwegian and international ship owners (Vard Group, 2015a). VVT are recognized as an industry example by their implementation of lean philosophy. In the latest years, the shipyard has expanded the lean implementation into other departments. The latest department to be included was the procurement department.

The unit of analysis in this research is Vard Group's value chain with production in Vung Tau. In order to go more in depth of this value chain, one specific project will be highlighted through discussions and analysis in order to specify the data collected and to simplify the scope of the research. Background information of this project is presented in the following section.

Building NB838

The vessel is building number 838 for Vard Group, and was sold December 16th 2014 to Farstad Shipping in Ålesund. Earlier, VVT have built platform supply vessels and anchor handler vessels, which have been based upon prototypes previously built at Vard Group's other shipyards. NB838 is the first construction vessel to be built in Vung Tau, and thus the first prototype vessel build on this shipyard. The sales price is confidential, however

the contract price was NOK 550 millions. Estimated delivery date for the vessel is Q4 2016. Most of the components and equipment needed for the building process is bought.

5. Analysis and Discussion of RQ1-2

5.1 Introduction

The aim for this research is to investigate to what extent lean procurement, identified to be lean supplier selection, lean relationship management and lean supplier development, will be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country. In order to answer this research problem, five research questions have been formulated. It was necessary to divide the study into two research designs, where the RQ1-2 are of descriptive nature, and RQ3-5 are of explorative nature. The aim for this chapter is to answer the two descriptive research questions. This chapter has a two-folded structure, where RQ1-2 will be answered respectively. Sub-conclusions will be identified, laying basis for remaining research. References from the literature study will be repeated throughout this chapter. Case study findings presented in this chapter are based on interviews with informants from Vard Group's identified value chain, as well as archival records.

5.2 Vard Group's Global Value Chain

This subchapter aims to answer RQ1, presented below:

RQ1:
Where in the case organization's value chain are procurement activities conducted?

In order to answer RQ1 it was first necessary to describe Vard Group's global value chain with building location in Vung Tau and further investigate where the stated procurement activities are conducted. This subchapter has a two-folded structure. The first section identifies and describes Vard Group's global value chain with building location in Vung Tau. As RQ1 uses a descriptive design, a clear discussion will not be given in this subchapter. However, a sub-conclusion is provided in the second section in order to answer RQ1.

5.2.1 Activities in the Value Chain

The following figure illustrates the case organization's identified value chain. It is important to emphasize that this figure is a simplified and sequential representation, where in reality procurement, engineering and fabrication activities are performed in near concurrency throughout the project execution. Furthermore, this value chain is based on building NB838, and details may therefore differ from the building process of other vessels. One of the informants in Vard Group stated that none projects are completely the same within shipbuilding, and great variations may occur.

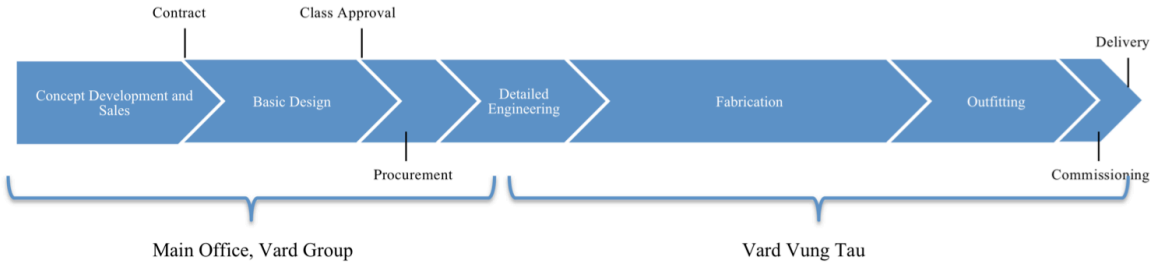

Figure 5.1: Vard Group's global value chain with building location in Vung Tau

As the figure above illustrates, the main office in Ålesund handle the first phases in the value chain before the project is taken over by Vung Tau in the detailed engineering phase. The rest of the phases are thereafter handled by VVT. This value chain is thereby characterized as a global value chain, where the value adding activities are performed at various global locations. Each phase in the value chain will further be described below based on information from building NB838.

Concept development and sales

Concept development and sales is the first phase in the value chain, taken care of by the main office in Ålesund. This phase is very often conducted in a similar manner independent on the building location in Vard Group. For NB838 the process was the following: Farstad Shipping, which is the shipowner, contacted Vard Group in Ålesund in

November 2013. A broker had then sent a tender to Farstad Shipping on behalf of Technip, which is one of the worlds largest subsea companies. Thereafter, Farstad Shipping contacted Vard Group in 2013 where they requested a concept development respected to Technip's criteria. Farstad Shipping is thereby characterized as tier 1-customer, whilst Technip is a tier 2-customer from Vard Group's perspective. This is illustrated in the figure below. Thereafter, the process went back and forth between Farstad Shipping and Vard Group in order to prepare the building specifications. It was Farstad Shipping who decided that they wanted the vessel built at the yard in Vietnam, due low cost-levels compared to Norway. However, the price on the main equipment used on the vessel is generally the same, as several of the same suppliers often are used on the different projects independent on the building location and nationally of the buyer.

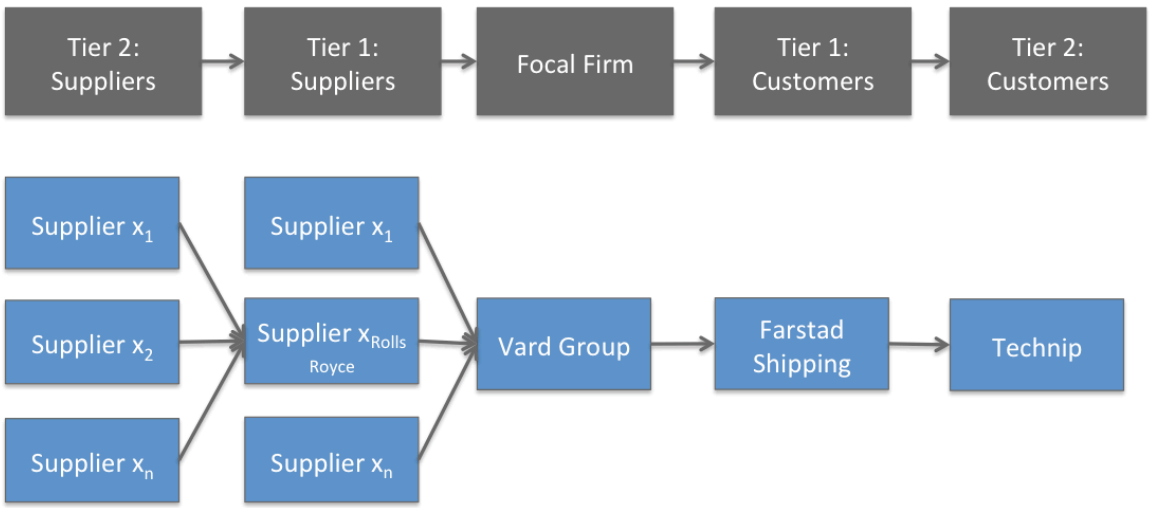

Figure 5.2: Simplified map of the supply chain

Further, this phase includes an agreement upon potential suppliers, which can fulfil the specifications and requirements from the tender process mentioned above. For customized and highly advanced vessels, suppliers of main equipment are of high importance. Both Vard Group and the shipowner will provide a makers-list. Informants from Vard Group communicated that the makers-list proposes suppliers of, what Vard Group identify as, *key products* for the vessel. The procurement department in Vung Tau take further care of the

makers-list and handle the contractual agreement with the suppliers after the contract is signed between Vard Group and the shipowner in the following phase.

Contract

The contract is signed after accomplishment of the concept development phase, as well as when the shipowner and Vard Group have agreed upon the makers-list. Right after the contract is signed the procurement department in Vung Tau are included in the process. This is important in order to obtain technical support from the suppliers early, as they need the main equipment on the drawings in the basic design phase and before the detailed engineering can start. This applies especially for NB838, as the vessel is a prototype. A vessel using an old design on the other hand, does not require the technical support in order to conduct the basic design phase. However, the processes further, independent of new design or not, require comprehensive planning by the procurement department. The yard wants the products delivered when they are needed, not before and certainly not after. The procurement department therefore need to develop a purchase plan immediately after the contract is signed.

Basic design

The basic design phase is related to the concept development and sales phase, and is mainly developed by the design department in Ålesund. This phase includes a roughly design of the vessel, where the main components and equipment are included on the drawings.

Procurement

As mentioned, the purchase plan is developed immediately after the contract is signed. The purchase plan is systemized in accordance to SFI Group System. The SFI is used between enterprises within the maritime and offshore industry, and is a code of information. In Vard Group each product group has a designated SFI code, which is used throughout the system regarding purchases, bookings, installations and other functions (Guvåg et al., 2012). A vessel is roughly divided into nine sections, where each section is further divided

into more detailed sections based on SFIs. In the purchase plan, VVT specify clarification and delivery dates, which are required by the production department for when they need the equipment at the yard. These dates are in the first place based on earlier experience from the production department, as they know how long time each item will need from production starts at the supplier's site until delivery in Vung Tau. For the main engine they plan 48 weeks: 40 weeks in production, and 8 weeks for transport. However, the dates may be adjusted during the process before a final contract is signed with a supplier. VVT receive the makers-list from the main office in Ålesund, and will based on this develop the purchase plan. A tender process amongst the recognized suppliers on the makers-list needs then to be conducted. However, some of the components are decided upon before VVT take over the responsibility. One example is the main crane for NB838, where several technical criteria had to be discussed with the supplier before the contract was signed. Only MacGregor would accommodate for the criteria given, and it was put as an addendum to the contract that this supplier would be used. Further, the main office in Ålesund contact suppliers likely to be selected, so costs can be estimated in order to provide a contract price for the shipowner. This is necessary, as the key products on the makers-list are characterized by having high value. Obtaining key products are considered as major purchases that demands project-specific contracts. There is no limit for how many suppliers that may be listed on a makers-list, however for NB838 at least one, and up to seven, suppliers were recognized. On average, three suppliers were listed for each SFI.

VVT divide their purchases into three main categories. The first category is the mentioned key products listed on the makers-list. The second is products obtained through purchase orders, which are characterized as low value items where no contract with the supplier is needed. The final category is products obtained through framework agreements, which are characterized as low value standard equipment used on every vessel. For these products, long-term contracts are signed with a supplier unrelated to a specific project.

As stated in subchapter 1.3, one limitation for this research is to only investigate strategic components. Based on Kraljic's purchasing portfolio (1983), it is possible to roughly categorize the key products. The dimensions in the Kraljic's purchasing portfolio are represented by supply risk and profit impact, measured from low to high. Literature suggests measurement criteria for each dimension (van Weele, 2014). Applicable criteria will be further emphasized. As the supply of key products is project-specific, it makes the

switching costs low from one project to another. However, switching costs would be considered as high if a supplier of key products would be changed during a project. As the components are ordered early in the project phase to ensure on-time delivery, one could expect delays in production if a supplier of a key product would be changed during a project. Further, if a supplier is changed during a project, VVT are obligated to do a new tendering process amongst remaining suppliers on the makers-list, which would be time and resource consuming, and in worst case increasing the delay. With respect to the tendering process, available substitutes and scarcity of suppliers in the market is limited to suppliers proposed on the makers-list. As identified, there will on average be two potential suppliers left on the makers-list. The scarcity of suppliers will be high and available substitutes will be considered as low, which increases the supply risk. In terms of geographic distance, case study findings revealed that the key components never are obtained from Vung Tau, however often purchased from Norwegian suppliers. Hence, the geographic distance from Norway to Vung Tau is long, which is increasing the supply risk. An overall evaluation of the key products would in general imply a high supply risk. Furthermore, the other dimension of Kraljic's purchasing portfolio is discussed. The profit impact relates to the impact of the purchasing on the bottom line for the company. As mentioned, the key products are in general of high value, where they together constitute for around 75% of the total value on a vessel. Further, the impact the key products have on the quality of the vessel is crucial, which is discussed more thoroughly in the next chapter, chapter 6. Hence, the profit impact for the key products is considered as high. Based on this simplified analysis of the Kraljic purchasing portfolio, the key products have a high supply risk and a high profit impact. Thus, the key products are further described as *strategic components* based on Kraljic's purchasing portfolio. As identified under limitations to the research problem, given in chapter 1.3, the strategic items will be the main focus for further discussion in the next chapter, of lean supplier selection, lean relationship management and lean supplier development. This is based on Johannesen, Schjølberg and Vik (2013), who emphasize that when a selection of elements from the lean supply model is used, it should be applied on products where quality, reliability and responsiveness is of concern. This corresponds with the recommended strategies for strategic components presented by Caniëls and Gelderman (2005), who argues that the aim for the relationship with strategic suppliers is to build a long-lasting partnership in order to achieve improvements in quality, delivery, reliability, lead-times, product development, product design and reduction of costs. However, the two other identified purchase

categories, obtained by purchase orders or framework agreements, will not be totally excluded, as they will represent a benchmark for further discussions.

Class approval

Next phase after the basic design is *class approval*. The vessel needs to be approved by *Det Norske Veritas* (DNV) in accordance to maritime rules and regulations.

Detailed engineering

In the *detailed engineering* phase the design department in Norway and the one in Vietnam cooperate, and gradually are the project handed completely over to VVT. The difference between basic design and detailed engineering is that the latter is more detailed and includes more components like pipes and cables on the drawings.

Fabrication

The next phase is fabrication, and the activities related to this phase are all performed in Vung Tau. The fabrication phase starts when the first steel plate is being cut and lasts until outfitting phase starts. The shipowner is able to change their orders during the basic design, detailed engineering and fabrication phase. However, change-orders may have an impact on the total price of the vessel and delivery consequences, which the shipowner will have to take the risk for if the change order occurs late during the building process.

The shipbuilding in Vung Tau is section based, meaning that each section is constructed separately before being assembled afterwards. One section can for instance contain the main engine. It is important that the large equipment is included in the section before the vessel is assembled, in order to avoid problems related to cutting in the hull after assembly. When the vessel is launched in the dock, the commissioning phase can start. Thus, this phase starts in the middle of fabrication. The outfitting can be handled simultaneously as the commissioning. This is because major parts of the commissioning are carried out in the machinery room, whilst outfitting is mostly prepared at another floor in the vessel. During fabrication, outfitting and commissioning, the shipowner is

continuously on inspection on-board the vessel making sure the vessel is in line with the required specifications.

