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The Impact of Production Strategy on Purchasing:

A Case Study of National Oilwell Varco Molde

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SUMMARY

This thesis is a case study research of National Oilwell Varco Molde (NOVM), to illuminate how a change in production strategy could affect the purchasing process. NOVM has traditionally been a market demanding customized offshore cranes, and pursues today an engineer-to-order (ETO) production strategy. Due to changes in today´s market demand, NOVM's response is to implement a standardized offshore crane, with use of a make-to-order (MTO) production strategy.

The aim of this thesis is to investigate how a change in production strategy will influence the purchasing process. Particularly, to see whether there will be any difference in the purchasing process within the case organization, when moving from ETO to MTO production strategy. There is some challenges regarding the transformation from a customized production to a more standardized production, and these challenges are taken into consideration during this research. In order to investigate this issue, there is a need to analyze the present purchasing process in an ETO production strategy, which is a subject that has received little attention in previous literature, as well as the planned purchasing strategy in a MTO environment. To explore the purchasing process in these production strategies, there is conducted several interviews, meetings and deep insight in the case study organization. The collected data is analyzed with support from the theoretical framework, it is discussed and a conclusion and implications are presented. In the end of the research, there are some suggestions for further research.

ACRONYMS AND ABBREVIATIONS

ABS	American Bureau of Shipping
API	American Petroleum Institute
ATO	Assemble-to-order
BTO	Buy-to-order
CODP	Customer Order Decoupling Point
DNV	Det Norske Veritas
EN	European Standard
ETO	Engineer-to-order
FAT	Final Acceptance Test
HVAC	Heat Ventilation Air Condition
KPM	Kraljic´s Portfolio Matrix
MTO	Make-to-order
MTS	Make-to-stock
NORSOK	Norsk Sokkels Konkurranse Posisjon
NOV	National Oilwell Varco
NOVK	National Oilwell Varco Korea
NOVM	National Oilwell Varco Molde
OPP	Order Penetration Point
PIMS	Performance and Improvement Management System
PO	Purchasing Order
QC	Quality Control
SCM	Supply Chain Management
STS	Ship-to-stock
VO	Variation Order
WIP	Work in Process

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1. INTRODUCTION

During the past year, the oil and gas industry has experienced significant changes in the market. The decline in oil prices during autumn and winter 2014, has led to a deterioration in the oil market, which already has strongly influenced the suppliers in regards to the oil companies cutbacks, in terms of capital investment and workforce reductions (Nissen-Meyer, 2015). This decline forces the suppliers to a new way of thinking, and to meet the market with more cost-effective solutions. As proposed by Statoil, standardization of offshore components is the suggested response to the market changes (Lorentzen, 2014).

The decline in the market in the oil and gas industry has forced suppliers to look for solutions that can accommodate these changes. A previously Master Thesis has shed light on the effects of a change in production strategy to make components more standardized, concerning costs and lead-time (Ramde & Jamt, 2014). However, there has not been any attention to how such a change in production strategy will affect the overall organization, except cost and lead-time. This study will focus on purchasing, to shed light on effects of a change in production strategy. As purchasing represents a major part of the supply chain in an organization, it is intriguing to shed light on the effects of implementing a new production strategy on the purchasing process, especially in the current market situation.

This study describes the use of a case study approach, to shed light on the purchasing process for an organization that produces customized offshore cranes. Further, to illuminate how a change in a production strategy will affect the present purchasing process for an organization.

1.1 National Oilwell Varco

National Oilwell Varco, Inc. (NOV) manufactures, designs, and sell components and drilling equipment for the oil and gas industry worldwide. NOV is an American cooperation, established in 1841, with headquarters located in Houston, Texas. Their field of expertise is in the oil and gas industry, where NOV produces and delivers innovative drilling and handling equipment, as well as services, for their oilfield customers. NOV also delivers supply chain services, due to their strategically locations worldwide, located at close range to major drilling and production activities. NOV is operating within three different types of segments: rig systems, wellbore technologies, and completion & production solution (National Oilwell Varco, 2015).

With over 150 years of experience in the oil and gas industry, NOV is a world leader within their segment, and has a long reference list of delivering innovative, high-quality cranes and equipment for their customers (National Oilwell Varco, 2014).

As of 2014, NOV had approximately 63,500 employees worldwide, with almost 900 facilities located around the world, within about 60 countries (United States Securities and Exchange Commission, 2014). Out of the 63,500 employees, around 21,000 of the employees work within the rig solution segment. NOV Inc., completely owns NOV Norway, which is a division consisting of approximately 5000 employees, whereas these employees work within the rig systems and aftermarket segment. NOV Norway´s headquarter is located in Kristiansand, and is the largest private employer in southern Norway. In addition to NOV Norway's headquarter, the company has branch offices in Asker, Arendal, Stavanger and Molde, and sub-divisions in Trondheim and Tønsberg (Lervik, 2014).

NOV Molde (NOVM) specializes in developing cranes, winches, and winch systems for their offshore customers, as well as hose-stations and mobile offshore units. Further, NOVM has a worldwide reputation for their offshore cranes, as well as their expertise and high performance. One of their main customers in Norway is Statoil, a leading energy company in the oil and gas production. NOVM has two sub-divisions that are located in

Molde, with approximately 400 employees, and Hjelset, which contains of around 120 employees. Hjelset is a test facility, where the completion of all testing and assembly of NOVM cranes takes place. The office located in Molde contains the purchasing department, engineering, and aftermarket services.

1.2 Case Study: National Oilwell Varco Molde

All of NOV´s activities in Norway form a broad specter of competence and knowledge, and together NOV Norway are recognized for their expertise, and has become the leaders of their respective market. For NOVM, their offshore cranes are innovative and customized for all segments within the oil and gas industry, with a history of technical innovation and customer satisfaction (National Oilwell Varco, 2009).

NOVM describes their customization of offshore cranes as an ETO production strategy there NOVM produces one-of-a-kind offshore cranes, were design and production takes place in parallel. However, one of NOVM major challenges is a shift in their respective market that has occurred over the past years. The present ETO offshore crane is not cost effective, due to its unique design that will differ from each produces offshore crane. Furthermore, the extensive use of engineering in such a production will increase costs throughout the project. Components of an ETO offshore crane is purchased and produced separately, hence errors and mistakes are detected during assembly leads to an increase in costs, as it is expensive to make last-minute changes.

NOVM's customers, like Statoil, have shifted their demand of an all-customized-high-tech offshore crane, to demanding a more cost efficient offshore crane. In order to respond to changes in this market, NOVM has explored a solution of producing a new standardized offshore crane, according to a MTO production strategy, in order to meet new market demands. NOVM intend to reduce costs and lead-time to reclaim lost market shares, as well as increase their volume of sale.

To further research the change in production strategies, this thesis will conduct a case study of NOVM to explore encountered affects in such a change of production strategy.

1.3 Research Problem

The research problem is the foundation of a research. Creswell (2013) defines the intension of a research problem as *"to provide a rationale or need for studying a particular issue or "problem"" (Creswell, 2013, p. 130).* The investigation of a study bases on the research problem that are narrowed into one or more questions. The research question is the base of how to conduct a study and what type of data collection methods that is necessary to use, to be able to answer the research question and to find a conclusion to the study. The research question can be divided into categories, where it can be a central question and sub-questions, or more than one central question. The central question is the main question, and the sub-questions are support questions to the central question (Creswell, 2013).

The theoretical view of purchasing often bases on standardized, mass produced items. Gosling and Naim (2009) indicates that there is a lack of knowledge on ETO supply chains (Jonathan Gosling & Naim, 2009). In the literature regarding purchasing in an ETO context, there are limited research conducted on this topic, which needs further investigation. To research the lack of literature, a case study of NOVM will help to explore the limited research in this context.

The research area for this thesis bases on the author's interest, but also the opportunity to investigate an area that need more attention. The case study for this thesis is NOVM, which is implementing a new production strategy to be able to meet the demand in the market. This leaves the organization with challenges, in regards to implementing the new production strategy, and define how to manage this production strategy in practice.

After being in touch with NOVM over a long period, the knowledge of NOVM increased the insight in the challenges in the organization. One of their problems was to define the purchasing process in regards to the MTO production strategy.

A Master Thesis related to this issue was written during spring 2014, where the authors was investigating the potential costs and lead-time of the new standardized offshore

crane (Ramde & Jamt, 2014). Since the authors of the earlier thesis had not taken the purchasing process in the new project into considerations, and the purchasing activities when implementing a new production strategy is a challenge for NOVM, the problem is narrowed down to this area of research.

1.4 Research Question

The central research question (Creswell, 2013) will contribute to enlighten the limitations in the literature, and be valuable for NOVM when implementing the new MTO production strategy. The central research question for this research is:

"How will a change in the production strategy, shifting from engineer-to-order to make-to-order, affect the purchasing process for National Oilwell Varco Molde?"

In context to the research question, a *change in production strategy* is defined as the move from NOVM's present ETO production strategy to a new MTO production strategy. *Purchasing process* encompasses all the activities associated with purchasing that are carried out in NOVM. These activities includes purchasing of components, purchasing fabrication, and selecting suppliers. However, the process of sales and design of an offshore crane is not in-depth researched when investigating the research question. *Affect* is to explore how a change in production strategy will influence the purchasing process for NOVM. In order to answer the research question, there is necessary to explore NOVM's purchasing process in their present ETO production strategy, as well as investigate how purchase will be conducted in a MTO production strategy. By investigate the two different production strategies in relation to the purchasing process, there is possible to investigate characteristics and differences between these production strategies.