Outfitting

The next phase after fabrication is the outfitting phase. In this phase the vessel is outfitted with the remaining equipment, which was not installed in the fabrication phase. Remaining steel work and instalment of equipment on deck is finished. Furthermore, the cabins will be furnished and the galleys will be installed.

Commissioning

Although some of the commissioning starts in the fabrication phase after the vessel is launched, the main part of commissioning work is still carried out after the outfitting. For all strategic equipment and devices, commissioning and instalment is part of the contract agreement with the supplier. They need to make sure that the equipment is in line with the specifications in the contract. Furthermore, the supplier also need to be present in Vung Tau for the sea trial in order to test and fine-tune their equipment during a testing period before the vessel is ready for delivery to the shipowner.

5.2.2 Sub-conclusion RQ1

Based on RQ1: *Where in the case organization's value chain are procurement activities conducted?*, this research concludes that the procurement activities are conducted at various stages in the identified value chain. The figure below illustrates where the procurement activities are conducted throughout the value chain. The concentrated red colour indicates the procurement activities are mainly conducted in the earliest phases, whilst the faded red colour indicates that some procurement activities may occur during the later phases.

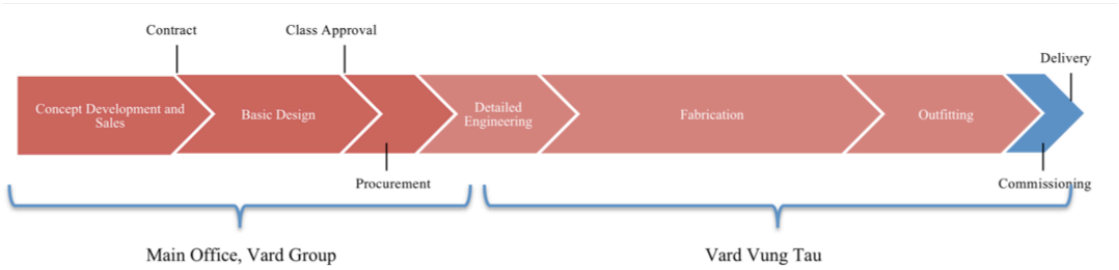

Figure 5.3: Procurement activities in the value chain

5.3 Lean Procurement in the case organization

This subchapter aims to answer RQ2, presented below:

RQ2:
How is lean procurement reflected in the case organization?

As the introduction and case description identify, see 1.1 and 4.2, VVT are recognized as an industry example of their lean philosophy, which has recently been implemented in their procurement department. In order to answer RQ2, it was necessary to describe how VVT identify lean procurement, and further describe how this is reflected in the entire case organization. This subchapter has a three-folded structure. The first section identifies the lean thinking at VVT. The second section describes the improvements VVT experienced after the implementation. The last section provides a sub-conclusion based on RQ2.

5.3.1 Lean thinking

For VVT lean thinking started as an improvement initiative of the production in order to obtain better control as they focus on having an early outfitting strategy. This implies that a major focus for them was to include big components and equipment as early as possible in the building process in order to avoid cutting the hull after the vessel has been assembled. VVT have received attention for their successful implementation of lean thinking in their production department from other yards within the Group. However, VVT propose that their idea is that lean needs to be implemented in all departments within the organization to obtain complete synergy effects of the philosophy. VVT further propose that the main focus for them in order to be lean is to set dates for when the different parts are needed at the yard, and that all departments need to work in accordance to these dates. This creates great interdependence between the different departments, and hence their system Prima Vera has been of great importance for the lean implementation. Prima Vera is mainly planning of activities, which is highly important for this industry. Improved planning activities will impact the other departments, including procurement. Improvement in the procurement activities is highly dependent on a well functioning planning system. However, as procurement related activities and major parts of design

activities are conducted at the main office in Ålesund it was relevant to map the perception of lean from the informants located in Ålesund. The informants at the main office expressed that they were unfamiliar with lean thinking. They further communicated that this was not relevant for Vard Group as far as they knew of.

5.3.2 Improvement after lean implementation

The informants at VVT agreed that after the lean implementation the whole organization has a better overview over the progress of the projects, as all the different departments in VVT are part of the system. Furthermore, they emphasized that a better total understanding of the different components and equipment has now evolved amongst the employees in the different departments. Now, everyone seems to have a better understanding, and further has the opportunity to see whether the equipment is on schedule or not. Additionally, one of the informants revealed that the employees are now able to ask specific questions about components where they earlier did not have any reference point for that specific component.

5.3.3 Sub-conclusion RQ2

Based on RQ2: *How is lean procurement reflected in the case organization?*, this research concludes that there is an organizational strategic gap within the case organization's global value chain with respect to the lean philosophy. The gap is illustrated in the figure above, and indicates that the identified value chain experiences a two-folded perception of lean. Lean thinking is implemented at the internal perspective in VVT and not at the main office in Norway. As RQ1 concluded that many decisions concerning procurement related activities are handled at the main office in Norway this gap may create difficulties for the case organization to conduct procurement activities in line with lean procurement literature.

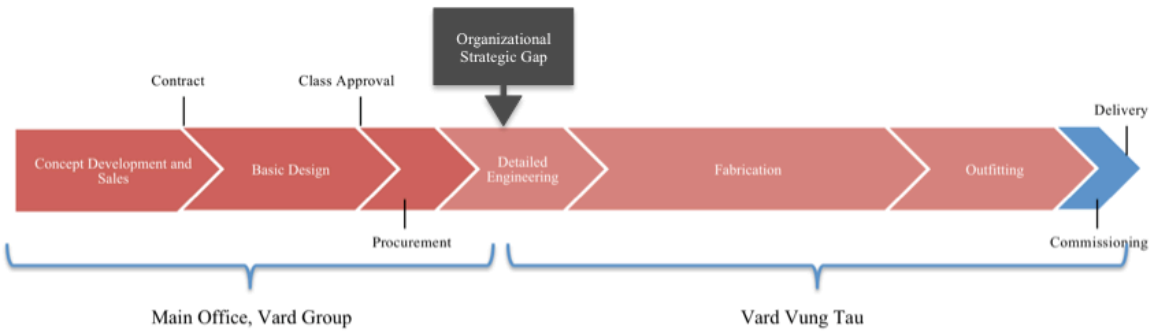

Figure 5.4: Organizational strategic gap in the value chain

6. Analysis and Discussion of RQ3-5

6.1 Introduction

In the previous chapter RQ1-2 were answered. Vard Group's global value chain with building location in a low-cost country was identified, and an evaluation of the lean implementation in the case organization was given. The aim for this chapter is to answer the three remaining research questions. This chapter has a three-folded structure, where RQ3-5 will be answered respectively in the following subchapters. Throughout the chapter results from case study findings will be analysed with regards to lean procurement literature, respectively lean supplier selection, lean relationship management and lean supplier development. References from the literature study will be repeated throughout this chapter. Furthermore, the analysis will be discussed respectively in each subchapter, in order to answer the research questions. Case study findings presented in this chapter are based on interviews with informants from Vard Group's identified value chain, as well as archival records.

6.2 Lean Supplier Selection

This subchapter aims to answer RQ3, presented below:

RQ3:
What characterizes lean supplier selection, and to what extent will lean supplier selection be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to answer this research question it was first necessary to conduct a literature study to identify what characterizes lean supplier selection. This study was presented in section 2.3.1. The organization's processes related to supplier selection has thereafter been identified and mapped. This process has in the following subchapter been analysed with respect to the literature identified in the literature study.

This subchapter has a five-folded structure. The first section will identify the supplier selection process of strategic components. This section will be referred to when analysing literature and results from the case study findings related to *ensuring lean supply*, *rationalizing components and suppliers* and thereafter *supplier selection model* in the following three sections. In each of the latter sections, a discussion will be given in order to evaluate to what extent lean supplier selection is applicable for the identified value chain. In addition, it will be evaluated *why* this literature may not be applicable. The last section presents a sub-conclusion with respect to the research question.

6.2.1 The Supplier Selection Process

Results from case study findings identified that Vard Group's selection of strategic suppliers has a two-folded structure. First, suitable suppliers will be selected for a makers-list for a project. Thereafter, one supplier will be selected amongst those preferred suppliers. Vard Group have a standard makers-list proposal, which will be adjusted with respect to the vessel type. When the project-specific makers-list is developed, at least three makers for one certain product category will be suggested. This makes Vard Group able to benchmark between the suppliers in order to achieve the best commercial result. Vard Group evaluate and compare their makers-list with one provided by the shipowner. The

shipowner's requirements are considered as highly important. Several informants identified that the shipowner often has specific requirements related to certain components, often because of separate product development activities arranged between the shipowner and that certain supplier. However, results from case study findings revealed that the makers-list presented by the shipowner does not drastically differ from the one Vard Group hold. This is because the shipowner often, in similarity with Vard Group, is an actor within the Norwegian maritime cluster, where both actors have good experience and knowledge of potential suppliers. Besides, the shipowner tends to suggest suppliers that Vard Group have not included on their makers-list. The shipowner does this in order for Vard Group to benchmark the shipowner's suggestions against Vard Group's proposed suppliers.

When developing the project-specific makers-list, it is revealed that both the shipowner and representative from the main office at Vard Group participate in the process. However, the procurement manager at VVT is in a position where he is able to influence the process. The procurement manager at VVT may suggest suppliers during development of the makers-list. Additionally, the procurement manager may evaluate other suppliers than the ones proposed in the makers-list once VVT take over the responsibility of the project. When VVT take over the responsibility of the project, it is the procurement manager at the shipyard who selects amongst suggested suppliers from the makers-list, or more rarely select other suppliers not proposed. In order to do this, the procurement department will start a tendering process from the different suppliers listed for each component. A standard request template is prepared at VVT, which includes key information about the vessel, required clarification and delivery dates for the specific components. When ready, it is sent to the potential suppliers on the makers-list. Thereafter, VVT receive offers from the potential suppliers, which are sent to the technical department. The technical department evaluates against required specifications. Thereafter, it is returned to the procurement department. If technical department have any comments the procurement department send it back to the suppliers, so they can correct it. When the technical department have approved the information is handed over to the shipowner. The owner is involved in all phases of the building process, and has the final saying. When the owner has approved, the procurement department can start negotiating on prices with the various suppliers.

6.2.2 Ensuring Lean Supply

The foundation of lean procurement is to identify value creation for the customer, which involves all actors in the value chain (Torvatn, 2014). In order to create value for the final customer, it is crucial to look at the supply chain as a whole where both upstream and downstream relationships with customers are managed (Bicheno and Holweg, 2009). Lean literature suggests that a lean organization will become more productive if they are cooperating with lean suppliers, as they then will have focus on lean requirements concerning costs, quality and reliability (MacDuffie and Helper, 1997; Simpson and Power, 2005).

Several informants from Vard Group communicated through the interviews that it is not of their concern to prioritize suppliers using lean philosophy, defined as lean suppliers, when suppliers are selected for a project. Nevertheless, one informant stated that as long as the supplier delivers a quality-component on right time, VVT do not interfere with the production philosophy used for delivering that component. This is in line with van Weele (2014), who argues that it is *preferable* to work with a lean supplier, but not a demand as long as they are able to deliver with high reliability. Further, van Weele (2014) argues that the supplier should be able to deliver components frequently in small batches. Results from case study findings revealed that VVT calculate a lead-time of 52 weeks when strategic components are purchased from Norway. This includes, 40 weeks of production, eight weeks of transportation, and an additional four weeks of slack. In order to receive these components on time, they are prioritized in the procurement process, where they are ordered for a one-time delivery. Hence, for the industry of which VVT are operating, having frequently small batches of strategic components will not be relevant.

Literature suggests switching towards lean supply if current suppliers are not already lean, or influence current suppliers for becoming lean. The literature identifies challenges linked to each alternative. As stated in previous section, VVT do not emphasize selection of lean suppliers. In addition to this, results from case study findings disclosed that *lean* is not a frequently discussed topic with suppliers. Informants from Vard Group could not elaborate on which of their frequently selected suppliers are pursuing a lean philosophy. However, the same informants did state that it was likely that some of their frequently selected suppliers of strategic components did have such production philosophy. Brunvoll is a supplier of strategic components, frequently selected for Vard Group's projects. One

informant from Brunvoll could confirm that *lean* is not a topic they commonly discuss with Vard Group or any other customer. However, the informant revealed that Brunvoll indeed are pursuing a lean philosophy, where current goal is internal success. Lean literature suggests that smaller suppliers are easier to influence for becoming lean (MacDuffie and Helper, 1997). The informant from Brunvoll claimed that they would be very receptive if Vard Group would put demands on them towards the lean production philosophy:

"We will absolutely listen to our customers, not least if it was Vard Group that would have asked us, as Vard Group are an important customer to us"

Even though Brunvoll is not in general recognized as a small organization, the informant communicated that the total value of the components they occasionally delivers to Vard Group's projects are smaller than the total value other competitors would deliver. For instance, Rolls Royce often deliver a package of equipment for a vessel, including thrusters, engines and propulsion, where the total value would be significantly higher. Through results from case study findings, it was disclosed that Rolls Royce are presumed as a larger organization than Brunvoll, where they are much more rigid and more difficult to influence.

Less responsiveness was a challenge linked to switching towards lean supply, due to the possibility that the supplier has engaged in commitments to other buying companies (MacDuffie and Helper, 1997). However, this was further described to be of concern generally for lean supplier selection. Lean literature argues that it is important for an organization to evaluate if their suppliers acknowledge their shared supply chain as the most important. Further, the organization is recommended to ensure that their suppliers are not part of a supply chain where demands from other customers are in conflict with own requirements (Torvatn, 2014). The informant from Brunvoll identifies Kleven, Ulstein Group, Havyard Group and Vard Group as their most important customers. They are aware that Vard Group are a significant contributor within the offshore service vessel industry, which is recognized to be an important sector for Brunvoll. However, the informant revealed that it varies over years in terms of which one is their most important customer, where they in the last few years have supplied most for Havyard Group's projects. However, the informant could assure that they would do whatever possible to ensure that all their customers are satisfied, where they argue that they never would be less

responsive towards any of their main customers due to conflicting demands. Furthermore, one informant from Vard Group stated that they presume themselves as the main customer of Rolls Royce with respect to offshore service vessels. The informant further claimed that they do not have much knowledge about other customers of Rolls Royce. Vard Group are aware of their competitors, but do not have information in regards of the demands they put on Rolls Royce as a supplier. However, with respect to the customer-supplier relationship, the informant did indicate a belief that other customers have the same demands towards Rolls Royce as their competitors.

6.2.2.1 Discussion - Ensuring Lean Supply

The previous section provided an analysis where results from case study findings were seen against literature concerning ensuring lean supply. Through this analysis, it was identified that it is not of Vard Group's concern to prioritize lean suppliers when they are to be selected for a project, as long as the suppliers are able to deliver a quality product at the right time.It was revealed that lean is not a topic that is frequently discussed with suppliers. The analysis further identified that Vard Group do not have much knowledge of what demands other customers put on their shared supplier, or if they are conflicting with own demands. However, it is presumed that the demands are somewhat the same. The informant from Brunvoll could reveal that even if they contribute to several supply chains, he will argue that they are not less responsive towards their customers. Further, analysis revealed that literature concerning possibilities for influencing smaller suppliers to become lean might be applicable, as results from case study findings revealed that Brunvoll would be easier to influence than Rolls Royce. The organizational strategic gap, identified under 5.3.3, might be the reason why ensuring lean supply is not of concern for Vard Group. As the procurement processes of strategic components are prioritized early in the value chain, a lot of responsibility falls on the main office in Norway, where VVT are able to influence, but not dictate the process. Further, the shipowner is identified as a major influencer in terms of what strategic suppliers that will be selected for a project. This is due to the ETO production structure, where the offshore service vessels produced are highly customized upon the shipowner's requests. Hence, it might create difficulties for Vard Group to ensure lean supply for their production. Based on this, it is possible to argue that lean literature concerning ensuring lean supply will not be applicable for the Vard Group's global value

chain with building location in Vung Tau. However, this would apply even if Vard Group did not have a global value chain. It may be argued that the lack of applicability is linked to the organizational strategic gap and the ETO production structure, and not necessarily to the long geographical distance in the value chain.

6.2.3 Rationalizing Components and Suppliers

Literature suggested that lean practice for an organization is to identify all non-value adding components used for production (Bicheno and Holweg, 2009). Several informants could through the interviews notify that all the strategic components used for production of the vessel are carefully selected. The selection was identified in section 6.2.1 by the supplier selection process, where the shipowner has a final saying for which components will be used in the production, especially the strategic components. The literature further suggested using a team approach for identifying non-value adding components (Bicheno and Holweg, 2009). With respect to the strategic components, it was through chapter 6.2.2 revealed that a number of different departments, both from Vard Group and the shipowner, together identify components that will be used for production.

According to lean literature, a lean organization should be working with a few reliable suppliers able to provide a large range of different components (Bicheno and Holweg, 2009; Torvatn, 2014). Thus, lean supplier selection of strategic components should be concerned around obtaining as many strategic components possible from the same supplier. Several informants from the interviews with Vard Group could reveal that it was an advantage if they could obtain a various number of components from one individual supplier. For NB838, Rolls Royce were selected as a strategic supplier, as they were able to deliver a package constituting of the main engines, the main thrusters, and the main propulsion systems. Further, Motorola were a preferred supplier by the shipowner, where the organization was listed as a strategic supplier for five different radio-related components on the makers-list for NB838. One informant stated that they could have tried to influence the shipowner for selecting other suppliers for these components. However, they would not do this, as it is favourable for Vard Group to obtain several components from a single supplier when it is possible. This is due to possibilities of negotiating better

prices and terms for delivery. Further, the informant emphasized that the selection of these suppliers highly depends on the shipowner's preferences.

6.2.3.1 Discussion - Rationalizing Components and Suppliers

The previous section provided an analysis where results from case study findings were seen against literature concerning rationalizing components and suppliers. The analysis revealed that literature concerning identification of non-value adding components is highly applicable for Vard Group's global value chain with building location in Vung Tau. However, the applicability can be linked to Vard Group's ETO production structure, where the CODP is located in the initial phase of the project. The activities downstream from this point are planned based upon customer orders. The CODP will affect the selection of suppliers, and the high customization makes sure that non-value adding components does not appear. Further, the analysis revealed that several departments from both Vard Group and the shipowner contribute for selecting components. Hence, this literature concerning team approach for identifying non-value adding components may also be described as applicable. Based on the analysis, it was revealed that lean literature, which concerns to obtain a large range of components from a few reliable suppliers, might be applicable for supplier selection in Vard Group's global value chain with building location in Vung Tau. This was important based on the possibility to negotiate on terms and prices. However, analysis related to criteria used for supplier selection will be discussed in the next section, where *price* as a criterion will be further evaluated.

6.2.4 Supplier Selection Model

Lean literature suggests that the organization should use a *supplier selection model* with lean criteria in the process of selecting suppliers (Johannesen, Schølberg and Vik, 2013). Based on results from case study findings, it was disclosed that Vard Group do not emphasize the use of such model.

Based on the two-folded structure of the supplier selection, identified in section 6.2.1, all informants from Vard Group divulged that one major criterion for selecting supplier to the

makers-list is related to technical aspects, as the suppliers must be able to deliver in accordance to the high technical standards that are required. The technical aspects are not associated with the technical solutions for the component alone, but for the contribution to the technical solutions for the vessel as whole. One informant from Vard Group emphasised that the supplier should be a technology driver in the segment they work in. For instance, high power utilization related to fuel consumption is important for engine suppliers, as green logistics is of high concern in the market. Further, the experience the supplier has in the market is important, as it can be seen as quality insurance.

In the second phase of the supplier selection, the suppliers are selected from the makers-list. The same criteria for developing the makers-list related to *technical aspects* and *experience* are further evaluated in this process. Further, results from the case study findings indicated *price* and *quality* as important criteria. It is identified that VVT prioritize procurement of strategic components listed on makers-list, due to long lead-times. Thus, the sooner the supplier is able to deliver *technical support* to VVT the better. For some components the ability to deliver technical support early in the process is seen as a criteria. Further, experience with the various suppliers is important related to the *delivery reliability*. If VVT have bad experience with the reliability to one supplier, they will consider purchasing components from another supplier even if they are giving a higher price. This is because it is more expensive for VVT to be delayed in the production due to one supplier, than to pay 20% extra for the component in the beginning of the process. Hence, several informants from Vard Group emphasized that even though price is of high concern when selecting suppliers from the makers-list, this is not their main criterion. From the suppliers listed on the makers-list, the shipowner has demands for which suppliers that are to be selected for many of the components. This is often based on their fleet, where it is in their advantage to have the same suppliers of main components due to after sales and service. If VVT have motives for selecting another supplier, they have to provide an explanation for why, followed by required technical information as relevant for describing and meeting specified capacity and standards.

One suggested criterion for lean supplier selection is to have the suppliers located geographically closely as it generates for information sharing, quality levels and cost reductions at facilities. In addition, lean literature argues that the organization will avoid challenges if their suppliers are located close to their facilities (Bashin and Burcher, 2006;

Wilson and Roy, 2009). The strategic components used for production at VVT are often purchased from suppliers operating in the Norwegian maritime cluster. The reason for this is linked to the criteria of supplier selection, where quality, experience and reliability are of concern due to the good international reputation of the Norwegian maritime cluster. For lean procurement, challenges are related to incorporating design and volume changes (Bashin and Burcher, 2006). As identified in section 6.2.2, VVT calculate 48 weeks lead-time for some components, and will always calculate extra four weeks of slack when they purchase strategic components from Norway. The informants are aware that VVT become less flexible by selecting Norwegian suppliers. In order to cope with the challenge of incorporating design, VVT are prioritizing the suppliers early in the project, where suppliers often are working with the design team in Ålesund. Further, case study findings declared that speaking the same language and having the same cultural background is beneficial in a buyer-supplier relationship. By having Norwegian people in strategic positions at VVT eases the challenge when strategic components are purchased from Norway. However, informants from Vard Group emphasize that having Norwegian suppliers based on *culture* preferences is not decisive for supplier selection.

Further, literature suggests that an overall reasoning in supplier selection should be related to competences the supplier have that contributes to own product development, and if the suppliers is willing to cooperate closely with a long-term perspective (Torvatn, 2014). From the interviews with Vard Group, it was revealed that selecting suppliers contributing to development of the vessel is of high concern. Nevertheless, informants revealed the supplier selection is project-specific, where the suppliers of strategic components are reviewed thoroughly each time a project is developed. Thus, the long-term aspect for supplier selection may be discussed. This is further elaborated under section 6.3.1, and more thoroughly under subchapter 6.4.

6.2.4.1 Discussion - Supplier Selection Model

The previous section provided an analysis where results from case study findings were seen against literature concerning the supplier selection model. Related to supplier selection, literature suggests using the supplier selection model with lean criteria. From the interviews with various informants at Vard Group, it was revealed that VVT is not using

such model. Further, the supplier selection process is identified to be an activity that takes place at various stages of the defined value chain, where both the main office in Ålesund and VVT contributes. Since the organization have different strategies, where VVT is the only site aiming to have lean procurement, it would be difficult to develop a supplier selection model that would be appropriate for Vard Group as whole. Further, a challenge of implementing a supplier selection model is related to the ETO production structure, where the shipowner puts requirements for selection.

However, there are some lean aspects related to how the supplier selection is conducted today. The first step in the supplier selection model is to reduce the number of potential suppliers, based on standards and components the suppliers have available. It is possible to identify the development of the makers-list as a first step, where only suppliers that are capable of delivering in accordance to technical criteria will be further evaluated. Moreover, only established suppliers with great experience are selected as potential suppliers. Further, when a supplier is selected from the makers-list, criteria related to *competencies*, *quality*, *delivery terms*, *reliability* and *technical support* are evaluated. In addition *price* is a criteria, however revealed to not be the most important. The criteria Vard Group use for supplier selection is in line with those proposed by lean literature. The literature did not specify exact criteria. However, the literature emphasized quality, delivery reliability (Wilson and Roy, 2009; van Weele, 2014), culture, behaviours, delivery performance, price (Wilson & Roy, 2009) and zero defects (van Weele, 2014). Ability to deliver technical support is a criterion VVT use, which is not recognized by lean literature.

Furthermore, geographical proximity was implied as an important aspect by the lean literature (Bashin and Burcher, 2006; Wilson and Roy, 2009). Analysis revealed that similar culture and believes with suppliers are advantageously, however not a criteria for the Group. The geographical proximity is a criterion that will not be applicable, as VVT are building customized high-end vessels in a low-cost country. The analysis revealed that strategic components often are purchased from the Norwegian maritime cluster in order to ensure quality for the shipowner. The additional lead-time needed for obtaining these components may be identified as waste with respect to a lean philosophy. In addition, it makes VVT less flexible, and a challenge might occur with respect to change order. The extra lead-time may be considered as the price Vard Group are paying for producing

customized high-end vessels in a low cost country. Consequently, the lead-time makes VVT less flexible and less lean.

To summarize, VVT use some of the proposed criteria when they are selecting suppliers: *competencies*, *quality*, *delivery terms*, *and reliability*. However, the applicability of the literature can be identified as limited due to two reasons. First, Vard Group is an ETO producing organization, where the vessel is highly customized upon the shipowner's requests. Hence, the criteria VVT set for supplier selection may be overruled by the shipowner. Second, the geographical proximity criterion does not apply for VVT. This may be considered as an important criterion for a lean organization operating in the segment of offshore service vessel. The Norwegian maritime cluster is recognized for being flexible ETO producers, which is their strength due to frequent late change orders. When the vessel is produced in Vung Tau, VVT get less flexible, and hence less lean. The applicability of the lean literature is therefore a challenge due to the combination of ETO production and a global value chain, where lead-times are increased and flexibility is lowered.

6.2.5 Sub-conclusion RQ3

Based on RQ3: *What characterizes lean supplier selection, and to what extent will lean supplier selection be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?*, this research concludes that lean supplier selection literature emphasizes the buyer to ensure lean supply by either evaluate if current suppliers are lean, if they are in position to be influenced for becoming lean, and if not - change to lean suppliers. It is further emphasized to work with a few suppliers that are reliable and able to provide a large range of different components. Additionally, literature emphasized to identify all non-value adding components used for production. Lean supplier selection emphasizes important evaluation criteria for the selection process to be: quality, reliability, culture, behaviours, delivery performance, price, geographical proximity, competencies contributing to own product development, willingness to work with a long-term perspective.

Based on the analysis and discussion above concerning lean supplier selection this, research concludes that it will be easier to influence a small supplier for becoming lean than a more significant supplier. Further, this research concludes that *ensuring lean supply* will not be applicable for the case organization and their global value chain due to two main reasons. The first reason is the identified organizational strategic gap. The second reason is due to the ETO production structure. It is concluded that the lack of applicability is not due to the geographic distance. Further this research concludes that *obtaining a large range of components from a few reliable suppliers* is applicable for Vard Group. This is due to the possibility to negotiate on terms and prices from the buyer side when buying several components from same supplier. However, the price was later identified to not be the most important criteria for supplier selection. The research further concludes that lean literature concerning *identification of non-value adding components* is highly applicable for the case organization. The applicability can be linked to the ETO production structure, as the shipowner is involved throughout the whole project execution and decides the specifications of the vessel. Lastly the research concerning supplier selection concludes that some of *the lean supplier selection criteria* related to competencies, quality, delivery terms, reliability and price are applied by the case organization. The research further concludes that using a supplier selection model with lean criteria will be difficult for the case organization due to the identified organizational strategic gap. Further, a challenge of implementing a supplier selection model is related to the ETO production structure, where the shipowner puts requirements for selection. It is therefore concluded that a supplier selection model with lean criteria will not be applicable for the case organization.

6.3 Lean Relationship Management

This second subchapter aims to answer RQ4, which is presented below.

RQ4:
What characterizes lean relationship management, and to what extent will lean relationship management be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to answer this research question it was first necessary to conduct a literature study to identify what characterizes lean relationship management. This study was presented in chapter 2.3.2. The organization's activities related to relationship management have thereafter been identified and mapped through interviews with key informants in the value chain. These activities have in the following section been analysed with respect to the literature identified in the literature study.

This subchapter has a four-folded structure. The three first sections will analyse results from the case study findings against literature respectively concerning *rationalizing the extent of supplier relationships, relationship governance* and *information and cost sharing.* For each of the sections, a discussion will be provided in order to give an evaluation of to what extent lean relationship management is applicable for the identified value chain. In addition, it will be evaluated why this literature may not be applicable. The last section presents a sub-conclusion with respect to the research question.