2. THEORETICAL FRAMEWORK

The theoretical framework is the foundation of this study, and this chapter is presenting the relevant theoretical aspects related to this research. This includes the importance of the purchasing process, involving all activities associated with purchasing. Furthermore, it is presented a purchasing model, a sequent order of how to perform purchasing, which is an excerpt of the purchasing process. An explanation of the various production strategies, and strategic management as a link to purchasing in an organization, is also presented in the theoretical framework.

According to Jahnukainen and Lahti (1999), purchasing has the largest impact of product costs for a business. As a result of a conducted study, it emerged that purchasing consists of 50-90% of the total product costs (Jahnukainen & Lahti, 1999). The purchasing is important for an organization, due its impact on an organization´s turnover and a potential for saving costs and efficiency improvement (van Weele, 2014). Efficient purchasing is essential for companies, especially for companies with customization of their products (Jahnukainen & Lahti, 1999).

Purchasing is related to suppliers and environmental factors, as well as products (Olsen & Ellram, 1997). Olsen and Ellram (1997) has listed factors that influence the management of purchasing:

Product Characteristics

1. *Novelty*
2. *Complexity*

Supply market characteristics

1. *Suppliers‘ power*
2. *Suppliers‘ technical and commercial competence*

Environmental characteristics

1. *Risk*
2. *Uncertainty*

(Olsen & Ellram, 1997, p. 104)

These factors are used as a base of the structure of the theoretical framework with respect to purchasing, where the focus is on products, suppliers and environmental characteristics that could affect the purchasing process. The product characteristics are in relation to the products to purchase, and presented in the theoretical framework by introducing a product portfolio. The suppliers and the environmental role in purchasing is further presented, as both are central in context to purchasing activities. The listed factors is a basis of what to explore in the theoretical framework when researching purchasing. Purchasing is described as a unit in the supply chain (Jahnukainen & Lahti, 1999). Hence, supply chain management are further explored to link the factors of purchasing together.

2.1 Procurement and Purchasing

When collecting data regarding purchasing and the purchasing process, it seems like different authors are using both the term purchasing and procurement interchangeably. These terms has two different meanings, and to separate these two, it is important to illustrate the difference between procurement and purchasing.

Procurement is describing the action of buying goods and services, including the lifecycle from the planning stage to the use of the end-product. Procurement is addressing the activities linked to third-party-and in-house suppliers (Lysons & Farrington, 2012).

Purchasing is about managing an organization's resources in an optimal way, to be able to serve the customers (van Weele, 2010). Purchasing focuses on utilizing resources, by focusing on costs, also it can focus on core competence rather than costs (Brynhildsvoll, 2011).

Purchasing has many different definitions. According to Lysons and Farrington (2012), the objectives of purchasing can be defined as *"to buy materials of the right quality, in the right quantity from the right source delivered to the right place at the right time at the right price" (Lysons & Farrington, 2012, p. 6)*. This is a classic definition of purchasing, but it has some shortcomings to be well defined and precise. Since the word "right" in this

definition can be inaccurate in real life, the authors further suggest a precise definition of purchasing: *"Purchasing is the process of procuring the proper requirement, at the time needed, for the lowest possible costs from a reliable source"* (Lysons & Farrington, 2012, p. 6).

Procurement is a broader term than purchasing, where procurement is including all the activities of acquiring the needed suppliers or services, while purchasing primary involves transactional and commercial activities. Purchasing is viewed as a part of the procurement process (Lysons & Farrington, 2012).

2.2 Purchasing Model

Purchasing involves several activities, and can be conducted with a start and an end, where specific activities linked to purchasing is done in a certain order (Brynhildsvoll, 2011). The general purchasing model presented in figure 1, displays stages in purchasing and the relation between the stages, preformed in a logical order of how to purchase a product or service (Brynhildsvoll, 2011; van Weele, 2014). The purchasing model is important for organizations as a tool for how to plan and utilize resources to achieve results in relation to purchasing. The purchasing process is not similar for all organizations, therefore the purchasing model and its sequences, might vary among organizations. Therefore, the purchasing model can be viewed as an excerpt from a broader purchasing perspective.

Figure 1: Purchasing Model (adapted from van Weele, 2014 p. 28)

2.2.1 Define Specifications

The first phase in the purchasing model is to define specifications when purchasing a product or service. The customers' orders products with a various degree of specifications, which will vary among organizations (van Weele, 2014). To define the

order specifications, there is essential to have enough information from the customer. An order specification contains standard and technical specifications (Brynhildsvoll, 2011). A standard specification or functionally specification (van Weele, 2014) includes either pre-defined standards, or leaves the supplier the opportunity to find cost efficient solutions. It is a greater opportunity for the purchaser to negotiate over prices when using a standard specification (Brynhildsvoll, 2011).

Highly specific products require detailed specifications and production. Technical specifications are describing the characteristics of the product that are ordered and an indication of the activities required from the suppliers (van Weele, 2014).

The order specification documents contains specifications related to product quality and certificates, logistic specifications, like quantity and delivery agreements and maintenance specifications, which includes services and spare-parts. The specifications should also include legal and environmental requirements, describing safety, health and environmental conditions in the production process. Financial constraints should also be specified, so the supplier remains within the set budget from the buyer (van Weele, 2014).

The specification is the formal approval of purchasing, and intends to prevent errors in the further stages of the purchasing model. The errors should be prevented to avoid unnecessary costs and lead-time (van Weele, 2014).

In some cases, the specifications can be changed during the production. The degree of changing specifications and the limit of when the changes could be done, are depending on the product and relates to the production strategy. If there is an opportunity for changes, the purchaser is responsible to inform the supplier and make sure the supplier confirm these changes (van Weele, 2014).

2.2.2 Select Supplier

Since the purchasing model is a sequential process, the supplier selection is done from the basis of the defined specifications. The basics of selecting a supplier are to find the appropriate supplier for each individual purchase (Brynhildsvoll, 2011). Selection of the best supplier is essential for the purchasing and the end-product. Supplier selection is done by summarizing the qualification requirements for the product, based on the purchase order specification (van Weele, 2014). Most organizations have databases with existing suppliers, and often when there are replicated purchases there is a determined list of suppliers to use. When purchasing products with higher value, a request to different suppliers could be necessary for the ability of receiving competitive offers (Brynhildsvoll, 2011). The first step here is to decide on either turnkey or partial subcontracting. If the buyer decides to turnkey subcontracting, all the activities, including design, are placed with the selected supplier. If the decision is to partial subcontracting, all activities are divided into parts that are separately contracted out to, often, various suppliers (van Weele, 2014).

If the purchaser decides to let the suppliers compete over a project, a bidder list is created. When the purchaser has received the submitted bids from the different suppliers, the purchasing department will evaluate, and take in consideration all the aspects from the bid. There are many aspects to take in to consideration, like technical, logistics, financial and legal aspects. The buyer will view the total cost for the projects, instead of comparing prices for different components at this stage. In case of strategic suppliers, there are important to conduct a risk analysis for the suppliers and components. In some cases, there will be more than one supplier selected for a product category within a project, it is multiple sourcing (van Weele, 2014).

2.2.3 Contract Agreement

When the supplier selection stage is completed, a contract between buyer and supplier will be developed. Before conducting a contract, there is an opportunity for the buyer and the supplier to negotiate over prices, delivery terms, payment and other relevant issues (van Weele, 2014).

When purchasing with foreign suppliers, the exchange rate could impact the prices. Project durations could be lasting over years, and the currency exchange might change radically from the stage of contract agreement to the payment takes place. To avoid losses in terms of this, exchange clauses should be implemented in the contract (van Weele, 2014).

A contract should also contain terms of payment, which often are based on the suppliers performance, where the payment are done similar to the degree of progression (van Weele, 2014) or prepaid due to larger scope of projects (Brynhildsvoll, 2011). Clauses and warranty conditions is included, to secure the product from being defected and ensure the specifications and quality defined in the order are included (van Weele, 2014). Warranties on prepaid products should be stated in the contract to secure the buyer if the contract agreement is not fulfilled (Brynhildsvoll, 2011).

2.2.4 Ordering

When terms and conditions for the product is placed in the contract, the order can be set for purchase. A purchase order (PO) is the formal ordering of the product, and often sent electronically through a purchase order requisition, which is initiated manually. (Brynhildsvoll, 2011). The PO includes the set specifications performed in the first stage of the purchasing model. When PO is sent, the supplier has to acknowledge its receive, by sending a conformation of the PO back to the purchaser (van Weele, 2014). The PO, together with the order confirmation, is the legal contract of the purchased product or service (Brynhildsvoll, 2011).

2.2.5 Expediting

This stage is crucial for the project, therefore it is important that the supplier know all specifications for the product, but also that the materials that is being used is in stock. In case of a stock out or delays, the supplier should notify the buyer immediately, to avoid larger consequences (Brynhildsvoll, 2011).

When the product is set for delivery for the buyer, an acceptance test of the product is conducted. This test is to examine the products technical and functional aspects, to check that maintains set requirements. In case of a large size product with many technical operations, there might be conducted several acceptance tests to verify the product during the production (van Weele, 2014).

To address any defects or problems during a production, a reporting system is often used. In case of any defects, the supplier should report these to the purchasing organization. These problems should be dealt with immediately, in order to prevent future incidents in the process (van Weele, 2014).

2.2.6 Evaluation

When the product is completed and set into operation, the purchaser has to follow up the process. Documentation related to the product and its suppliers has to be filled. For organizations that are using a rating system of their suppliers, the purchaser has to use this system to rate the individual supplier in terms of quality and performance. By creating an evaluation of the suppliers, it can contribute to more effective future projects, and improve both the buyer and the supplier´s acknowledge of improvements (van Weele, 2014).