6.3.1 Rationalizing the Extent of Supplier Relationships

The lean literature concerning relationship management differs in terms of the recommended extent of supplier relationships. Some scholars argue that lean relationship management includes commitment, mutual trust and long-term relationships (Bashin and Burcher, 2006; Bicheno and Holweg, 2009). It is recommended that *total cost* should be of concern in the supply of all components, where quality, delivery reliability, simplification of transactions and a future potential for price reductions are emphasized (Bicheno and Holweg, 2009). However, other scholars argue that a combination of arm's length

relationships and long-term relationships are sufficient for ensuring lean relationship management. With this perspective suppliers of standardized components may be managed through an arm's length relationship where price is of concern, not total costs (McIvor, 2001).

Lean literature argues that the ABC-classification is a suitable tool for establishing lean relationship management. In subchapter 5.2.1, the makers-list-components were classified as strategic components. The strategic components together constitute for about 75% of the total value of a vessel, and may be considered as A-components. The framework agreement components, however are estimated to have a total value of 10% of the total value, and may be considered as C-components. The purchase order components are estimated to constitute for 15% of the total value of the vessel, and may be considered as B-components. However, it is identified that there will be some variation in the distribution of value with respect to all the A-components, as one informant stated that the total value of one strategic component may vary from 15-30% of the total value of the vessel. Nevertheless, the total value of one A-item is still considered to be higher than the total value of respectively all B-, and C-components.

For the A-components (strategic components), close relationships and partnerships are recommended strategies for relationship management. Tight control of the supplier should be of concern, including records and follow-ups, and expediting to reduce lead-times (Bicheno and Holweg, 2009). As previously stated, the strategic components on a vessel are project-specific. However, informants could reveal that it is of high importance to ensure relations to several suppliers within the same project segment outside of the projects. This is necessary for Vard Group in order to maintain a commercial edge.

Several informants from the interviews could reveal that Vard Group use framework agreements for the supply that are identified as C-components. Various people have authority to develop these agreements, and they will apply for all sites within Vard Group. For VVT, components obtained from framework agreements are characterized as standard components used on every vessel produced. A typical component is weather tight doors. The doors are commonly used on all vessels, but the number of doors needed for one vessel depends on the size of the building. The recommended strategy is to have low priority for these components, where simple or modest control is needed for the

relationship management, using an arm's length relationship strategy (Bicheno and Holweg, 2009).

Literature suggests using a cost-benefit analysis in order to understand the occurring cost structure for a management strategy. It is important that the benefits are greater than the costs (Cousins et al., 2008). For VVT, a combination of arm's length and long-term relationships are used. However, VVT's strategy differs compared to the lean literature suggesting tight control of A-components, and an arm's length relationship of C-components. In similarity with the ABC-classification, the cost-benefit analysis emphasizes having long-term strategic cooperation with suppliers generating high value for the product (Johannesen, Schølberg and Vik, 2013). However, Vard Group generate for long-term relationship with the standardized products through their framework agreements. The framework agreement works as a call-off agreement for VVT, where they place an order based on a serial or production number given by the supplier. This type of agreement eases the procurement process. As one informant stated:

"It is very easy, you just choose from the catalogue what door you want, the number of doors needed, and then you have the price"

When a framework agreement is signed with a supplier, VVT will only consider that supplier for that certain component. Further, VVT will not develop similar framework agreements with any competing suppliers. It is a long-term controlling agreement with duration of 3-5 years.

6.3.1.1 Discussion - Rationalizing the Extent of Supplier Relationships

The previous section provided an analysis where results from case study findings were seen against literature concerning rationalizing the extent of supplier relationships. The analysis revealed that the strategic components generate a high value for the vessel, where extensive resources are needed for planning and acquiring these components. However, the supply of these components is always considered as project-specific based on request from the shipowner. This makes it difficult to achieve a long-term partnership with the supplier, as suggested in the lean literature. Furthermore, with respect to the ABC-classification and the cost-benefit analysis, it is not beneficial for VVT to have multiple

suppliers of C-components where price is decisive, as the resources used for the purchasing process could be considered as waste compared to the extent of resources needed for purchasing strategic components. Through the framework agreement, Vard Group generate for simplified transactions, quality and reliability through a long-term relationship with the suppliers, making them able to put required resources for ensuring strategic components.

As the lean literature suggests strategies generally for mass production companies, it is through this analysis identified that the requirements will differ for an organization with an ETO production structure, where the shipowner influences the extent of the supplier relationships. However, the lean literature may to some extent be applicable, where the literature can be seen as somewhat reversed for Vard Group's identified value chain.

However, the analysis revealed that it is of high importance to ensure relations to several suppliers from the same project segment outside of the projects. It was revealed necessary for Vard Group in order to maintain a commercial edge, in addition to be able to benchmark when Vard Group have a request from one of their suppliers. Thus, the extent of supplier relationships with strategic suppliers may be seen as somewhat in between of an arm's length relationship and a long-term collaborative partnership. The supply is project-specific, however an on-going relationship concerning innovation and product development is of high concern. This aspect is discussed further in section 6.4.

6.3.2 Relationship Governance

Lean literature argues that the power in a relationship may be buyer-dominated, supplier-dominated or balanced. Lack of bargaining power on either the supplier or buyer side will affect the power-balance in the collaboration (van Weele, 2014). Literature claims that organizations may experience a lock-in situation if the segment is supplier-dominated (van Weele, 2014). However, as the strategic components are project-specific, it reduces the possibility for a lock-in situation. Furthermore, literature suggests that the supplier might end up in a lock-in situation due to their investments towards ensuring lean supply. In addition, the supplier might lose their territory after termination of the contract due to the investments (van Weele, 2014). However, from analysis presented in subchapter 6.2.2, it

was revealed that Vard Group do not have requirements on their suppliers with respect to their production philosophies. Moreover, case study findings indicated that suppliers are not heavily investing in their relationship with VVT. When VVT are selecting a strategic component for their production, they send a request to suppliers on the makers-list, where they select the supplier producing the component best matching their requirements. If VVT request other functionalities that one supplier is able to deliver, they will most likely select another supplier able to match the requirements better. One informant from Brunvoll commented that they are producing around 250-300 thruster systems each year. Further, the informant stated that they are aware that competing suppliers always are evaluated for supplying to VVT's projects. With this production volume and their awareness of not being guaranteed selection for a project, it is indicated that the suppliers do not experience a lock-in by being a project-specific supplier. Conversely, several informants stated that this is a healthy competition were suppliers are constantly improving in order to increase the chance of being selected for future projects.

Some scholars argue that lean relationship governance is obligated to equality where both parties contribute to trust and openness (Lamming, 1993). However, other scholars argue that this statement is too rigid, as relationship governance may be characterized as lean without pursuing a relationship based on complete equality, as accrued benefits is often obtained by the customer (McIvor, 2001). Hence, it is possible to have lean relationship governance, without total equality in the relationship, where the customer has a paternalistic position with most power, influence and responsibility in the relationship (MacDuffie and Helper, 1997; McIvor, 2001;Womack, Jones and Roos, 1990). Based on information obtained from the interviews, it is somewhat unclear whether Vard Group have a paternalistic position in the relationship, since most informants from Vard Group argued that they were equal parties. As one informant stated:

"We are completely at the mercy for our suppliers. Without good suppliers and collaborators, we would not have been where we are today"

Further, it was indicated by the same informant that Vard Group could be the link in the value chain where a new design from their supplier is presented. This is beneficial for the supplier, as they will achieve joint marketing by presenting innovation together with Vard Group. Other informants indicated the importance of this type of collaboration:

"A lot of things on the ship are their equipment. We make their products possible"

Further, one informant indicated that this collaboration is highly interdependent:

"If you look at the value creation in the value chain, it is us as shipbuilders that are the passageway to the market for all the suppliers, so we are interdependent of each other. When the market is challenged, we have to have joint actions for creating something new in the market. We make us interesting together"

The maritime cluster in Norway is seen as a laboratory for the Norwegian producers. When the products are presented internationally in a global market, the actors in the Norwegian maritime cluster are cooperating together against international shipbuilders based on the competencies they have gained in the domestic market.

However, other informants indicated that Vard Group do have a paternalistic position in relationship with their suppliers. One informant stated that Vard Group are on top of the hierarchy, where the suppliers are dependent on them, and not vice versa. One informant from Brunvoll stated that that they are humble if they get selected for a project, as they acknowledge the achievement of Vard Group by being able to realize a project. However, the supplier indicated that it is to some extent interdependence. The informant argued that if they are selected for a project they know they have the competence in the equipment they are providing, which is crucial for finishing the whole project. Further, the supplier indicated that Vard Group were aware of this interdependence, as mutual respect is important in such relationships.

Further, it can be analysed if the size of the suppliers will influence whether Vard Group have a paternalistic position in the relationship or not. Through questions related to the contracts, it was expressed that the size of the supplier will influence the power balance in the relationship. One informant at VVT indicated that Vard Group try to use their own contract with suppliers in all situations. They then use a template, where they edit the name of the company, dates and other relevant aspects. However, the informant further stated that it happened that the supplier wanted to use their own contract, which always leads to discussions. Rolls Royce were identified as a big organization, where they are ridged in terms of their contracts. Hence, the informants revealed that it is easier to influence a smaller supplier in a relationship.

6.3.2.1 Discussion - Relationship Governance

The previous section provided an analysis where results from case study findings were seen against literature concerning relationship governance. Based on this analysis, there is unclear to what extent it is possible for Vard Group to have a paternalistic position in relationship with their suppliers, as many aspects points to a interdependence between a buyer and a supplier for a shipbuilding company with a global value chain. The applicability of relationship governance can be considered high, as the case organization is revealed to acknowledge their supplier competencies and to be highly dependent on their strategic suppliers, and vice versa. Further, the analysis points out that when bigger suppliers are used in a project, they are not as easy to influence, and sometimes the supplier become more dominant in the power balance. Due to the ETO strategy, the shipowner will influence the relationship governance between Vard Group and their suppliers. This affects the applicability of the lean literature concerning relationship governance for Vard Group's global value chain with building location in Vung Tau. With a value chain perspective, Vard Group can be identified as a tier, only included for a limited period of time. With the identified value chain, it is VVT's responsibility to build the vessel, and to provide guarantee for one to two years. The relationship between the shipowner and the suppliers, however, will maintain through the lifetime of the vessel, maybe lasting for 25 years. Hence, the relationship the shipowner has with their suppliers is very important for Vard Group. It is VVT's responsibility to ensure that these relationships are managed in the best commercial manner as possible so the shipowner does not have to pay extra costs by ensuring their preferred suppliers. If VVT are seen as a logistical link in the production, their aim is to build a vessel where the shipowner decides what components that should be included. This statement is also indicated through the makers-list, where VVT are in position to select other suppliers, as long as the supplier is a:

"... recognized manufacturer, subjected to equipment being of first class marine quality supplied by a maker with first class reputation and preferably global representation and aftermarket network/services"

6.3.3 Information and Cost Sharing

Lean literature highlights the advantages of sharing information and cost between the buyer and supplier (Lamming, 1996; Johannesen, Schølberg and Vik, 2013). However, it is argued that benefits acquired through equal information and costs sharing, will be obtained by the customer (McIvor, 2001). Asymmetrical sharing of information is hence identified as a challenge. Further, apportionment of fault may cause waste in the relationship (Johannesen, Schølberg and Vik, 2013). In lean relationship management, equal information and cost sharing is important for ensuring mutual improvement and cost reductions (Lamming, 1996).

It was declared through the interviews that Vard Group are cautious with respect to information and costs shared with their suppliers. From the interviews, it was not claimed any initiatives for cost sharing. Conversely, it was indicated that Vard Group are highly attentive towards legitimately distribute costs wherever possible. An example is the incoterms Vard Group use in their contracts with their suppliers. If VVT purchase an expensive component, it is of VVT's concern that the contract states that the component will be delivered with *Cost Insurance Paid* (CIP) or similar incoterms. This specifies that the supplier, in addition to paying for the shipment of the components to VVT, must insure the shipment where they are responsible if anything happens to the cargo during shipment. However, the informant stated if it had been clear that an independent forwarder, for instance, were responsible for damaging the cargo, the costs would be on their behalf. Either way, the incoterms will create a base for apportionment of fault if something unfortunate would happen to the cargo.

In terms of the information sharing, several informants from Vard Group claimed that they are sharing limited information with their suppliers. Vard Group use the database Share Point for sharing information with suppliers and shipowners. When a supplier is selected for a project, they share technical information with VVT through Share Point. Thereafter, the shipowner confirms that the equipment is of the right technical standards, and that it corresponds to the agreed specifications. The suppliers have limited access to this database. Some of the suppliers are able to upload information to this database themselves, whilst others do not have access at all. Another informant emphasized that it is important for them to hold back some information for the suppliers, especially outside of the project.

Complete information sharing will make it difficult to negotiate with suppliers before signing the contract.

The extent of what information is shared with a supplier is linked to the equipment that is to be supplied. For instance, Vard Group must share information related to the requirement specification illustrating what effect equipment must have. For an engine or a thruster, the specifications might be related to requirements of weather conditions, speed, and so on. Vard Group then need to share drawings with the suppliers, so they know how much space they have for their equipment. This information can be highly sensitive. Further, the informant revealed that it is highly dependent if the sharing of information is symmetrical from one project to another.

The informant from Brunvoll confirms that the extent of information sharing applies. The informant stated that they obtain the information necessary for them to do their job. Further, the informant emphasized that they respect that Vard Group will hold back some information. In terms of what information they share with Vard Group, the informant emphasized that they are willing to share more information with buyers that are loyal towards them, as the trust between parties is built over time. This is supported by a statement from an informant in Vard Group, who stated that it is a difference in the extent of information sharing related to suppliers Vard Group have worked together with for many years, where they try to limit access of information to new suppliers. These statements may be interpreted to indicate that the project-specific relations hinder optimal information sharing with respect to lean literature. However, the informant from Brunvoll further emphasized that the Norwegian maritime cluster in general act in an orderly manner towards information sharing, where sensitive information does not tend to leak out. Further, both the informant from Brunvoll and several informants from Vard Group identified that geographical proximity eases the information sharing in terms of less misinterpretations.