2.3 Strategic Management

Purchasing has great importance for an organization´s overall performance and profit (Brynhildsvoll, 2011). The degree of how to manage purchasing as a strategy is related to the volume and complexity of purchase (Kraljic, 1983). The purchasing department within an organization should contribute to support the other departments within an organization, and therefore, purchasing is often linked to supply chain management (Brynhildsvoll, 2011). Van Weele (2010) states: *"purchasing and supply chain management are increasingly recognized by top managers as key business drivers"* (van Weele, 2010, p. 3).

There are several definitions describing supply chain management (SCM), one definition is:

> *"SCM encompasses the planning and controlling of all processes involved in procurement, conversation, transportation and distribution across a supply chain. SCM includes coordination and collaboration between partners, which can be suppliers, intermediaries, third party service providers, and customers"*
> *(Harrison, van Hoek, & Skipworth, 2014, p. 8)*.

Supply chains are networks that are adding value for an organization as a link between suppliers and customers, and supply chain management is used to handle such links in the organization (Lysons & Farrington, 2012). Strategies to obtain an organization´s competitive advantage are connected to the organizations purchasing and supply chain management (Adobor & McMullen, 2014). To manage the supply chain requires strategies for the organization (Lysons & Farrington, 2012). Hence, strategy is defined as:

> "*The direction and scope of an organization over the long term which achieves advantage for the organization through its configuration of resources within a changing environment and to fulfill stakeholder's expectations"*
> *(Lysons & Farrington, 2012, p. 34)*.

There are several ways of managing strategies in an organization. Organizational strategies are divided into three categories: *corporate strategies, business strategies and functional or operational strategies* (Lysons & Farrington, 2012, p. 37). Corporate strategies are in relation to structures, locations, relationships and other long-term based strategies. Business strategies relates to competitive advantage (Lysons & Farrington, 2012). The business strategies are separated to three sub-categories: cost leadership, differentiation and focus strategy. Cost leadership is a strategy of minimizing costs, where the aim is to achieve lower costs than the competitors. Differentiation bases on unique products, often differentiated by design, brand, technology or service, or a combination of these. When focusing on a specific customer or groups of customers, the strategy is often focused, where those customers are being served at an optimal level (van Weele, 2010).

The third strategic category in an organization is functional strategies, which are linked to the functional areas in the organization, including purchasing. Strategies in relation to purchasing are developed from the organizational strategies, and are used to reach the organizational strategies (Lysons & Farrington, 2012). Purchasing strategies are related to different ways of handling the resources and suppliers in an organization to optimize the outcome and profit. This includes the strategies linked to relationship with suppliers, sourcing and the overarching strategies in an organization (Karjalainen & Salmi, 2013).

Sourcing is a central part of purchasing and purchasing strategies. Sourcing strategies are based on minimizing costs and complexity of purchasing. Sourcing concerns the process of finding, identification, selecting and development of the best suppliers. The strategically part of sourcing include the strategically choices related to which supplier to buy from, the relationship to the suppliers and the contract agreements with the suppliers (Lysons & Farrington, 2012; van Weele, 2010). Sourcing could be done local, regional or global, and by single or multiple sourcing. A local sourcing strategy is often related to higher flexibility and better terms of delivery, compared to global sourcing (van Weele, 2010).

The sourcing strategy involves supplier selection and relationships with the suppliers, as referred to as buyer-supplier relationship (van Weele, 2010) or purchaser-supplier relationships (Lysons & Farrington, 2012) in the literature. The relationships bases on the power of balance and dependency. By being dependent on a supplier, it could have some impact on price when purchasing. Having the opportunity to choose among different suppliers is considered as an advantage for the organization (van Weele, 2010).

The power of balance are divided into three types of relationships:

- *Buyer-dominated power of balance*
- *Supplier-dominated power of balance*
- *Balanced power of balance*

(van Weele, 2010, p. 196).

The power of balance should be either at the buyer, the supplier or a balanced relationship, between the buyer and the supplier. Furthermore, the power of balance in such relationships are often related to the products, which is further described in section 2.12 (van Weele, 2010). Obtaining supplier relationship is considered as a strategic choice in supply chain management (Adobor & McMullen, 2014). Strategies and supply chain management is connected to purchasing in such way that purchasing aims to integrate with other parts of the supply chain, and are based on the overarching organizational strategies.

2.4 Customer Order Decoupling Point

Customer order decoupling point (CODP) or order penetration point (OPP), is defined by Olhager (2003) as: "*the point in the manufacturing value chain for a product, where the product is linked to a specific customer order"* (Olhager, 2003, p. 320). This is a business level concept, which are used in the aspect of how involved the customer is, and which activities are performed after the customer order takes place. The CODP are dividing the operational process into two parts, upstream and downstream of the CODP. Upstream of the CODP is the forecast-driven activities, while on CODP and downstream the activities are customer-order-driven (Olhager, 2003; Wikner & Rudberg, 2005).

The CODP can be used to further describe the characteristics on ETO and MTO, and help illustrating the difference between production strategies. The requirements of the planning techniques varies for the two categorizations of activities; upstream and downstream. The difference in the planning techniques is visible when comparing MTO and ETO. In a MTO organization, the stock includes only a few components and raw material. The customer order becomes a project, and the manufacturing process is conducted within that project (van Weele, 2014). The design stage is a forecast-driven activity, while fabrication and procurement, final assembly and shipment are customer-order-driven activities. Forecast-driven activities bases on optimizing the product, inventory, supplier relationship and productivity. Customer-order-driven activities focuses on an optimization of the process, customer relationships, delivery time and flexibility (Olhager, 2003).

The position of the CODP is influenced by the characteristics of production, market and product. However, factors like delivery time and production time could also impact the position of the CODP (Olhager, 2003).

In both an ETO and MTO production, the specific customer order evolves to a project, with few items in stock (van Weele, 2014). There are no forecast-driven activities in an ETO production, as illustrated in figure 2 (Olhager, 2003). The activities performed are on the basis of the customer order, where the purchasing is based on specifications in each individual project (van Weele, 2014). An ETO situation is characterized, as mention earlier, by the design and flexibility (Olhager, 2003).

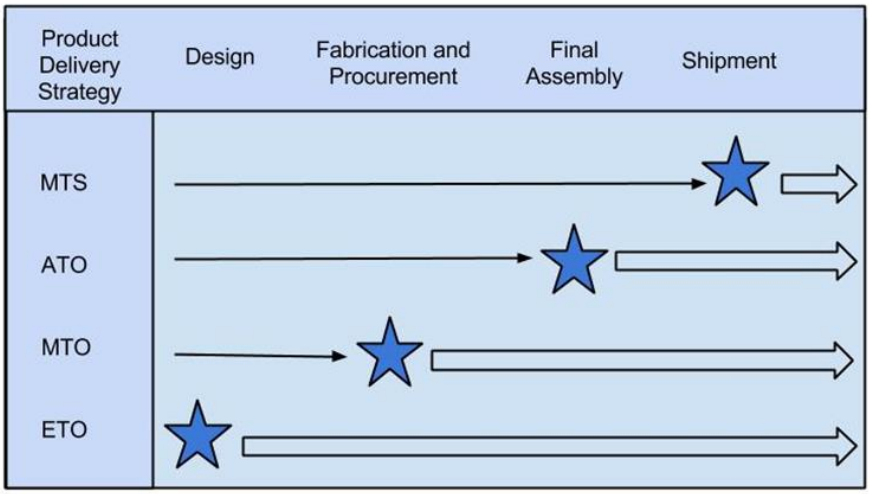

Figure 2: Customer Order Decoupling Point (adapted from Olhager, 2003 p.320)

Figure 2 illustrates the CODP, shown as stars within four selected production strategies. The thin arrows displays the forecast-driven activities, while the thick arrows are illustrating the customer-order-driven activities.

Shifting the CODP is done by a shift either forward or backward. There are some strategically reasons for shifting the CODP, by shifting the CODP forward, it will reduce the delivery time, and the reliability to the customer increases. In addition, the manufacturing efficiency, by optimize the process will be improved. The negative effects by a forward shift of CODP, is less customization of the products, and more risk of

forecasting and forecast-driven products. This leads to a higher degree of inventory level and work in process (WIP)[1].

A shift backward is leading to an improved customization, with a higher customization level the company is able to focus on quality. This will lead to a longer delivery time to the customer, as well as the reliability. Forecast-driven activities will be reduced, and there will be a reduction in inventory of products in stock. This will also reduce the number of obsolete products in inventory. The optimization opportunities of the process decreases, which leads to a reduction in manufacturing efficiency (Olhager, 2003).

2.5 Production Strategies

Production strategies (Soman, Van Donk, & Gaalman, 2004) have different names in the literature, and are among others referred to as; manufacturing processes (van Weele, 2014), manufacturing environment, production systems (Subash Babu, 1999), supply chain structures (Jonathan Gosling & Naim, 2009) and manufacturing systems (Soman et al., 2004). Furthermore, this study uses *production strategy* as the selected term.

The production strategies bases on when to start the production or manufacturing activities in context of the reception of a customer order (van Weele, 2010). The production strategy selected by each organization, are related to the product type, the demand of the product and the overall supply strategy of the organization (Jonathan Gosling, Hewlett, & Naim, 2011). To better describe the variety of production strategies, the production strategies can be divided into categories, based on their characteristics. The most common categories are: make-to-stock (MTS), build-to-order (BTO), assemble-to-order (ATO), make-to-order (MTO) and engineer-to-order (ETO) (Jonathan Gosling & Naim, 2009; van Weele, 2010). The production strategies differs from the location of the CODP (Olhager, 2003).

[1] A definition of WIP: *"the difference between cumulative progress of two consecutive and dependent processes, which characterizes work units ahead of a crew that will perform work (e.g. work units that have not processed yet, but that will be"* (González, Alarcón, & Molenaar, 2009, p. 96).