6.3.3.1 Discussion - Information and Cost Sharing

The previous section provided an analysis where results from case study findings were seen against literature concerning information and cost sharing. Based on the analysis,

VVT avoid sharing costs with their suppliers where they legitimately use incoterms in order to ease appointment of fault if unforeseen events occur. Hence, the applicability of the lean literature concerning cost sharing may be discussed. The literature proposes that in lean relationship management, it is important to have cost sharing in order to achieve full benefits of lean. By shared costs, the end customer gains added value in terms of reduced prices. However, this analysis have identified that cost sharing will not be applicable for Vard Group's global value chain with building location in Vung Tau. Conversely, Vard Group get more attentive towards the sharing of costs with their global value chain. This can be linked to the ETO production structure, as the suppliers are selected based on individual projects. Due to the lack of long-terms perspective, it would not be beneficial for Vard Group to share costs with suppliers, and vice versa.

Further, the analysis indicated that Vard Group share almost all information with the shipowner, except purchasing prices from the suppliers. This can be related to the ETO production structure, where the vessel produced is highly customized for the shipowner, making information sharing vital. Furthermore, both informants from the supplier and buyer side indicated that information sharing is important in order to produce the technically best vessel possible. However, the information shared with suppliers is limited to technical and requirement specifications. It is a mutual understanding from the buyer and supplier side that some information is held back. Based on this, lean literature concerning information sharing will not be applicable for Vard Group's global value chain with building location in Vung Tau. Since the selection of suppliers is project-specific, where information is not shared outside of projects, it hinders the potential for advantages gained from full information sharing with respect to lean literature.

6.3.4 Sub-conclusion RQ4

Based on RQ4: *What characterizes lean relationship management, and to what extent will lean relationship management be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?*, this research concludes that benefits from lean supply can be achieved through a combination of arm's length and long-term relationships with suppliers, where cost-benefit and ABC-analysis can be used for establishing suitable relationships. Further this research concludes that lean relationship management

emphasizes that complete equality is difficult in a relationship. However, the buyer can have a paternalistic position in the relation, where he acknowledges the supplier's important position in the relationship. Furthermore, the buyer must acknowledge the suppliers important position in the relationship. Lastly mutual information and cost sharing is important in order to achieve lean relationship management.

Based on the analysis and discussion above concerning lean relationship management, this research further concludes that the lean literature mainly intended the mass production sector will differ for an organization with an ETO production structure, where the shipowner influences the extent of the supplier relationships. However, the lean literature may to some extent be applicable, where the literature can be seen as somewhat reversed for the case organization; having long-term relationships with non-strategic suppliers, and more an arm's length relationship with strategic suppliers. However, that the case organization's relationship with strategic suppliers may be seen as somewhat in between of an arm's length relationship and a long-term collaborative partnership. The supply is considered to be project-specific, but an on-going relationship is yet important in order to maintain a commercial edge, innovation and product development, especially within this industry.

Further this research concludes that the applicability of relationship governance is high, as the case organization is revealed to acknowledge their supplier's competencies and to be highly dependent on their strategic suppliers, and vice versa. Based on the results from the case study findings this research concludes that neither cost nor information sharing will be applicable for the case organization. This is related to the ETO production structure, as the suppliers are selected based on individual projects. Due to the lack of long-terms perspective, they will not be able to obtain the same benefits as a long-term partnership.

6.4 Supplier Development

This second subchapter aims to answer RQ5, which is presented below:

RQ5:
What characterizes lean supplier development, and to what extent will lean supplier development be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?

In order to answer this research question it was first necessary to conduct a literature study to reveal what characterizes lean supplier development. This study is presented in subchapter 2.3.3. The organization's processes related to supplier development has thereafter been identified and mapped through interviews with key informants in the value chain. This process has in the following section been analysed with respect to the literature identified in the literature study.

This subchapter has a four-folded structure. The sections will respectively analyse results from the case study findings against literature concerning, *kaizen events with suppliers, conducing joint improvement activities, dedicated assets* and *knowledge sharing and trust*. In each of the sections, a discussion will be provided in order to give an evaluation of to what extent lean supplier development is applicable for the identified value chain. In addition, it will be evaluated why this literature may not be applicable. The last section presents a sub-conclusion with respect to the research question.

6.4.1 Kaizen Events with Suppliers

Lean literature suggests kaizen events with suppliers as an important element of supplier development in order to facilitate a culture of continuous improvement in the supply chain (MacDuffie and Helper, 1997). As mentioned in section 6.2.1, Brunvoll, which is recognized to be one of Vard Groups' frequently, selected suppliers are familiar with lean philosophy where it has been applied within their organization. The reason they implemented it was to improve own efficiency, as the informant claimed it as suitable to implement lean within own organization before involving any external parties. However,

the same informant further emphasized that they understand lean as the whole process and everything must flow from the sale is concluded until the vessel is delivered. It was further found that the supplier is optimistic to conduct lean together with a customer, and especially with Vard Group, as they are recognized to be one of their most important customers, as mentioned in section 6.2.1. The informant further argued that a process to coordinate with another party would therefore not need to be too comprehensive as their organization is already familiar with the lean thinking.

Further it was revealed under section 6.2.1 that Vard Group do not have any requirements on their suppliers with respect to their production philosophies, as long as they deliver a high quality product on time.

The literature further suggests that the focus in the supplier development process should be on the activities adding value for the final customer and to eliminate the non-value adding ones (Marks and Barkman, 2007; Stark, 2004). Several of the informants revealed that the shipowner has the final saying when deciding the strategic components on the vessel as it is considered highly customized. This implies that the shipowner is in position to select and affect the activities adding value for them. Moreover, informants in Vard Group expressed that it has not been relevant to map the activities, as each project is rather unique.

6.4.1.1 Discussion Kaizen Events with Suppliers

The previous section provided an analysis where results from case study findings were seen against literature concerning kaizen events with suppliers. The analysis indicated that neither the main office in Ålesund nor VVT have conducted kaizen events with their suppliers. As revealed under chapter 5.1, a great share of the procurement activities in the identified value chain are conducted at the main office in Ålesund. Thus, it can be argued that the organizational strategic gap, introduced under chapter 5.3, affects Vard Group's ability to conduct kaizen events with suppliers. Anyhow, this analysis found that the supplier is optimistic to conduct lean thinking together with their customer, whilst Vard Group on the other hand do not consider it as necessary to require their suppliers to become lean. Furthermore, this analysis revealed that the ETO structure used for building

the vessel affects the possibilities for conducting kaizen events with suppliers. As the suppliers are used for specific projects, kaizen events can be difficult with strategic suppliers due to the limited time-scope of the cooperation. Based on this, it is argued that lean literature concerning kaizen events is to a limited extent applicable for Vard Group's identified value chain, due to the identified organizational gap and ETO production strategies. However, based on previous discussions, see 6.3.1.1, the applicability of kaizen events with supplies selected based on framework agreement may be different. These suppliers have an agreement lasting for 3-5 years with Vard Group, and applicability may be more relevant with these suppliers. However, as this research is limited to strategic components, this is a field for further research.

6.4.2 Conducting Joint Improvement Activities

Lean literature emphasizes the importance of joint improvement activities in order to facilitate for supplier development. However, the literature differs in terms of the recommended extent of influence for the improvement activities by the different parties. Some scholars argue that the buyer has a paternalistic position in the relationship by being the initiator of the development activities and thereby in position to know how the supplier best can develop (MacDuffie and Helper, 1997; Simpson and Power, 2005). Whilst other scholars argue that the supplier development is a joint effort between buyer and supplier (Liker and Choi, 2004), where relational development is a more appropriate term to use (Lamming, 1996). One of the informants in Vard Group revealed that the relationship between them and their suppliers is characterized by exchange of ideas and thoughts. The same informant further stated:

> *"They bring their innovation to us so that we can integrate it into our design."*

This statement is consistent with the informant from Brunvoll, who stated that they often visit shipbuilders to present their newest improvements and innovations. Both of these statements are further in line with the scholars acknowledging that suppliers can propose own ideas, which can lead to innovation and contribute to develop the buyer's product. An informant in Vard Group further revealed that the cooperation within the Norwegian maritime cluster is sometimes so close, independent on the logo of the organization and

this is what makes the cluster so competitive. This statement is hence in line with the scholars who argue that both parties contribute to build a good and long-term relationship being valuable for both parties.

Several of the informants in Vard Group revealed that the Group have development projects going with many of their suppliers nearly all the time. One of the informants further refers to another project where Rolls Royce were able to deliver a product that was essential for Vard Group getting the contract with a shipowner. This reinforces the arguments from the scholars stating that the development is a joint effort between supplier and buyer where both parties can contribute to reveal the opportunity for improvement. Furthermore, one of the informants in Vard Group stated:

"We are definitely developing together with our suppliers. There is no way going around it."

The same informant further emphasized that they are working close with their suppliers to innovate and to improve the whole vessel, where every vessel has something new. Another informant in Vard Group revealed that the importance of the strategic suppliers competencies in order to develop the vessels are of high importance, he stated following:

"It is very important! It is very important because if we don't have competent suppliers who we can trust when it comes to product development or new concepts that we make, we do not manage to sell anything."

These statements strengthen the discussion given under subchapter 6.3.2.1. Here, it was questioned if Vard Group have a paternalistic position in the relationship with their suppliers. The relationship is instead in line with the scholars arguing that the improvement activities between buyer and supplier are characterized by joint improvement where both parties contribute to innovate.

However, one of the informants in VVT revealed that improvement incentives are very rare included in the contracts between VVT and the suppliers, as these contracts very often only are project-specific. It was further revealed that development projects to create innovation and improvements often are handled by the design department in Norway. For example, the design department is working together with the suppliers to conduct tests and measurements of fuel consumption and resistance in the water in a test pool at NTNU.

This is thereby in line with the lean literature, suggesting that suppliers can propose their own ideas and hence contribute to innovation and development of the buyer's product.

On the other hand, one of the informants in Vard Group revealed that Farstad Shipping, the shipowner of NB838, are conducting a distinctly degree of product development with their cooperation partners and suppliers of equipment by stating:

"Farstad have an excellent cooperation with their people working on the vessels and using the equipment on a daily basis and all the way back to the producer of the respective equipment."

Lean literature further emphasizes that supplier development can be a challenge if the supplier serves several customers at the same time who have different or even conflicting demands (MacDuffie and Helper, 1997). Based on the discussion under section 6.2.1, it was revealed that Brunvoll would put much effort on satisfying their customers, and that conflicting demands very seldom was a challenge for them. Moreover, several informants in Vard Group revealed that their customers are serving several customers at the same time, and that this has not been a challenge for them. However, one of the informants nevertheless acknowledged that they are careful with the information they share with these suppliers, as they know they also serve their competitors.

Another challenge identified in the literature study is resistance to radical changes, such as lean implementation, from supplier organizations with strong identity (MacDuffie and Helper, 1997). As already mentioned in the section above, the informant from Brunvoll stated that if Vard Group asked them to implement lean they would be positive to this suggestion. However, the literature further argues that smaller suppliers may be more responsive to the customer's suggestion compared to larger suppliers (MacDuffie and Helper, 1997). Several of the informants in Vard Group indicated that Rolls Royce are more rigid compared to other suppliers, as they for example want to use their own contracts. This may indicate that this organization has a stronger identity compared to other supplier organizations. However, the informants in Vard Group emphasized that this does not affect their relationship to Rolls Royce and the choice of supplier.

6.4.2.1 Discussion - Conducting Joint Improvement Activities

The previous section provided an analysis, where results from case study findings were seen against literature concerning accomplishment of joint improvement activities. The section has revealed that Vard Group do not have any paternalistic position in the development process with their suppliers. However, they are instead highly dependent on their suppliers, as the suppliers can propose own ideas and contribute to improve the vessels with their innovation. Lean literature concerning joint improvement activities is therefore found to be highly important for Vard Group. However, it is further discovered that the joint improvement activities are primarily conducted in Norway and not in Vietnam. One of the informants emphasized the maritime cluster in Norway as a special and important environment for joint improvement activities amongst the actors, independent on the logo of the organization. This makes the cluster rather unique and allows innovation across the different organization. The same aspect is not identified in Vietnam. They are instead highly dependent on the improvement activities conducted in Norway. However, due to the already mentioned organizational gap these improvement activities are not conducted with a lean perspective, which the literature review suggests.

Lean literature concerning joint improvement activities is to a limited extent applicable for Vard Group due to the lack of understanding of lean by the people involved in the joint improvement activities at the main office in Ålesund. However, if the main office were included in the lean thinking process and the improvement activities then were conducted with a lean perspective this literature could be applicable to a significantly higher extent.

6.4.3 Dedicated Assets

The literature study revealed three key characteristics creating competitive advantage for a partnership, where the first one is *dedicated asset* (Dyer, 2000). Dedicated assets include committing financial, capital and personnel resources to the development task and to share timely and sensitive information (Simpson and Power, 2005). One of the informants in VVT revealed that the strategic components, such as main engine, are standard products for high-end offshore vessels. This implies that strategic suppliers offer several types of engines at different sizes, as these are most often not customized for a vessel. These

products do therefore not require any specific investments in terms of financial, capital or personnel resources from neither the buyer nor the supplier side.

Furthermore, the literature study reveals that the investment may improve the network's ability to develop unique products. When it comes to development projects one of the informants at the main office in Norway stated that:

"We cooperate with several of our suppliers to develop products nearly all the time."

This development program requires sharing of sensitive and timely information between the parties, such as information concerning design. Both actors thereby invest in the development program by providing their sensitive information to the other party. However, the same informant could not reveal which suppliers they are having product development programs with, as this information is considered confidential. The informant from Brunvoll stated that they have conducted joint improvement programs with Vard Group. The same informant further revealed that when the market situation was tough, Vard Group asked their suppliers to cooperate and invest in the relationship in this period by giving special discount and adjust the payment profile.

The literature study further reveals that the advantage of dedicated assets is of greater importance in complex industries compared to arm's length relationships (Dyer, 2000). The discussion concerning relationship management in section 6.3.1 found that for Vard Group and their suppliers the relationship is in between an arm's length relation and a partnership. The strategic components are project-specific as it is the shipowner who decides these products. One of the informants in Vard Group stated that MacGregor were participating in the initial phase for NB838 before any contract was signed between Vard Group and Farstad Shipping. The supplier was then participating with dedicated assets in terms of personnel resources in the relationship.

Furthermore, the literature reveals that investing in dedicated assets can be a challenge. Both parties must be convinced that it is within their best interest to accept direction and assistance from their customer (Simpson and Power, 2005). The informant from Brunvoll stated that they sometimes participate in the initial process of a project before a contract is signed between Vard Group and shipowner. They are then providing the customer with drawings and information, but they do not know if they are to be chosen for that specific

project yet. However, he argues that participation in the initial phase increase the chances for being chosen for the project. Yet, the informant emphasizes that it is the shipowner who has the final saying in that choice. The same informant further stated that they have to take this risk if they want the contract. They have to offer the customer their resources, even though they do not know if they will get the contract at the end.