- Make-to-stock (MTS): MTS products contains limited customization, and are made in accordance to the demand and a predefined product line. Such products are often in stock, ready for a customer order (Porter, Little, & Peck, 1999).
- Build-to-order (BTO): Within an BTO context, the customer is free to choose between different preset components, build together randomly, to their final product (Krajewski, Wei, & Tang, 2005).
- Assemble-to-order (ATO): The customer are choosing between some set products, which already are in stock, ready for assembly when a customer place an order. ATO products are often stored in a warehouse after being forecast manufactured and part assembled (Porter et al., 1999).

The production strategies of interest and relevance for this study are ETO and MTO, and is further described during the next sections.

2.6 Engineer-to-Order

There are several definitions of ETO, with a variety of perspectives. The different definitions of ETO include customization of products, with complex and new design (Jonathan Gosling & Naim, 2009). As an example, Amaro, Hendry and Kingsman (1999) describe ETO products as customer specific products, which require unique engineering design or customization (Amaro, Hendry, & Kingsman, 1999).

Van Weele (2014) defines ETO as:

> *"All manufacturing activities from design to assembly and even purchasing of the required materials are related to a specific customer order. Production is usually on multipurpose machinery, requiring highly skilled operators, for example large customer-specific equipment and machines and vessels"*
> (van Weele, 2014, p. 6).

The definition by van Weele includes the purchasing of the products to the customer, together with a description of the manufacturing process in a in an ETO production strategy.

ETO companies are doing the design and the specification of the product after the customer has placed the order. The characteristics of ETO are that the products are unique, one-of-a-kind products, which bases on the characteristics and requirements set by the customer. Some of the components are highly customized, but there is also a degree of more standardized components in the end-product. There are often very low production volumes, with few orders, and a big variety of products (Hicks, McGovern, & Earl, 2000). ETO products often relates to machines within the capital equipment industry, used for making other things (Kingsman, Hendry, Mercer, & de Souza, 1996). Within an ETO supply chain, there is often more directly contact with the customer, compared to other production strategies (Porter et al., 1999).

An ETO production creates high uncertainty, with customized and complex products. The engineering of design is time consuming, and the products need to be specified during the designing process (Hicks et al., 2000). The decoupling point is typically located in the design phase in an ETO supply chain (Jonathan Gosling & Naim, 2009). The level of detail when designing a product, and the specific engineering of such products, requires an efficient manufacturing process. It is also uncertainty regarding the production and lead-time in an ETO production. Flexibility is crucial to be able to respond to changes in the requirements of the products, since there is a small degree of standardization an ETO production. To improve purchasing and the relation between the different processes in a project, it is essential to have good information sharing regarding the design, standard components, planning and performance. A high level of customization also leads to higher costs (Hicks et al., 2000).

Bertrand and Muntslag (1993) presents different characteristics of an ETO organization, by dividing them into different situations:

1. *Product characteristics*
2. *Market and competitors*
3. *The production organization*

(Bertrand & Muntslag, 1993, pp. 4-5).

Product characteristics: ETO products are complex and customer-specified products, where each customer has specific requirements and standards for the end-product (Bertrand & Muntslag, 1993).

Market and competitors: Sales in an ETO organization can be different from one year to another, due to the organizations sensitivity to changes in the market. It is only few, larger orders each year, and the exact demand is difficult to predict with an ETO production strategy. The competitors are often many, and the competition is primary over prices and quality level of the products (Bertrand & Muntslag, 1993). However, customization of products is used as a competitive advantage in the market (Jonathan Gosling & Naim, 2009).

The production organization: When producing a product in an ETO organization, the customer order often becomes a project. Within this project, the activities are often performed in parallel (Bertrand & Muntslag, 1993). The production can be divided into two stages, *physical stage and non-physical stage* (Bertrand & Muntslag, 1993, p. 5). The physical stage consists of the component manufacturing, assembly and installation of the production. Engineering, design and process planning activities are performed in the non-physical stage (Bertrand & Muntslag, 1993). Both the project costs and duration are important factors when negotiating with suppliers in an ETO context (Hicks et al., 2000). Within an ETO organization, the supplier relationship will vary, due to the complexity of the business (Amaro et al., 1999).

2.7 Make-to-Order

MTO has many similar characteristics as ETO, thus MTO products are more standardized compared to ETO products. A MTO production strategy is often preferred in relation to large product lines or products with expensive stockholdings. The characteristics of a MTO production strategy is predefined product design, with products which is produced after a customer places an order (Kingsman et al., 1996).

The MTO organization has knowledge about the offered product, but the demand could be difficult to predict. The specification of the products and the uncertainty of orders, make the planning and the control phase the critical part for MTO firms. The product specifications might vary during the production phase. The specifications of the products are decided either when the customer is placing an order of the product, or after the request is confirmed. Further, the level of uncertainty relates to the difficulty of predicting number of orders and the time spent on the resources, since the number of order varies. Such uncertainty of variations can also impact the lead-time for MTO products (Corti, Pozzetti, & Zorzini, 2006).

In a MTO context there is no, or minimal, of finished products in stock (Lee & Fu, 2014). According to van Weele (2014), *"only raw materials and components are kept in stock"* (van Weele, 2014, p. 244). Since MTO is a project-based production strategy, production of components is not performed before the reception of a customer order. Therefore, it is limited products in stock (van Weele, 2014).

2.8 Customization, Standardization and Modularization

An implementation of standardized production or services requires various types of investments to start the process, related to investment in design, employee training and capital equipment. At this stage in the process, the learning curve for the company is steep (Wang, Wang, Ma, & Qio, 2010). Standardization improves the predictability and reliability, and reduces the costs, both for the buyer and the supplier (Lysons & Farrington, 2012). The efficiency of standardized production is relatively high and the design time is low, which leads to a shorter delivery time to the end customer.

Standardization makes it easier to reduce the number of failures, lower the risk of the need for rework, and reduce the material handling costs. This will contribute to reduce the total costs to the buyer, by reduce the supplying company´s costs when offering standardized products or services (Lysons & Farrington, 2012; Wang et al., 2010). The end-customers are satisfied with standardized products and services by being offered lower cost solutions and a faster delivery time compared to customized products (Wang et al., 2010).

Customization on the other hand is tailored solutions, which is specified to the customer's needs, where the customer is involved in the process of the product design (Jonathan Gosling & Naim, 2009). Customization of products leads to higher costs and longer delivery time than standardized products, but a higher customized level and solutions create a higher value for the customer. Due to lower efficiency and productivity than standardized solutions, there are higher costs and lead-times. Customization will meet the customers exact demand, resulting in a higher revenue and market expansion (Wang et al., 2010).

Focusing on the internal effects for a company, standardized solutions might be driven by the operational department, while the marketing or sales department often directs customized solutions. This is because the standardization is focusing on cost reduction and operational efficiency, and the customization has more focus on market and customers (Wang et al., 2010).

Modularization is several predefined, standardized modules or components, where each individual customer decides the combination of them. These components are predefined and standardized. Modularization could be described as a mixture of standardization and customization. Modularization gives fever product variants than customized product, but more variety and flexibility than pure standardized products (Ernst & Kamrad, 2000).

2.9 Supply Chain Flexibility

Flexibility ought to be implemented as a part of the strategic management in the overarching supply chain and strategies for an organization (Naim, Potter, Mason, & Bateman, 2006). Flexibility in general, can be defined as: *"the ability to change or react with little penalty in time, effort, cost or performance" (Upton, 1994, p. 73).* Flexibility bases on the level of uncertainty, whereas sources of uncertainty are customers and their various demand and order quantities. Other sources of uncertainty are often the supplier's performance in the supply chain and uncertainty linked to manufacturing (Lysons & Farrington, 2012; Naim et al., 2006).

High levels of uncertainty are crucial to avoid, for maintaining and optimizing the supply chain, since there in many situations could be an unpredictable demand. A simple way of avoiding uncertainty is having products in stock, to able to meet customers demand (Lysons & Farrington, 2012). The high level of uncertainty is central in an ETO context, since such products are produced from a customer's specification and cannot be premade and stored. Such high level of uncertainty results in some challenges for organizations with project specific demand, like ETO and MTO. Uncertainty is connected to flexibility, in the sense flexibility can be used of reducing the demand uncertainty (J Gosling, Purvis, & Naim, 2010).

Gosling, Purvis and Naim (2010) presents supply chain flexibility as a combination of internal and external types of flexibility (J Gosling et al., 2010). Internal flexibility are linked to the organizations sourcing strategy and the selection of suppliers, while external flexibility are in relation to the supply chain and the relationship with existing suppliers (Stevenson & Spring, 2009). Supply chain flexibility relates to the ability of changing or response to changes within a buyer-supplier relationship. Supply chain flexibility gives the organization the opportunity to meet changes in the market by being able to be flexible, by changing product or strategies. The internal flexibility is situated on the supplier's activities in the supply chain, like manufacturing, warehousing and different types of logistics, like transportation (J Gosling et al., 2010).

Sourcing flexibility is related to the ability of quickly redesigning the supply chain and respond to requirements in the market. This includes changing the suppliers, where many suppliers available influence the flexibility (J Gosling et al., 2010). External flexibility is according to Gosling et al. (2010) divided into: *new product flexibility, mix flexibility, volume flexibility, delivery flexibility and access flexibility* (J Gosling et al., 2010, p. 12). Mix flexibility is also referred to as product flexibility, which are together with volume flexibility able to reduce the uncertainty of demand. Product flexibility is being able to allocate the capacity of production of several products, and reallocating the resources spent on the products in line with the demand of the different products. Volume flexibility is related to the ability of changing the outcome of the production in line with the demand (Goyal & Netessine, 2011).