6.4.3.1 Discussion Dedicated Assets

The previous section provided an analysis where results from case study findings were seen against literature concerning dedicated assets. It has been revealed that VVT are to a limited extent experiencing dedicated assets in relation to their suppliers. This is because their relation is mostly considered to be project-specific, where the supplier mostly offers the same products to the whole industry. The main office in Norway is however, conducting development programs with several of their suppliers nearly all the time. This requires dedicated assets in terms of investments in the development program where both parties are providing their time and sensitive information to the other party. Moreover, the suppliers are often located closely within the maritime cluster in Norway, which makes the investment in development programs easier, as the distance between them is short. However, again there has not been any focus on dedicated assets in terms of lean implementation within the relationship between Vard Group and their suppliers. This again is related to the already mentioned organizational strategic gap, where the informants at the main office are unfamiliar with the philosophy. The applicability of dedicated assets with a lean perspective is therefore limited.

6.4.4 Knowledge Sharing and Trust

The following section will present findings and discussions concerning the two last key characteristics identified in the literature study: knowledge sharing and trust.

The second characteristic identified in the literature study is *knowledge sharing*, and refers to the network's ability to exchange valuable knowledge, which can help the partnership to be more efficient and effective (Dyer, 2000). It was further argued that both suppliers and

customers could benefit from entering into a knowledge transfer arrangement (MacDuffie and Helper, 1997). Both the informants in Vard Group and Brunvoll emphasized national and international fairs as an important arena to meet their suppliers and customers. Here they can share their knowledge and information with them about the market, their news and their business activities. Further, the informant from Brunvoll revealed that they could arrange a visit to Vard Group in Ålesund to present their new ideas and improvements of their equipment without being involved in any specific projects. This was further confirmed by one of the informants in Vard Group who stated that they receive knowledge about new equipment from the suppliers, which has not been introduced on the market yet. As previously analysed, under 6.3.2, Vard Group would then be seen as a link in the value chain, where producers present improvements and innovations together with them. The innovation from the supplier can then improve the total quality of the whole vessel, whilst the supplier will benefit from marketing of their product in relation with Vard Group. This is in line with the lean literature, which suggests that both supplier and customer can benefit from knowledge sharing arrangements. Both informants further revealed innovation and improvement as vital in order to survive in this industry, as it is characterized by high extent of innovation and fast technological changes.

It was further revealed that VVT are not involved in any structured knowledge sharing programs with their suppliers, these are instead handled by the main office in Ålesund. This is thereby in line with the literature which emphasizing that the innovation process primarily takes place in Norway (Halse, 2014). The literature further argues that knowledge sharing can be difficult to transfer, but especially for a shipbuilding company with a global value chain, due to tacit knowledge (Halse, 2014). The informant from Brunvoll revealed that knowledge sharing is easier within the Norwegian maritime cluster due to the geographical proximity. Anyhow, if the customer decides to build abroad, they will absolutely serve that customer and deliver to the foreign location he continued. He further emphasized that their relationship to the shipyard in Vietnam is great, and the transfer of equipment has not met any problems. However, he acknowledged that a Norwegian management with experience from the Norwegian shipbuilding industry has been of significant importance for this success. He further stated that these people already have the knowledge from the maritime cluster, which is of great advantage for the relationship.

The literature study further reveals two key factors affecting the knowledge transfer process from customer to supplier, *the supplier's absorptive capacity* and *organizational identity* (MacDuffie and Helper, 1997). One of the informants in Vard Group mentioned the Norwegian maritime cluster, where the suppliers are well established with many years of experience. They have known Vard Group for many years and hence know what they expect. This can make the absorptive capacity high for the suppliers located within the maritime cluster. As revealed from previous analysis, see 6.2.4, it is seen as an advantage to have the supplier located close by and speaking the same language. However, it was not identified to be a decisive criterion for supplier selection, as long as the supplier is able to deliver in accordance to the shipowner's requirements. Yet, one of the informants in Vard Group revealed that some of their customers require that the strategic components be not produced in low-cost countries like China.

The second factor affecting the knowledge transfer process was organizational identity. It is the individuals working in the organization, which affect how willing the organization is to embrace changes. It was mentioned in section 6.2.2 that smaller suppliers might be more willing to learn, whilst Rolls Royce are acknowledged as a more rigid organization where they want to handle the processes on their premises. In the case description, given in chapter 4, it was mentioned that especially the Norwegian suppliers for the shipbuilding industry has grown significantly during the last years. Hence it is likely to assume that their organizational identity has become stronger over the years.

However, even though absorptive capacity and organizational identity is important, the literature study emphasized motivation for learning and high trust between the parties to be crucial for transferring knowledge. *Trust* is the third and last key characteristic for creating competitive advantage within a partnership, which was mentioned in the literature study. All the informants in Vard Group revealed that they have very good relations to all their suppliers, which they can trust. One of the informants in Vard Group stated following:

"There need to be trust. If we cannot trust each other then it will not work."

This statement is thereby in line with the literature study, which emphasizes trust as critical for partner success and maybe the most important factor. Yet, one of the informants in Vard Group acknowledged that they have to be aware that their suppliers also serve their competitors and therefore they cannot trust their suppliers 100% always.

Another of the informants within the Group emphasized that trust cannot be built between two computers, it needs to be built between people and you need to be aware that if people have something to gain they will risk that trust. This is in line with the response from the informant from Brunvoll. He stated that he experiences Vard Group as a professional organization, which he has full trust in. However, on the other hand he pointed out the importance to be aware of the risk of people with other purposes within all organizations. Moreover, one of the informants in VVT revealed that there is a varying degree of trust to their different suppliers. There are suppliers they have worked with over several years, which they can share information and knowledge with. On the other hand there are new suppliers they need to limit the transfer of information and knowledge to, and especially when it comes to the design of the vessels. The same informant further revealed that the risk of being copied is greater in Asia than in Norway, even though they have not experienced anything like that in Vietnam yet.

6.4.4.1 Discussion Knowledge Sharing and Trust

The previous section provided an analysis where results from case study findings were seen against literature concerning knowledge sharing and trust. The analysis found that knowledge sharing is very important for this industry as it is characterized by high innovation and fast technological changes. However, it was revealed that the main office in Ålesund mainly handles the knowledge sharing between Vard Group and suppliers, whilst VVT are mostly not involved in any of these arrangements. Results from the case study findings revealed it as an advantage to have the suppliers located close by and speaking the same language. However, it was further found that the location of the supplier does not make any difference when a supplier is chosen, as long as the supplier can meet the requirements set by the shipowner. It was moreover, emphasized that a Norwegian management with experience from the Norwegian shipbuilding industry has been of importance for the success for the yard in Vung Tau. These people have already the knowledge from the maritime cluster, which is of great advantage for the relationship between the yard and the suppliers. This can therefore reduce the challenge concerning tacit knowledge for global value chains.

Results from the case study findings found that there has not been any transfer of knowledge concerning the lean philosophy yet amongst Vard Group and their suppliers, due to the already identified organizational gap. This will therefore limit the extent of applicability of knowledge sharing for the identified value chain in a lean perspective.

The literature study further emphasized trust as crucial for transferring knowledge concerning lean. Results from the case study findings revealed that Vard Group have very good relations with their suppliers, which they can trust. The supplier side further confirmed that the trust is mutual. The informants in VVT emphasized however that there is a varying degree of trust to their suppliers, and that the risk of being copied is greater in Asia compared to Norway. This may be a challenge for global value chains, which affect the knowledge sharing with new foreign suppliers. However, based on these findings, there is reason to believe that the suppliers will trust a transfer of lean thinking into their organization as they already have trust in Vard Group. On the other hand, there is reason to believe that Vard Group will trust their suppliers and their motivation to work with lean if they already have a trustworthy relationship to their suppliers. This implies that the lean literature concerning knowledge sharing for the identified value chain will be more applicable if the whole value chain was thinking lean. However, the challenges concerning the global value chain and tacit knowledge will still exist.

6.4.5 Sub-conclusion RQ5

Based on RQ5*: What characterizes lean supplier development, and to what extent will lean supplier development be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?,* this research concludes that lean supplier development literature emphasizes to create a culture of continuous improvement by using kaizen events with suppliers and to focus on the activities a value stream map finds to be the most value adding ones. Moreover, to conduct joint improvement activities where both customer and supplier contribute with mutual benefits is revealed as important. Lastly, competitive advantage for lean supplier development is characterized by investment in dedicated assets, knowledge sharing and building of a trust worthy relationship.

Based on the analysis and discussion above concerning lean supplier development this research concludes that kaizen events with strategic suppliers are to a limited extent applicable for the case organization. This is due to the identified organizational gap and ETO production strategies. The research further concludes that joint improvement activities are to a limited extent applicable for the case organization as the people involved in these activities are unfamiliar with lean thinking. However, if these employees were included in the lean thinking process and the improvement activities then were conducted with a lean perspective this literature could be applicable to a significantly higher extent. Moreover, this research concludes that the applicability of dedicated assets with a lean perspective is limited for the case organization, due to the already mentioned organizational strategic gap. With respect to knowledge sharing and trust, results from the case study findings found that there has not been any transfer of knowledge concerning the lean philosophy yet amongst Vard Group and their suppliers. This is again related to the identified organizational strategic gap. This research therefore concludes that the applicability of knowledge sharing for the identified value chain in a lean perspective is limited. This implies that the lean literature concerning knowledge sharing will be more applicable if the whole value chain was lean thinking.

7. Conclusion

The purpose of this research has been to contribute to the development of ETO literature, by identifying the applicability of lean procurement for an ETO producer, when the organization has a global value chain with production in a low-cost country. In order to do this, a case study was conducted for providing an answer to the research problem: *To what extent will lean procurement be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country?* The case organization for this research has been Vard Group, and the unit of analysis has been their global value chain with foreign building location in Vung Tau.

In order to answer the given research problem an extensive literature study was conducted for defining lean procurement. This research defined lean procurement by lean supplier selection, lean relationship management and lean supplier development. Five research questions were further formulated to answer the given research problem using a two-folded structure. RQ1-2 were of descriptive nature for the case organization, laying foundation for the remaining research. RQ3-5 were of explorative nature. In order to answer these research questions qualitative methods were used as main technique for data collection. Data was collected through interviews with informants from the case organization's value chain.

In the two previous chapters, sub conclusions have been provided. Based on these it is possible to provide a conclusion for the research problem. This case study research revealed two main findings, which proved to affect the applicability of the three defined lean procurement elements. The first main finding is related to the complex production environment in which the case organization operates, characterized by an ETO structure where procurement activities are conducted both in Ålesund and in Vung Tau. The second main finding is related to the identified organizational strategic gap with respect to the lean philosophy. As major parts of the procurement activities are conducted at the main office in Ålesund, where they do not pursue a lean procurement strategy, it will have impact on the applicability of the lean procurement.

The research revealed that when a shipbuilder has an ETO structure, it implies that the shipowner has a final saying in the decisions concerning strategic components. This research recognized the importance of the strategic components delivered to a vessel, as

they contribute to a significant value creation for the shipowner. With a value chain perspective, the shipbuilder can be seen as a logistical tier contributing to the value chain for a limited period. The suppliers, however, are delivering value to the shipowner through their components during the lifetime of the vessel, lasting for about 25 years. Hence, the applicability of lean procurement, in terms of lean supplier selection and lean relationship management with respect to strategic components, will be limited as it should be of overall concern for the shipbuilder to establish supplier relationships with respect to the shipowner's requirements. However, the ETO structure does facilitate applicability of a minor part from the lean supplier selection literature concerning identification of non-value adding components. As the shipowner has a final saying, all components will give value. Furthermore, this research revealed that one aspect from lean relationship management related to long-term relationships is to some extent applicable. However, the applicability will be limited, as the relationship will not concern specific projects, but an on-going collaboration for maintaining a commercial edge with respect to product developments and innovation. This is thus related to the lean literature concerning supplier development. Of the aspects, the literature study proposed to be important for supplier development there are several aspects, which will be applicable for a global shipbuilder, building specialized high-end vessels in a low-cost country. Conducting joint improvement activities and knowledge sharing is revealed important activities for the Norwegian maritime cluster, as they are related to the creation of innovation within the buyer-supplier relationship. For the case organization these was considered not applicable due to the identified organizational gap. However, for an organization without this gap joint improvement activities and knowledge sharing with suppliers will to a much higher extent be applicable with a lean perspective.

To summarize, this research concludes that lean procurement in terms of lean supplier selection will to a very limited extent be applicable for a global shipbuilder, building high-end specialized vessels in a low-cost country. The applicability is related to a minor aspect concerning identification of non-value adding components. Due to the ETO structure, this literature is applicable. Further, this research concludes that lean procurement in terms of lean relationship management will be applicable to a limited extent for a global shipbuilder, building high-end specialized vessels in a low-cost country. The applicability is limited to establishing long-term relationships to ensure innovation outside of projects. Finally, the research concludes that lean procurement in terms of lean supplier

development will be applicable to a moderate extent for a global shipbuilder, building high-end specialized vessels in a low-cost country. The applicability is limited to joint improvement activities, knowledge sharing and dedicated assets, given that the entire organization is pursuing a lean procurement philosophy.

8. Limitations and Further Research

8.1 Limitations of the Research

This subchapter recognizes the limitations applying for this research.

Based on the research problem, time limitations put pressure to narrow down the scope of this study. A single case study approach was selected. A potential vulnerability of a single case design is that it is possible that the case turns out not to be the case it was though to be in the outset. To minimize chances of misrepresentation, and to maximize the access needed to collect evidence, single case designs require careful investigation of the potential case (Yin, 2003). Due to the time limitations, it was difficult to carry out such investigations thoroughly. Due to this, the case used for this case study turned out to be more complex that what it was thought in the outset. This research contains a broad collection of various aspects: lean, procurement, ETO, global value chain, the maritime cluster, and so on. These aspects needed to be included due to the case unit, which created a baseline for a relatively complex case study. However, due to the time limitations it would have been difficult to change the case unit. Thus, the researchers decided to follow through with the case, where the aim was to grasp the surface of mentioned elements, laying foundation for further research.