Stevenson and Spring (2009) are suggesting to involve the suppliers in the product design to achieve a higher degree of flexibility. This requires often a standardization of products or a modularization of the product design. The authors mean that there is a trade-off, where an organization should be either flexible at an internal or an external level. Organizations with customized products are often flexible by having flexible suppliers, compared to organizations that offer standardized products. This is in relation to the nature of customization, where the aim is to meet the customer's specifications, and flexibility is crucial to avoid the high level of uncertainty (Stevenson & Spring, 2009). In case of flexibility within an ETO production strategy Gosling and Naim (2009) states that *"there is no agreement on what types of flexibilities are required or if there are synergies or trade-offs between them"* (Jonathan Gosling & Naim, 2009, p. 747). The authors indicates that flexibility is important for the ability to reduce uncertainty, and a way to effectively compete in an ETO context (Jonathan Gosling & Naim, 2009).

2.10 Purchasing in an Engineer-to-Order Context

The majority of published literature has neglected research on purchasing in an ETO organization. Hicks et al. (2000) states that there is *"limited research into supply chain management in the low-volume Engineer-to-Order sector"* (Hicks et al., 2000, p. 179). Further, the authors points out that there are limitations in literature related to design of

a product within an ETO context, thus focuses more on the capability of the products and its specifications (Hicks et al., 2000).

Since ETO bases on customization and no predefined design, the purchasing process commences when receiving a customer order request. The specifications are important, and need to be properly to perform the design of the product. The technical specifications of the product needs to be detailed. In an ETO organizations, the engineers are specifying the details of a product, since designing a product by a customer's specifications (Hicks et al., 2000). When designing the product, the ETO organization will forecast the key components needed, based on their experience. This is just a prediction, due to the uncertainty of the exact end-product at the design stage (Jahnukainen & Lahti, 1999; Shen, Pang, & Cheng, 2011). Components that contains the longest lead-time should have the priority of design and purchase in such projects, to avoid unnecessary delays later in the project. Some of the suppliers are already chosen when the product is designed, due to specifications that are made for a certain supplier (Hicks et al., 2000).

2.11 Purchasing in a Make-to-Order Context

As in regards to purchasing in ETO, there are a limited number of sources regarding purchasing linked to a MTO production strategy. According to Jahnukainen and Lahti (1999), most of the literature focuses on methods related to mass production, and states that: *"the performance of the supply chain has not reached the level of units in the chain"* (Jahnukainen & Lahti, 1999, p. 103).

Jahnukainen and Lahti (1999) has investigated problems and characteristics regarding purchasing in MTO organizations:

- *slow inventory turnover,*
- *poor timing and long delivery times for critical components,*
- *poor component delivery punctuality.*

(Jahnukainen & Lahti, 1999, p. 110)

In a MTO organization, the inventory turnover is good (Jahnukainen & Lahti, 1999) as the components are purchased in accordance to a specific customer order. Furthermore, only raw materials and components are kept in stock, often held by suppliers (van Weele, 2014).

For maintaining an efficient purchasing process, the authors suggest a better supplier cooperation, rather than searching for the lowest price when buying a product. To obtain a closer relationship with the supplier, it is suggested to separate supplier management and the purchasing department. Another suggestion to obtain a closer relationship is to reduce the number of suppliers, where the idea is to have few main suppliers with sub-suppliers (Jahnukainen & Lahti, 1999).

2.12 Kraljic's Portfolio Matrix

There are many approaches of purchasing models and matrices. A well-known, and often used purchasing portfolio approach, is Kraljic´s portfolio matrix (KPM) (Gelderman & van Weele, 2003).

Portfolio matrices are used for strategic planning, marketing and purchasing. Purchasing matrices help to classify products of purchasing and the suppliers (Nellore & Söderquist, 2000), and help purchasing managers to differentiate the strategies of their suppliers (van Weele, 2010). According to van Weele (2010), "*the key in purchasing and supply strategies is the issue of the influencing the balance of power between the company and its key suppliers" (van Weele, 2010, p. 195).* To avoid dependency upon the supplier, the balance of power in a buyer-supplier relationship should be in the buyer´s favor (van Weele, 2010).

The analysis of the purchasing portfolio is according to van Weele (2010), divided into two steps:

1) *An identification of the strategic commodities and suppliers*
2) *Analyze the purchasing profit impact and supplier risk*

(van Weele, 2010, p. 195)

The first step involves raising awareness of existing products and suppliers. Furthermore, the products and suppliers are implemented in the purchasing portfolio matrices and analyze in accordance to profit impact and supplier risk (Weele, 2010).
KPM is the dominant approach and most used in regards to purchasing (Gelderman & van Weele, 2003). The purchasing portfolio is a general approach, which is used for both purchasing and supplier management, where classification of products, strategies and analysis regarding suppliers are central of the portfolio purpose of use (Knight, Tu, & Preston, 2014). The origin of the KPM is from Peter Kraljic in 1983, where he presented the article "*Purchasing must become supply management*", where the author explored the use of purchasing to manage supply (Kraljic, 1983).

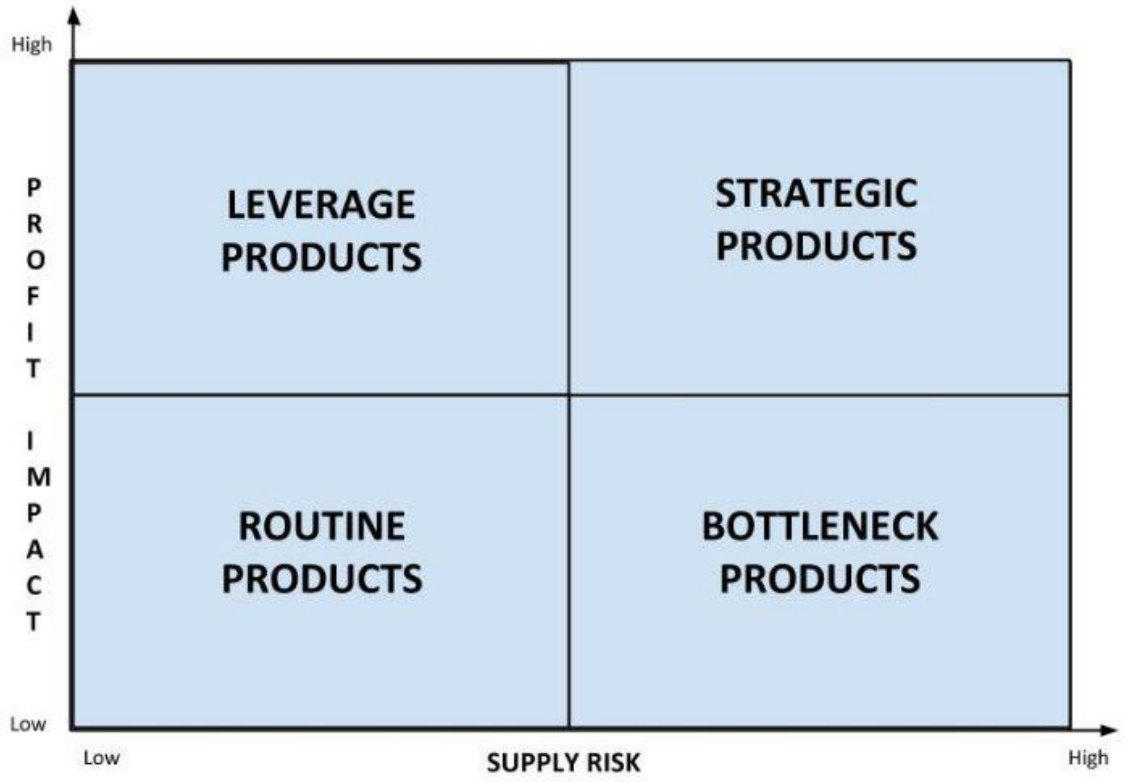

Figure 3: Kraljic Portfolio Matrix (adapted from van Weele, 2014 p164)

This matrix bases on products classified by high or low profit impact and supply risk, as illustrated in figure 3 on the horizontal and vertical lines of the quadrants. The main idea of the matrix is to have minimization of supply risk and a maximization of buying power (Gelderman & van Weele, 2003). The supply risk and profit impact are two variables that is hard to define in general (van Weele, 2010). The organization should define these

measures on the basis of what the organization has ability to, or want to measure (Kraljic, 1983). Profit impact, or financial impact, could be measured on for instance costs or quality, while supply risk could be based on supplier position, costs or substitutes (van Weele, 2010). The matrix is divided into four quadrants of product classifications: bottleneck products, strategic products, leverage products and routine or non-critical products. The purchasing matrix are linked to a supplier matrix, where the four quadrants with products has different supplier strategies, and the number of suppliers are greater at the left side in the matrix, compared to the right side (Gelderman & van Weele, 2003).

2.12.1.1 The Matrix Structure

The four quadrants in the matrix represents four classifications of products, and purchasing strategies linked to the product classifications. The different products require different consumption of resources, like time and cost (van Weele, 2010).

Strategic products have a high profit impact and a high supply risk, defined as *"high-tech, high-volume products, which are often supplied at customer specification"* (van Weele, 2010, p. 195). Strategic products are often single source products by suppliers that are hard to replace (Caniëls & Gelderman, 2005). The balance of power between buyer and supplier are often dominated by one of the parts, but it can also be a balanced relationship between buyer and supplier (van Weele, 2010). To manage the strategic products, analysis related to risk, market and optimization could be helpful (Kraljic, 1983).