The complexity of the case can further be linked to the mentioned organizational strategic gap identified in analysis, discussions and conclusions. The organizational strategic gap laid basis for a significant number of the sub-conclusions taken for this study. A limitation can be linked to case organization for this research, as more appropriate and complementary conclusions could have been taken with respect to the research problem if such strategic gap had not been present.

Further, the analysis and discussions for this research argued that the strategic components are purchased from the Norwegian maritime cluster when the vessel is built in Vung Tau. This is often the situation, however, it must be emphasized that it is not given. Nevertheless, informants revealed that strategic components never are purchased local suppliers. Hence, discussions and conclusions taken respected to geographical proximity still apply for this research.

Another limitation of this research can be linked to the Kraljic portfolio analysis used for defining the strategic components in this research, which was based on limited sources of data. However, due to lack of access to supplementary data it was not possible to conduct the analysis more thoroughly.

Further, limitations of this research can be directed to the data obtained from the information at Brunvoll. First, it is a risk that the informant embellished his answers, as the informant was aware that the research was conducted for Vard Group, which is an important customer for their organization. Secondly, a limitation for the analysis and discussion can be linked to the lack of informants from the supplier side of Vard Group's value chain. This research uses only one supplier for establishing an impression of how suppliers perceive Vard Groups supplier selection, relationship management and supplier development. For strengthening this perception further, additional informants from the supplier side should have been included. Further, this research could have benefited by obtaining data from the buyer side of Vard Group's value chain. The researchers tried to get in contact with more suppliers, as well as the shipowner of NB838, Farstad Shipping. However, the researchers experienced difficulties by getting in touch with these actors in the value chain.

The researchers' lack of experience in conducting qualitative research can be seen as another limitation. This was discussed in chapter 3.7.2.1. It was devoted a great amount for studying aspects of qualitative research, regarding how informants should be informed, how to develop an interview guide, how to conduct interviews for increasing the validity, and other aspects that had to be considered.

Further, unstructured and semi-structured interviews were used as main method for data collection. A limitation of this method is that the researcher risks establishing a relationship with the informant when the interviews are carried out as a conversation (see 3.3.11). Hence, for this research there is a risk that the relationship between the researchers and the informants was decisive for the data acquired. Further, there is a possibility that the researchers have inhibited the informants by asking leading questions or by having misinterpreted their meta-communication, see 3.3.1.1. This will always be a risk when using qualitative methods for data collection. Further, as mentioned in subchapter 3.5, the researchers conducted the interviews in Norwegian with the Norwegian informants. There is a risk that some expressions by the informants have been lost in translation when the

data was translated into English before it was used for discussion and analysis. Further, some of the interviews were conducted in English. Nor the informants or the researchers have English as a native language. Thus, there might be sources of error due to misinterpretations and lack of vocabulary when the informant expressed their meanings. Further, as mentioned in section 3.3.1.2, a limitation of group interviews is that the informants only will express what is perceived acceptable for the public. There is a possibility that the informants from the group interviews held back some information, as they were afraid to say anything wrong in front of the other informants.

8.2 Further Research

This subchapter presents the fields for further research based on this research.

This research has investigated to what extent lean procurement is applicable for Vard Group, and opportunities and challenges concerning applicability of the defined lean procurement literature have been revealed for an ETO shipbuilding company. A further research will be to use these findings to develop a plan of actions for improvement of lean procurement for ETO producers.

Moreover this research has examined three of eight elements proposed in the lean procurement literature. Further research will therefore be to examining the five remaining elements of lean procurement and reveal the applicability of these elements with respect to the ETO context.

Furthermore, due to time limitations this case study have only examined the applicability of lean procurement with respect to the components categorized as strategic by the Kraljic's portfolio analysis. Further research can therefore be to investigate the applicability of lean procurement of the excluded categories*, leverage items*, *bottleneck items* and *non-critical items* within an ETO environment.

It have been used a single case study for this research where only one of the global value chains for Vard Group is considered. This was due to time limitations for this research. It will however be of high interest conduct study other global shipbuilders with an ETO structure to reveal if the findings will differ from the findings emerged in this research. Further research will therefore be to use the same case study protocol developed for this research on multiple cases.

This case study has only considered the global value chain within Vard Group. Another interesting aspect will therefore be to do a comparison of the local versus the global within Vard Group. Further research will therefore be to investigate if lean procurement is more applicable for the yards located within the maritime cluster compared to their foreign yards with the same owner.

A final suggestion for further research will be to conduct the same case study with more time available in order to interview more suppliers and in addition include the shipowner in the research.

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Appendices

8.3 Appendix 1: Interview guide 1-B1

Introduction

- *Thank the informant for his/her participation and ask if the interview may be recorded*
- *Give the informant information on the time scope of the interview*
- *Ask the informant about his/her position is in the firm, and what his/her responsibilities are*
- *Ask the informant about his/her relationship to the shipyard in Vietnam*
- *Tell the informant about the research and what it seeks to investigate*

Project specific questions

- Could you elaborate on the details of NB838?
    - Date of sale
    - Price
    - Customer
    - Estimated date for delivery

Concept development and sales

- Could you describe the process from the point where the customer contacted you for ordering the ship, to when you signed the final contract with your customer?
- Is this process similar to the general process in ship sales for VARD?
- On what stage of the project is the procurement function incorporated?

Presenting further direction for the conversation

- *Inform informant that the rest of the interview will concern strategic components*
- *Provide the informant a definition of strategic components*

Strategic suppliers in the value chain

- Could you describe one of the strategic suppliers for NB 838?
    - How many products do this deliver that are important for production? (RM)
    - How important is it that this has competencies that will contribute to your own product development? (SD)
    - How many customers do this supplier have? And how does this affect the responsiveness for your demands? (SS)
    - Have this supplier had any specific investments for meeting your demands? (SD)
    - Had Brunvoll delivered any strategic components for this ship?
    - Do you know if Brunvoll have delivered any strategic components for ships built in Vietnam?
- Is this description of a strategic supplier typical for other projects?
- What role does this supplier have in the different stages in the value chain, starting with concept development and sales, basic design, procurement, detailed engineering, fabrication, outfitting and commissioning?

- Is this role typical for a strategic supplier for other projects?
- How does VARD cooperate with their suppliers?
    - Do you have contact with suppliers only during projects? Or is it constant on-going relationship? (RM, SS)
    - When are the suppliers included in the shipbuilding process?
    - How is the process between Vard and its suppliers before the contract is signed for a project? (RM)
- Do you have any improvement projects that Vard and the suppliers collaborate on? For instance to reduce costs, lead-time, material used in operations, etc? (SD)

The contract with suppliers

- Could you elaborate on the development of the contract between Vard and the strategic supplier we talked about?
    - How long are the contracts? Project specific? Several years? (SS, SD)
    - Are there incentives in the contracts for improving quality and lead-time? (SD)
    - What are the consequences if unforeseen events happen, caused by a supplier? (RM)
    - If there are any change orders, how is this handled in the contract?
    - Are the contracts always followed, or are relations more important? (SD)
- Is this contract development typical for all strategic suppliers?

Makers list

- Could you elaborate on the process of developing a makers-list for NB838?
    - Who participates in the process? (SS)
    - How are the suppliers evaluated, and who contacts the suppliers? (SS)
    - How many suppliers are representative for each component on the list? (SS)
    - How are the suppliers selected? (SS)
    - Do you prefer to select suppliers from the maritime cluster? (SS)
        - Is the relationship affected by being in the same region? (SS)
        - How is the relationship with suppliers outside of the cluster? Any differences? (SS)
        - Do have any information of how your suppliers are cooperating with other suppliers in the maritime cluster? (SD)
- Is the development of this makers list typical for all suppliers?

Sales office in Singapore

- How many ships are sold from the sales office in Ålesund that was built in Vietnam?
- How many ships are sold from the sales office in Singapore that was built in Vietnam?
- The processes that we talked about, from the point where the customer contacted you for ordering the ship, to when you signed the final contract with the customer, are they similar when the ship is sold from the office in Singapore?
- If the ship is sold to an international customer from the sales office in Singapore, which requirements do they have towards the strategic components?
    - Are the components generally the same (same suppliers) as if the ship is built in Norway?

- Are the procurement processes generally the same as if the ship is built in Norway?

Information and knowledge sharing

- Could you elaborate on information and knowledge sharing between Vard and the suppliers (RM, SD)
  - Do you have an example?
- Would you consider the information and knowledge sharing with suppliers different in Vard Vung Tau compared to the Norwegian yards (RM, SD)
  - What are the differences?
  - What are the similarities?
  - Do you have an example?

Shipbuilding in Vung Tau

- Do you have other requirements concerning relationship management in a global supply chain compared to how it is done in Norway? (RM)
- Could you elaborate on how the strategic supplier relations are handled in Vung Tau? (RM)
  - At what point in the value chain does Vard Vung Tau select the strategic suppliers? (SS)
  - What criteria are important for selecting suppliers on the makers list? (SS)
  - Does Vard Vung Tau make one complete order on deliveries from Norwegian strategic suppliers? Or are several orders placed? (SS)
  - If one of the suppliers on the makers list cannot deliver the product, how dependent are you on that supplier? Is it easy to switch to another supplier? Or does the process of selecting a supplier start all over again? (RM)
- What challenges occur when producing in Vietnam compared to Norway?
  - How are problems such as delays or other unforeseen events handled?
  - Are there many change orders during a project?
    - How are the change orders handled?
  - Flexibility
  - Lead-time
  - Agent
  - VAT
  - Taxes
  - Information and knowledge

Lean work in the procurement function

- Could you describe what your idea of the term “lean” is?
- Could you describe what your idea of “lean procurement” is?
- Do you know if any of your strategic suppliers are producing under lean philosophy? (SS)
- Have you ever discussed lean thinking with your suppliers (SS, SD)

Closure of the conversation

- *Ask informant if he/she has anything to add to the conversation*
- *Thank informant for the participation*

8.4 Appendix 2: Interview guide 2-C1

Introduction

- *Thank the informant for his/her participation and ask if the interview may be recorded*
- *Give the informant information on the time scope of the interview*
- *Ask the informant about his/her position is in the firm, and what his/her responsibilities are*
- *Ask the informant about his/her relationship to the shipyard in Vietnam*
- *Tell the informant about the research and what it seeks to investigate*

Concept development and sales

- Could you describe the process from the point where a customer contacts VARD for ordering a ship, to when VARD sign the final contract with the customer?
- Could you elaborate on what processes that are included in the procurement function for a project?
- On what stage of the project is the procurement function incorporated?

Presenting further direction for the conversation

- *Inform respondent that the rest of the interview will concern strategic components*
- *Inform respondent of what we mean by strategic components*

Strategic suppliers in the value chain

- Could you describe a typical strategic supplier for VARD?
    - How many products do this deliver that are important for production? (RM)
    - How important is it that this has competencies that will contribute to your own product development? (SD)
    - How many customers do this supplier have? And how does this affect the responsiveness for your demands? (SS)
    - Have this supplier had any specific investments for meeting your demands? (SD)
    - Examples of often used strategic suppliers
- What role does the supplier have in the different stages in the value chain, starting with concept development and sales, basic design, procurement, detailed engineering, fabrication, outfitting and commissioning?
- How does Vard cooperate with their suppliers? (RM)
    - Do you have contact with suppliers only during projects? Or is it constant on-going relationship? (RM, SS)
    - When are the suppliers included in the shipbuilding process?
    - How is the process between Vard and its suppliers before the contract is signed for a project? (RM)
- Do you have any improvement projects that Vard and the suppliers collaborate on? For instance to reduce costs, lead-time, material used in operations, etc? (SD)

Contract with suppliers

- Could you elaborate on the development of the contract between Vard and the suppliers?

- How long are the contracts? Project specific? Several years? (RM, SD)
- Are there incentives in the contracts for improving quality and lead-time? (SD)
- What are the consequences if unforeseen events happen, caused by a supplier? (RM)
- If there are any change orders, how is this handled in the contract?
- Are the contracts always followed, or are relations more important? (SD)

Makers list

- Could you elaborate on the process of developing a makers-list?
  - Who participates in the process?
  - How are the suppliers evaluated, and who contacts the suppliers? (SD)
  - How many suppliers are representative for each component in the list? (SS)
  - How are the suppliers selected? (SS)
  - Do you prefer to select suppliers from the maritime cluster? (SS)
    - Is the relationship affected by being in the same region? (SS)
    - How is the relationship with suppliers outside of the cluster? Any differences? (SS)
    - Do you have any information of how your suppliers are cooperating with other suppliers in the maritime cluster? (SD)

Information and knowledge sharing

- Could you elaborate on information and knowledge sharing between Vard and the suppliers (RM, SD)
  - Do you have an example?
- Would you consider the information and knowledge sharing different from Vard Vung Tau and the suppliers (RM, SD)
  - What are the differences?
  - What are the similarities?
  - Do you have an example?

Shipbuilding in Vung Tau

- Do you have other requirements concerning relationship management in a global supply chain compared to how it is done in Norway? (SS, RM)
- Could you elaborate on how the strategic supplier relations are handled in Vung Tau?
  - At what point in the value chain does Vard Vung Tau select the strategic suppliers? (SS)
  - What criteria are important for selecting suppliers on the makers list? (SS)
  - Does Vard Vung Tau make one complete order on deliveries from Norwegian strategic suppliers? Or are several orders placed? (SS)
  - If one of the suppliers on the makers list cannot deliver the product, how dependent are you on that supplier? (RM)
    - Is it easy to switch to another supplier? (SS)
    - Does the process of selecting a supplier start all over again? (SS)
- What challenges occur when producing in Vietnam compared to Norway?
  - How are problems such as delays or other unforeseen events handled?
  - Are there many change orders during a project?
    - How are the change orders handled?

- Flexibility
- Lead-time
- Agent
- VAT
- Taxes
- Information and knowledge

Lean work in the procurement function

- Could you describe what your idea of the term “lean” is?
- Could you describe what your idea of “lean procurement” is?
- Do you know if any of your strategic suppliers are producing under lean philosophy? (SS)
- Have you ever discussed lean thinking with your suppliers (SS, SD)

Closure of the conversation

- *Ask respondent if he/she has anything to add to the conversation*
- *Thank respondent for the participation*

8.5 Appendix 3: Interview guide 3-A4

Introduction

- *Thank the informant for his/her participation and ask if the interview may be recorded*
- *Give the informant information on the time scope of the interview*
- *Ask the informant about his/her position is in the firm, and what his/her responsibilities are*
- *Tell the informant about the research and what it seeks to investigate*

The lean implementation process

- Could you describe your idea of the term "lean"?
- Could you elaborate on the lean philosophy you have at Vard Vung Tau?
    - When was lean implemented?
    - Why did you implement it?
    - How did you implement lean?
    - What was the process of implementing it?
    - What are the differences before and after implementation?
- Could you elaborate on what you have done at Vard Vung Tau for implementing lean procurement?
    - When was lean in the procurement process implemented?
    - Why did you want to implement it?
    - How did you implement lean?
    - What was the process of implementing it?
    - What are the differences before and after implementation?

Project specific questions

- Could you elaborate on the details of NB838?
    - Date of sale
    - Price
    - Customer
    - Estimated date for delivery

Concept development and sales

- Could you describe the process from the point where the customer contacted VARD for ordering the ship, to when you signed the final contract with your customer?
- Is this process similar to the general process in ship sales for VARD?
- On what stage of the project is the procurement function incorporated?

Contract

- Could you elaborate on the development of the contract between Vard and a supplier?
    - What is the time scope of the contracts? Project specific? Several years? (SD)
    - Are there incentives in the contracts for improving quality and lead-time? (SD)

    - What are the consequences if unforeseen events happen, caused by a supplier? (RM)
    - If there are any change orders, how is this handled in the contract?
    - Are the contracts always followed, or are relations more important? (SD)
- Is the contract somewhat different depended on the components the supplier delivers?
    - What are the differences?

Makers list

- Could you elaborate on the process of developing a makers-list for NB838?
    - Who participates in the process? (SS)
        - Is Vard Vung Tau involved in the development of the makers list? (SS)
        - When are you involved? (SS)
    - How are the suppliers evaluated, and who contacts the suppliers? (SS)
    - How many suppliers are representative for each component in the list? (SS)
    - How are the suppliers selected? (SS)
    - Do you prefer to select suppliers from the maritime cluster in Norway? (SS)
        - Is the relationship affected by being in the same region? (SS)
        - How is the relationship with suppliers outside of the cluster? Any differences? (SS)
        - Do have any information of how your suppliers are cooperating with other suppliers in the maritime cluster? (SS)
- Is the development of this makers list typical for all suppliers? (SS)

Shipbuilding in Vung Tau

- Could you elaborate on the procurement function in Vung Tau?
    - How is the procurement done?
    - Can you give an example of how the procurement will be done related to NB838?
- How is the trust and information sharing with you suppliers? (SD)
- What is the frequency of orders from one supplier? (SS)
    - Is there any difference between the suppliers?
- What challenges occur when producing in Vietnam compared to Norway?
    - How are problems such as delays or other unforeseen events handled? (SS)
    - Are there many change orders during a project?
        - How are the change orders handled?
- Can you elaborate on the flexibility you have in production when the strategic components are delivered from Norway?
- What is the lead-time when the strategic components are delivered from Norway?
    - How do you take this into account with respect to procurement and production?
- Can you elaborate on the process of when an agent is required for delivering components in Vietnam?
- Can you elaborate on the restrictions in terms of VAT and taxes when components are delivered to Vietnam?
- Can you elaborate on how the current situation in the oil market affects the production in Vietnam?
    - More change orders?

- From whom come the change orders?
- How does it affect flexibility?
- How does it affect lead-time?

Presenting further direction for the conversation

- *Inform respondent that the rest of the interview will concern strategic components*
- *Inform respondent of what we mean by strategic components*

Supplier of NB838

- Can you give an assessment on the value of on the components that was ready when the contract was signed? (SS)
- Who were the suppliers of these components?
- Are these suppliers always decided upon before the contract is signed? (SS)
- What influence do you have with respect to selection of strategic suppliers? (SS)
  - What is you opinion of this influence?
  - Does the degree of influence differ from project to project?

Strategic suppliers in the value chain

- Could you describe one of the strategic suppliers for NB838?
  - How many products do this deliver that are important for production? (RM)
  - How important is it that this has competencies that will contribute to your own product development? (SS, SD)
  - How many customers do this supplier have? And how does this affect the responsiveness for your demands? (SS)
  - Have this supplier had any specific investments for meeting your demands? (SD)
- Is this description of a strategic supplier typical for other projects?
- What role does this supplier have in the different stages in the value chain, starting with concept development and sales, basic design, procurement, detailed engineering, fabrication, outfitting and commissioning?
- Is this role typical for a strategic supplier for other projects?
- How does VARD cooperate with their suppliers?
  - Do you have contact with suppliers only during projects? Or is it constant on-going relationship? (SS, RM)
  - When are the suppliers included in the shipbuilding process?
  - How is the process between Vard and its suppliers before the contract is signed for a project? (RM)
- Do you have any improvement projects that Vard and the suppliers collaborate on? For instance to reduce costs, lead-time, material used in operations, etc? (SD)
- Do you have other requirements concerning relationship management in a global supply chain compared to how it is done in Norway? (SS, RM)
- Do you know if any of your strategic suppliers are producing under lean philosophy? (SS)
- Have you ever discussed lean thinking with your suppliers (SS, SD)

Information and knowledge sharing

- Could you elaborate on information and knowledge sharing between Vard and the suppliers (RM, SD)

    - Do you have an example?
- Would you consider the information and knowledge sharing with suppliers different in Vard Vung Tau compared to the Norwegian yards? (RM, SD)
    - What are the differences?
    - What are the similarities?
    - Do you have an example?

Sales office in Singapore

- How many ships are sold from the sales office in Ålesund that was built in Vietnam?
- How many ships are sold from the sales office in Singapore that was built in Vietnam?
- The processes that we talked about, from the point where the customer contacted you for ordering the ship, to when you signed the final contract with the customer, are they similar when the ship is sold from the office in Singapore?
- If the ship is sold to an international customer from the sales office in Singapore, what requirements do they have towards the strategic components? (SS)
    - Are the components generally the same (same suppliers) as if the ship is built in Norway? (SS)
    - Are the procurement processes generally the same as if the ship is built in Norway? (SS)

8.6 Appendix 4: Interview guide 4-D1

Introduction

- *Thank the informant for his/her participation and ask if the interview may be recorded*
- *Give the informant information on the time scope of the interview*
- *Ask the informant about his/her position is in the firm, and what his/her responsibilities are*
- *Tell the informant about the research and what it seeks to investigate*

The lean implementation process

- Could you describe your idea of the term "lean"?
- Could you elaborate on the lean philosophy you have at Vard Vung Tau?
    - When was lean implemented?
    - Why did you want to implement it?
    - How did you implement lean?
    - What was the process of implementing it?
    - What are the differences before and after implementation?
- Could you describe what your idea of "lean procurement" is?
- Could you elaborate on what you have done at Vard Vung Tau for implementing lean procurement?
    - When was lean in the procurement process implemented?
    - Why did you want to implement it?
    - How did you implement lean?
    - What was the process of implementing it?
    - What are the differences before and after implementation?
- Do you know if any of your suppliers are producing under lean philosophy? (SS)
- Have you ever discussed lean thinking with your suppliers (SS, SD)

Shipbuilding in Vung Tau

- Could you elaborate on the planning function in Vung Tau?
    - How is the planning done?
    - Can you give an example of how the planning will/is done related to NB838?
- How is the planning function working with lean?
- Could you elaborate on the production department in Vung Tau?
    - How is the process of production?
    - Can you explain the production related to NB838?
- How is the production working with lean?
- How do the planning, procurement and production function work together?
- Does it happen that the production, planning or procurement function work together with sites in Norway?
    - Elaborate, examples?
- What challenges occur when producing in Vietnam compared to Norway?
    - How are problems such as delays or other unforeseen events handled?
    - Are there many change orders during a project?

    - How are the change orders handled?
- How is the flexibility in production and planning when components are sent from Norway?
- What is the lead-time when components are sent from Norway, and how do production and planning take the lead-time into account?

Presenting further direction for the conversation

- *Inform respondent that the rest of the interview will concern strategic components*
- *Inform respondent of what we mean by strategic components*

Strategic suppliers

- What role does a strategic supplier have in the planning phase?
- What role does a strategic supplier in the fabrication, outfitting and commissioning
- Do you have any improvement projects that Vard and the suppliers collaborate on? For instance to reduce costs, lead-time, material used in operations, etc? (SD)

8.7 Appendix 5: Interview guide 5-E1

Introduction

- *Thank the informant for his/her participation and ask if the interview may be recorded*
- *Give the informant information on the time scope of the interview*
- *Ask the informant about his/her position is in the firm, and what his/her responsibilities are*
- *Ask the informant about his/her relationship to the Vard Vung Tau*
- *Tell the informant about the research and what it seeks to investigate*

General information

- For how many projects have you delivered components to Vard Group?
- For how many projects have you delivered components to Vard Vung Tau?
- How important is Vard for you as a customer? (SS)
- Who are you main customers? (SS)
    - Can you range these customers based on importance? (SS)
- Where in the world do you deliver most components?
    - Maritime cluster?

Supplier selection

- Do you deliver packages with components to your customers (SS)
- What demands do Vard put on you when you are evaluated as a supplier for a project? (SS)
- Do you have knowledge of the term lean? And do you use this in your production?
    - Is this something you would consider implementing?
    - Is this something you would consider implementing on request from your customer? (SS)
    - Which customer would be in position for influence you for becoming lean? (SS)
- How much value does the components you deliver have compared to the total value of a vessel? (SS)
- If you are in project with Vard, do you deliver to other customer simultaneously? (SS)
    - What demands do the other customers put on you? (SS)
    - Do you prioritize some customers over others when you deliver to several customers simultaneously? (SS)

Relationship management

- Can you elaborate on your relation with Vard outside of specific projects? (RM)
- How is Vard following you up when you are in project together? (RM, SD)
- To what degree do you share information and costs with Vard? (RM)
- To what degree do Vard share information and costs with you? (RM)
- Can you elaborate on what benefits you think will be acquired from this information sharing? (RM)

- Can you elaborate on what role you have towards Vard when you are in a project? (RM)
    - Equality?
    - Power dependence?

Supplier development

- Who is your main competitor?
    - Rolls Royce
- Can you elaborate on the competition with Rolls Royce?
    - Do you ever cooperate with each other in order to develop products? (SD)
- Would you be willing to contribute on a joint product improvement project with Rolls Royce (or other competitors), if for instance Vard would want this? (SD, RM)
- Can you elaborate on the trust between Brunvoll and Rolls Royce? (SD)
    - Fare of copying? (SD)
    - Cooperation for product development? (SD)
- How much project specific information does Vard have access to when you are in a project together? (SD)
    - Can you elaborate on how you trust Vard when sharing such information, as you are aware that they often selects your competitors as suppliers for projects? (SD)
- Do you have any specific investments in your relation with Vard? (SD)

Closure of the conversation

- *Ask informant if he/she has anything to add to the conversation*
- *Thank informant for the participation*

8.8 Appendix 6: Interview guide 6-F1

Introduction

- *Thank the informant for his/her participation and ask if the interview may be recorded*
- *Give the informant information on the time scope of the interview*
- *Ask the informant about his/her position is in the firm, and what his/her responsibilities are*
- *Ask the informant about his/her relationship to the shipyard in Vietnam*
- *Tell the informant about the research and what it seeks to investigate*

Makers list

- Can you give an assessment on how much value a typical makers list product represents based on the total value of a vessel?
- Can you give an assessment of the total value makers list products constitute based on the total value of a ship?
- Are these items always project-specific?
- Is there any suppliers that always are selected as suppliers for some makers list-components (SS)
    - Are some suppliers of makers list products a sole source for that product? (SS)

Presenting further direction for the conversation

- *Inform informant that the rest of the interview will concern strategic components*
- *Provide the informant a definition of strategic components*

Supplier selection

- Are all strategic items for a vessel carefully selected? (SS)
    - Can you elaborate on this process?
- Does the shipowner crosscheck and approve all suppliers of strategic components for the vessel? (SS)
    - Does this apply for the non-strategic components as well?
    - Purchase order-items?
    - Framework agreement-items?
- Who takes the final decision of which supplier that will be used? (SS)
- • If you consider one strategic supplier, for instance Rolls Royce, do you have knowledge of any of their other customers? (SS)
    - Are any of these regular customers of Rolls Royce? (SS)
- Do you consider Vard as a regular customer of Rolls Royce? (SS)
- Do you know what criteria other customers put on Rolls Royce? (SS)
    - Do these criteria interfere with criteria you put on Rolls Royce? (SS)
- What criteria do you put on potential suppliers? (SS)
    - What are the decisive criteria? (SS)
- Is it a criterion to have Norwegian strategic suppliers? (SS)

- What do you consider as challenges if the strategic supplier is not located close to the production site? (SS)
    - Is this a challenge Vard Vung Tau frequently will have to cope with?
    - How does Vard Vung Tau cope with these challenges?
- How important is it for you that the supplier has competences that contribute to own product development? (SS)
    - Are all suppliers of strategic components presented in the design phase with Vard?
- Would you define the cooperation you have with your suppliers as a long-term relationship? (SS)

Relationship management

- Can you elaborate on your relation with supplier outside of specific projects? (RM, SD)
- How do you follow up you suppliers when you are cooperating in a project? (RM)
- What information do you share with you suppliers? (RM)
    - Information and cost sharing (RM)
- Can you elaborate on what benefits you think will be acquired from this information sharing? (RM)
- What information do you not share with your suppliers? (RM)
    - Information and cost sharing
- Can you elaborate on what role you have towards your strategic suppliers when you are in a project? (RM)
    - Equality?
    - Power dependence?
- How dependent do you consider yourself on your strategic suppliers? (RM)
- How dependent do believe your suppliers are of you as customers? (RM)

Supplier development

- Do you ever cooperate with your suppliers for developing vessel designs? (SD)
    - In projects? (SD)
    - In between projects? (SD)
    - With which suppliers? (SD)
- Can you elaborate on the trust between Vard and your suppliers? (SD)
- How much project-specific information do the suppliers have access to during the projects? (SD)
    - How is the trust, when you are aware that these suppliers often collaborate with other shipbuilders? Fare of copying? (SD)
- Do you have any specific investments for collaborating with you suppliers? (SD)
- Do your suppliers have any specific investments for collaborating with Vard? (SD)

Lean

- Could you describe what your idea of the term “lean” is?
- Could you describe what your idea of “lean procurement” is?

- Do you know if any of your strategic suppliers are producing under lean philosophy? (SS)
- Have you ever discussed lean thinking with your suppliers (SS, SD)

Closure of the conversation

- *Ask informant if he/she has anything to add to the conversation*
- *Thank informant for the participation*