Bottleneck products are classified as products with a low profit impact and a high supply risk. For bottleneck products, it is the suppliers that are dominating the power in the relationship between buyer and supplier (Caniëls & Gelderman, 2005). On the financial point of view, these products are not very valuable, compared to other categories, thus the supply risk is high (van Weele, 2010). Products within this classification might cause problems for a project because of the power of the suppliers. Supplier control, backup plans or safety stock help avoiding problems that might occur regarding bottleneck products (Gelderman & van Weele, 2005).

Leverage products have a low supply risk, and such products can be purchased from several suppliers with a standard quality level (van Weele, 2010). Leverage products have a high impact on the financial results for the buyer (van Weele, 2010). Such products give the buyer the power regards to prices, substitution or bidding, since it often is bought in large volumes and a change in price has a great impact for the buyer (Gelderman & van Weele, 2005; van Weele, 2010). Focus on saving costs and manage the suppliers performance is important factors to take advantage of the buying power as a purchasing strategy. Leverage products has often an extra value in addition to the product itself. The additional value might be emphasized when selecting suppliers (Gelderman & Semeijn, 2006).

Routine products, or non-critical products are often small parts with a low value per part. Routine products contains few problems, as these can be purchased from many different suppliers, and are therefore classified as low profit impact and low supply risk. Products that are classified as routine products are often simple to purchase (van Weele, 2010), and the transaction costs of such products are high (Caniëls & Gelderman, 2005; Gelderman & van Weele, 2005). The aim with the purchasing strategy on routine products is to minimize the transaction costs, due to large handling costs. Efficient handling of these products, with standardized procedures and combine orders, are strategies of lowering purchasing costs on routine products. E-procurement is also a suggested purchasing strategy for efficiency handling of routine products (Gelderman & Semeijn, 2006).

2.12.1.2 Strategic Directions in the Matrix

The actions regarding strategic positions in the matrix´s quadrants are: stay at the existing position or move to other positions in the matrix. In some cases, the existing position in the matrix are the best position with no changing opportunities for that product, in other cases a shift into another quadrant could be a strategically choice (Gelderman & van Weele, 2003).

According to Kraljic (1983) *"Shifts in supply or demand patterns can alter a material´s strategic category"* (Kraljic, 1983, p. 112) This means, that a shift between the quadrants could be a consequence of a change in in the market.

Strategically, a shift from left to right in the matrix will reduce the number of suppliers for the buying company. A supplier reduction will lead to more dependency on the suppliers, which again will lead to higher prices. As a purchasing strategy, a shift from quadrants with high supply risk to quadrants with low supply risks is the best choice (Gelderman & Semeijn, 2006).

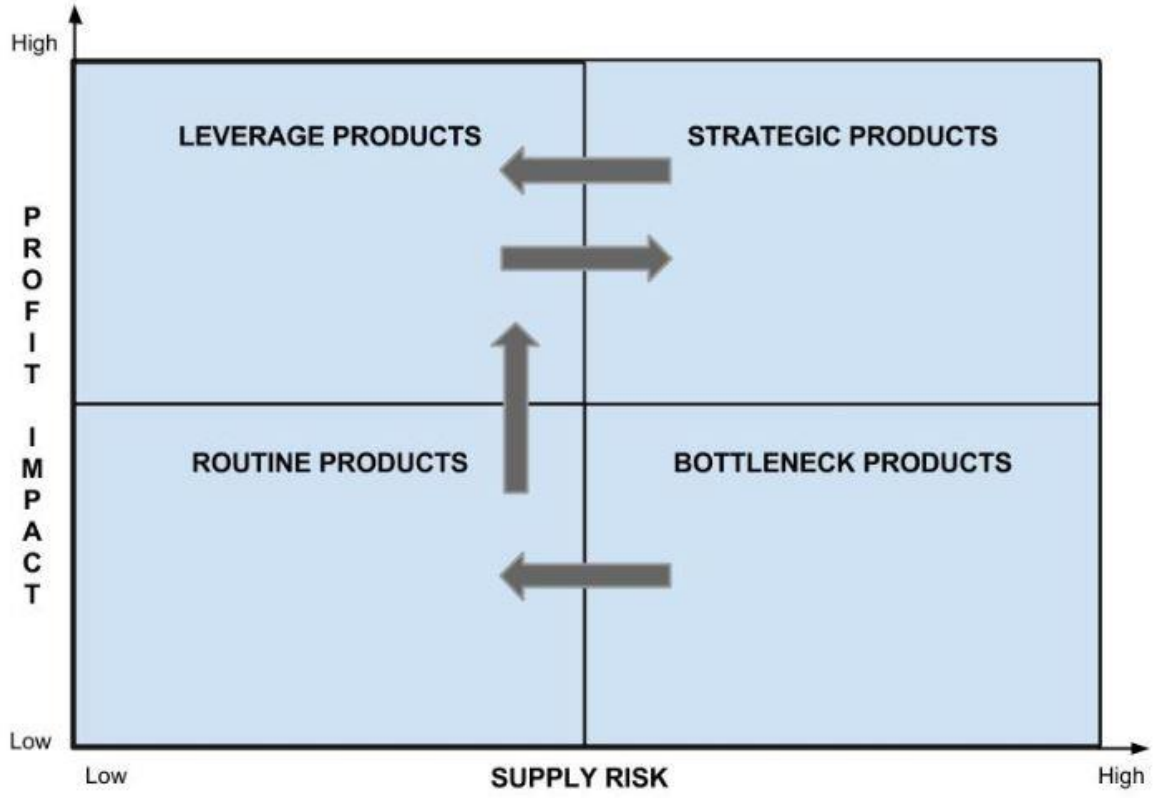

Figure 4: Strategic Directions (adapted from Gelderman and van Weele, 2003 p.212)

Shifts in the matrix, illustrated in figure 4, can be done as a strategic choice, and often bases on the organizations overall strategy, market situation and performance (Gelderman & van Weele, 2003).

Strategic products: In the position of strategic products, the suppliers are often important for the company for having a competitive advantage. In this relationship, there are mutual dependency between the buyer and supplier or the supplier are in a position where it is high switching costs for the buying company to move into another quadrant in the matrix. A move in the matrix from this position is hard, since the buying company often is dependent on the suppliers serving them strategic products, a shift will strategically be to leverage products, with lower supply risk (Gelderman & van Weele, 2003).

Bottleneck products: When moving from the bottleneck quadrant, the company will often aim to reach the routine quadrant. Making a shift from the bottleneck quadrant to the routine quadrant require a wider product specification or a need of finding new suppliers. The aim of reducing the number of bottleneck products is a reduction of supplier dependency (Gelderman & van Weele, 2003).

Leverage products: A move from the leverage products quadrant is a strategic choice, often directed against the strategic quadrant in the matrix. Such a move is to develop a strategic partnership with the suppliers. The partnership should be based on competitive advantage, where the supplier contributes the organization to reach the wanted position in the market (Gelderman & van Weele, 2003).

Routine products: A strategic shift from the routine quadrant often leads to the leverage position in the matrix. Such shift leads to lower purchasing costs, both direct and indirect costs and efficient processing (Gelderman & van Weele, 2003).

Quadrant in the Kraljic Matrix	Purchasing Strategy/Scenario	Relative Power	Power Position within Quadrant	Total Interdependence within Quadrant
Strategic	Maintain partnership Accept locked-in relationships Terminate relationships	Supplier dominance Supplier dominance Supplier dominance	Worst for the supplier Best for the supplier Moderate for the supplier	Highest Moderate Lowest
Bottleneck	Accept dependence Reduce dependence and risk	Supplier dominance Supplier dominance	Best for the supplier Worst for the supplier	Highest Lowest
Leverage	Exploit buying power Develop a partnership	Balanced Balanced	Best for the buyer Worst for the buyer	Lowest Highest
Routine	Pooling of requirements Individual ordering	Balanced Balanced	Best for the buyer Worst for the buyer	No significance difference No significance difference

Table 1: Comparisons of power and independence between buyer and supplier (adapted from Gelderman and Caniëls, 2005 p.153)

Table 1 summarizes and compares the power and interdependency in a buyer-supplier relationship. Interdependency are describing the relationship intensity, while power are directed against the balance of dependency in the relationship. This relationship has impact on the purchasing strategy, and is relevant for choosing the right strategy within the quadrants in KPM. Table 1 summarizes the power of the buyer and the supplier in each of the four quadrants, and illustrates how such relationship impact the two parties

in a relationship. The table can be used in addition to the KPM, as a strategic tool (Caniëls & Gelderman, 2005).

KPM has some shortcomings, and are often being criticized for its weaknesses, and other authors have presented some nuances of purchasing portfolio´s, with basis on the KPM (Gelderman & van Weele, 2003). Different authors are presenting different critiques regarding this portfolio. Most of the critique are based on the finding the right variables of supply risk and profit impact, and how to measure them correctly (Gelderman & van Weele, 2005). The approach have various degrees of how useful it is for all organizations, but the approach can contribute to be aware of how important strategies is in purchasing, as well as overarching strategies in the supply chain (Kraljic, 1983).

2.13 Theoretical Reflections

Since purchasing is a central part of the supply chain, it is vital importance to be able to see a broader picture of purchasing when studying strategies within supply chain management. The purchasing process contains activities that are closely connected to the already selected strategies in the organization, and a part of the key business drivers in an organization together with supply chain management. Whereas the purchasing model is a minor proportion of the purchasing process. From the different business strategies, there seems like NOVM are leaving a differentiation strategy in favor of a cost leadership strategy to achieve competitive advantage to be able to meet the market demand.

The ETO and MTO production strategies are characterized by having minimum products in stock and activities performed are not starting before a customer places an order. Both ETO and MTO are requiring a high level of resources when producing a product (Subash Babu, 1999). The focus of supplier development can reduce the delivery times, in both the production strategies ETO and MTO. Focusing orders, standardization of items and improved forecasting are methods of reducing uncertainty, which is central in ETO and MTO. A purchase of a fixed amount or mix of products can be done for standardized products. For a customized production, it is difficult to implement a determined amount or fixed product mix to purchase from the suppliers. In a standardized production, the

purchasing is more predictable compared to a customized production, since the volumes are the same and purchasing orders are repeatable. In a customized production, there are higher requirements of being flexible, due to more variation in orders and different requirements (Jahnukainen & Lahti, 1999)

The main difference between ETO and MTO is that MTO does not include the design stage, like ETO. In MTO, the product design is already performed, which makes the MTO production strategy more standardized than ETO. When changing production strategy from ETO to MTO, the CODP are moving from design to fabrication and procurement.

Both KPM and the purchasing model is general approaches. These analytical tools, and other aspects from the theoretical framework, are presented in table 2, where the authors, on the basis of the theoretical framework present some reflections of the expected findings of this research. KPM will be used as a tool to identify the differences in products in an ETO production strategy and a MTO production strategy. This is to better describe how a change in production strategy affects the purchasing process.

	ETO	MTO
Purchasing and Purchasing Model	Complicated to forecast what to purchase Requires detailed technical specifications	Easier to purchase products Less follow up during the stages in the model Less detailed technical specifications
Flexibility	High level of external and internal flexibility	Reduced internal flexibility
Products in KPM	Several strategic and bottleneck products	More leverage and routine products More standardized product
Suppliers	Few suppliers available Difficult to find new suppliers High degree of supplier development	More suppliers available Easier to find new suppliers Low level of supplier development

Table 2: Predicted Findings based on Theoretical Framework

Supplier relationships are important to take into consideration when researching purchasing. A motive of implementing a MTO production strategy for NOVM is to reduce costs in order to readjust to the current market situation. By implementing a MTO production strategy, the authors predicts that it will become easier to expand NOVM's supplier portfolio, as products will become standardized. Furthermore, an implementation of a new production strategy is predicted to ease the process of purchasing for NOVM, due to pre-defined designs and solutions.

3. METHODOLOGY

This chapter presents the research methodology in context to the chosen research questions for this study, introduced in section 1.4. Further presented is the design of the research, including relevant research approaches, to shed light the methods of how to answer the research question. Hence, the data collection methods used to conduct relevant data, including primary and secondary data. Nevertheless, the chapter contains a description of the research quality, to secure the reliability and validity of this study.

3.1 Research Design

The purpose of a research design is the plan for conducting a study (Creswell, 2013). Research design is defined by Yin (2014) as; *"a logical plan for getting from here to there" (Yin, 2014, p. 28)*. From the definition, *here* is a set of questions to be answered and *there* is the answers or the conclusion of the questions. Between the questions and answers, the collection and analysis of relevant data is done (Yin, 2014).

According to Yin (2014), there are five components of a research design:

1. *a case study´s questions;*
2. *its propositions, if any;*
3. *its unit(s) of analysis;*
4. *the logic linking the data to the propositions; and*
5. *the criteria for interpreting the findings.*

(Yin, 2014, p. 29)

The research question and the purpose of this study represent a comparison of the purchasing process using a MTO strategy and an ETO strategy, respectively. The unit of analysis to research in this case study is the company NOVM. The collected data will be linked to the purpose of the study and analyzed, and then the findings are interpreted into a conclusion and a suggestion for further research (Yin, 2014).

3.1.1 Research Approaches

Creswell (2014) presents three approaches to research; quantitative, qualitative and mixed methods research (Creswell, 2014). As mentioned in section 1.4, the research question is the foundation of a research, and the research approach is chosen to be able to conduct a study and answer the research question.

Quantitative research often bases on a comparison or correlation between two groups in terms of measurable variables, mostly with use of numerical data and statistical techniques (Creswell, 2013; Yin, 2009). Since it is not appropriate to base this study on numerical data or answer the research question with statistical methods, which is the base of a quantitative research, a qualitative approach is better fitted for this study. According to Creswell (2013), a qualitative approach is defined as:

> *"The final written report or presentation includes the voices of participants, the reflexivity of the researcher, a complex description and interpretation of the problem, and its contribution of the literature or call for change."*
> *(Creswell, 2013, p. 44)*

The qualitative approach are better to use in accordance to explore, explain and describe the research problem, for collecting more detailed information and data (Creswell, 2014; Yin, 2009). Qualitative research bases on theoretical frameworks, together with data collected in the field, where real-life situations are studied in their natural context (Creswell, 2013). Qualitative research is better when explaining events in a higher level than with use of qualitative data (Yin, 2009).

The third approach, mixed methods, is a type of research approach that is combining both qualitative and quantitative approaches when collecting and analyzing data. It is not necessary to combine these methods within this research, as numerical data are not relevant sources of evidence in accordance to the research question, and a pure qualitative approach are sufficient to investigate the research question (Creswell, 2014).

3.1.2 Case Study

Case studies is a research strategy that are useful in real-life situations, where the researcher has little control over events, and when the questions like "how" and "why" is the base of the research question (Yin, 2014). Yin (2014) defines case study as: *"a study that investigates a contemporary phenomenon in depth and in its real-world context" (Yin, 2014, p. 237)*. This definition is in relation to the description of a qualitative approach, where the investigation of real-life situations is central, and explores a case over a certain time. However, a mix between qualitative and quantitative methods are also possible in a case study. A case study is based on multiple sources of information and in-depth data collection, where the researcher are out in the field and collecting the data (Creswell, 2013; Yin, 2009). To help identify details and deep insight within the unit of analysis, NOVM, a case study method is an appropriate approach for this study.

A case study is divided into three strategies: exploratory, descriptive or explanatory studies. Explanatory case studies focuses on explaining the state of something, while descriptive case studies describes a phenomenon. Exploratory case studies are starting with some statements of what to explore, the purpose of the research, and some criteria's of how to successfully judge the exploration (Yin, 2014). An exploratory case study is defined as: *"a case study whose purpose is to identify the research questions or procedures to be used in a subsequent research study, which might or might not be a case study"* (Yin, 2014, p. 238). The exploratory strategy is applied when similar research questions has not been explored by other researches, and further aims to complement the research issue with little prior knowledge. The case study strategy is selected based on the type of research questions, which in this research has an exploratory nature, therefore the favor strategy for this case study is an exploratory strategy. This study has an exploratory nature, due to the aim to explore a new perspective of a case that is already been researched in a Master Thesis written spring 2014 (Ramde & Jamt, 2014; Yin, 2009).

The design of a case study can be either a single- or a multiple case study. This study contains a single case study, since it is a single study of NOVM, rather than a comparative

study that contains multiple cases of different organizations (Yin, 2014). The reason for not choosing to compare with other organizations is the difficulty of finding comparable organizations within the same circumstances, together with the confidentiality agreements of this study. With use of a multiple-case study, there will be limited in-depth information from NOVM, as of potential sharing of information with competitive organizations.

3.2 Data Collection Methods

In relation to the qualitative approach and the case study, the researchers collects data and the findings in the study. The data are collected by conducting interviews, examination of documents and observations. When collecting data, there will be a chain of evidence which links the data conducted from interviews and the data collected by other sources, to increase the quality of the case study (Yin, 2014). There are several ways of collecting data, thus there are no particular method that is better than other methods to collect data. Hence, within a qualitative approach, interviews are the favored data collection method (Yin, 2014).

3.2.1 Primary Data

Primary data are new data, which is collected by the researcher as purpose of the specific research question (Boeije & Hox, 2005). There are different methods of collecting primary data, and some examples of primary data are data collected by interviews and direct observations, like focus groups and case studies (Fitzpatrick & Boulton, 1994; Yin, 2014). In this case study, the primary data will be conducted from interviews and regular conversations and meetings with employees at NOV Molde.

3.2.1.1 Interview

To help answer the research question, it is natural to conduct interviews as a data collection method in a qualitative study (Remenyi, Williams, Money, & Swartz, 1998). There are several types of interviews. In qualitative methods, in-depth interviews are

often a preferred method of data collection. In-depth interviews are giving the researcher the opportunity to get information in more detail. This type of interviews can be divided into semi-structured interviews and unstructured interviews. Unstructured interviews are based on broader objectives, where it is minimum or no pre-defined questions in the interview (Fitzpatrick & Boulton, 1994). In semi-structured interviews, the interviewer is asking the respondent pre-written questions, but with an option for changes during the conversation (Longhurst, 2010). The respondents to the interviews can be selected by a snowball sample method. Meaning that one respondent lead the researcher to the next respondent, to find necessary information (Remenyi et al., 1998). Semi-structured interviews are a conversation, where the interviewer are listening and paying attention to what is told (Longhurst, 2010). An audio record of the interview helps the interviewer to pay attention to the respondent, in addition to make it easier to ask follow-up questions during the conversation (Gillham, 2007). This type of interview does not have standardized questions for all respondents, and the questions are specified for the respondent. Since the questions are not equal for all respondents, a comparison between the answers could be difficult, compared to ask the same questions to each respondent. The important part in such type of interviews for the researche, is to have a brief knowledge on the topic, to be flexible and able to ask relevant questions during the conversation. To be able to use the information obtained from the interviews, notes and audio record of the conversation is helpful. These notes from the interview are a part of the data analysis (Longhurst, 2010).

The design of the interview guide are about setting the overall research questions into a system, with topics that including questions. The questions in the interview are formulated as open questions, where the respondent answer without having pre-defined options. Open questions are often leading to better answers from the respondents, than closed question, where some pre-defined alternatives are given (Gillham, 2007). The interview focuses on the central part of the study, and the respondents are key informants of the organization.

After a business presentation at Molde University College in March 2014, the authors of this thesis became acquainted with a representative from NOVM, and began the process

of obtaining relevant information and insights of NOVM as an organization. After three meetings with the representative from NOVM, the authors had received sufficient knowledge of the organization, and began discussing challenges that NOVM had accounted for. Further, there were completed guided tours at NOVM´s business office and at NOVM´s sub-division at Hjelset during June 2014. In total, there have been approximately 15 meetings with the representative from NOVM during the period March 2014 to May 2015, with various lengths of one to three hours per meeting. However, there has also been communicated via approximately 50 e-mails with the representative from NOVM, which has increased the author's knowledge of NOVM.

In this study, there were conducted semi-structured interviews. The key informants for the interviews are employees of NOVM, whom are working within the purchasing department. These informants are relevant for the investigation of this study, due to their positions within the purchasing department, as well as their insight and knowledge of the new standardized offshore crane. In total, there were four informants for the semi-structured interviews, and these informants were carefully selected after several meetings and conversations with a representative from NOVM.

Before the conduction of the "official" interviews, the authors of this thesis had gained knowledge of NOVM as an organization, which gave a better foundation of NOVM´s challenges in regards to the topic "purchasing", but also led to a better foundation for the questions that were asked during the semi-structured interviews. Especially since semi-structured interviews requires the ability of asking good and relevant follow-up questions during the conversations. Additionally, the framework from the literature was familiar for the authors at the time the interviews took place.

In addition to the interviews, other sources of information are relevant to corroborate the evidences and the information obtained from different sources. Shortcomings by conducting data from interviews is the design of the questions, which must be well constructed and avoid leading questions, which might result in the answers that are expected from the researcher (Yin, 2014).

3.2.2 Secondary Data

Secondary data, is data which is collected by others for different purposes than the research question. Such data is useful in addition to the primary data (Boeije & Hox, 2005).

In this case study, the secondary sources are obtained from reports, documentations, and other types of information gathered from the case study organization, NOVM. This includes outputs from NOVM´s internal database, which is not attached in its original form in this study, due to the confidentiality agreements. Documentation gathered from NOVM includes presentations of the organization used in teaching, information brochures and administrative documents are used. Such information is real data from the case organization, which is not only created for the case study. This will lead to more exact and broad covered data, collected over a longer period. A weakness by using such documentation, is that it could be difficult to get access to the most important data, and the information could be incomplete if the selection of data is biased (Yin, 2014). Another secondary source of data that is used in this study, is the Master Thesis from spring 2014, which is written about the same case (Ramde & Jamt, 2014).

3.3 Research Quality

Presented in this section is the quality and reliability of the conduction of the case study. During the design stage of the study, the research quality is taken into considerations (Remenyi et al., 1998). Validation and evaluation of a qualitative research are important to make it possible to test the quality of research.

It exists many perspectives of validating a qualitative research (Creswell, 2013), but four tests are, according to Yin (2014), the most common to use in a case study:

- *Construct validity*
- *Internal validity*
- *External validity*
- *Reliability*

(Yin, 2014, p. 45).

3.3.1 Validity

Validity is, according to Yin (2014), divided into three categories that should be tested. Validity tests are checking if the researches have obtained full information from the respondents in the research (Yin, 2014). To ensure the validity of the research, the respondents from the interviews verify the researcher's reflections from the interviews (Remenyi et al., 1998).

Construct validity of the research is challenging to test in a case study. Many are criticizing the use of case studies and the difficulty of use an adequate set of operational measures to collect data. It is important to identify the operational measures for the study. Changes and its consequences which are researched in a case study, might be based on the researchers impression, rather than a real change or finding. To find out if changes bases on the case or the researches impression, the researcher must be able to specify the types of changes in the study, and relate them to the original objectives of the study. Construct validity are linked to the data collection and the composition of the study, and the data collection method (Yin, 2014).

The data collection in this study, is obtained from different sources to sustain the construct validity. There are conducted four interviews, in addition to the theoretical framework and other primary and secondary data. The theoretical framework is in relation to the research question, and was well known when conducting the interviews to assist to ask relevant questions.

Internal validity is a tactic, which looks at the relationship between some conditions. The relationship between conditions is telling how or why one condition is leading to another condition. Internal validity is only relevant for explanatory studies, not for exploratory studies (Yin, 2014). Since this is an exploratory study, the internal validity is not relevant to test.

External validity is testing if the findings in the study can be generalized and used for other cases. To explore if the findings are able to be generalized, the theory used in a single-case study is important. The external validity is dependent on the design of the study. A study with external validity should have replication logics, where the experiment are done more than once, or with designed as a multiple-case study (Yin, 2014). This case study is not easy to generalize in its nature, since it is a single-case study. To reach an external validity of this study, it should be replicated and conducted further research based on this study. A way to make generalization possible, is to expand the study to a multiple-case study. During this study, a comparison or benchmark with a similar organization was not an option. It was difficult to find a similar case, and by comparing two organizations in this study, there could be limitations of information gathered from the organizations due to nondisclosure.

3.3.2 Reliability

To do a reliable case study, it should be possible for other researchers to do exactly the same research all over again, with the same methods and procedures, and then reach the same conclusion and results as in the original study. Reliability will help to avoid errors and biases in the research. Furthermore, it is dependent on the data collection and the

data collection methods. Maintaining a database of the case study is a way of making the study reliable (Yin, 2014).

Since a part of this study is based on predictions of a new project and the researchers role in the research are central, there could be some difficulties of recreate this study. A part of the data bases on regular meetings and conversations with NOVM, and information that are obtained over time. The interview guide is added as an appendix, and the information from the interviews conducted and meetings with the organization is presented in chapter 4, to increase the reliability of this research.

4. FINDINGS AND ANALYSIS

The aim of this study is to compare NOVM's purchasing process within an ETO and a MTO production strategy. The findings are obtained from the data collection, like conversations, meetings and interviews with employees from NOVM, in addition to e-mails and other data gathered from the case study organization. The theoretical framework, which is presented in chapter 2, is the base for the conducted semi-structured interviews. The questions in the interview guides (appendices 9) are formulated to investigate the research question, and are not completely followed, but used as guidelines during the interviews. This chapter is structured on the basis of the data collected in the field, and presents the findings and analysis of these data.

4.1 Respondents

The respondents for the interviews are selected from the purchasing department at NOVM. The respondents have different assignments and responsibilities within the purchasing department, where one of the respondents are now working as an advisor and has previously been a purchaser for NOVM. The respondent is an engineer, which has worked as a constructor for 15 years. The respondent has worked a lot with production purchasing, purchasing in general, primarily in Asia and is involved in the MTO project. As an advisor, the respondent works with product development, composition of concepts for the fabrication and the supply chain, in addition to chose the location of NOVM´s production and fabrication. Further, the respondent has responsibility of the activities that creates the supply chain, like connecting engineers, logistics, fabrications and assembly at NOVM together.

Two of the respondents are senior purchasers, with responsibilities of two different divisions within purchasing at NOVM, fabrication-and component purchasing. The two senior purchasers have earlier worked in organizations with standardized production. The fourth respondent in the interviews are the purchasing manager for the fabrication purchasers.

4.2 Types of Purchasing at NOV Molde

The purchasing responsibilities at NOVM are twofold, and divided into fabrication purchasing or production purchasing, and component purchasing. The employees working with fabrication purchasing are purchasing production from suppliers, which involves ensuring that the suppliers are producing the components NOVM has designed. As an example from the interviews, the fabrication purchasers are purchasing steel in accordance to NOVM´s definitions and specifications, the steel structure on the offshore cranes, assembly and testing of the products. Further, fabrication purchasers are responsible for contracts with subcontractors.

A part of the component purchases are an intermediate between fabrication purchasing and component purchasing. Component purchasers primarily purchase standard products like standard bolts and hydraulic components, which are pre-defined components by the suppliers, and not custom made for NOVM. Such types of components are usually available from several suppliers with core competence, and are shelf items with short delivery time. Hence, component purchasers are also purchasing customized components based on NOVM's specifications and designs, like winch gears, hock block and slew bearing.

The main task for a component purchaser emerged from the interviews as: *"to provide the right component, at the right time, with the right quality".* The right component is chosen from technical specifications, set by the technical division at NOVM. Within component purchasing at NOVM, there are three disciplines: mechanical components, hydraulic components and electrical components. The purchasing process is the same for the component and the fabrication purchaser.

The purchasing process commences after an order becomes a project. The first phase of the project is a list of components, which are a part of the project done by the technical division at NOVM. Some of the components are in accordance to global agreements, others is a part of the negotiation of the project. One respondent mentioned that a project consist on 500-700 drawings of the crane-structure and 210 drawings of the

boom, from the engineering division at NOVM. A part of the engineering is to draw the crane, but also to select the right specifications of components.

Some of the interview-questions dealt with the current situation at NOVM, and their present ETO production strategy. These questions were asked to better explore an ETO and a MTO production. Primarily, NOVM is a customer-oriented organization, which traditionally are offering customized offshore cranes to the market. However, as discussed in chapter 1, the oil and gas market has undergone some changes during the past years, resulting in demand for a more cost-efficient offshore crane. The present market is now urging for standardization of products, and focuses on more cost-efficient solutions. Therefore, NOVM are compelled to respond to such changes, and introduces the new standardized offshore crane to their customers.

When NOVM sell a crane to a customer, it becomes a specific project for the order. When this project is established, all the disciplines are represented and it is assigned resources to the project with a project manager. The purchasing division is a part of the project. A typically project in ETO consists of a responsible employee for fabrication purchasing, one component purchaser, and one which is responsible for logistics. In addition, there is one person who is involved in quality control (QC). Project development consists of technical documentation of estimates and a defined cost summary for the offshore crane. The date for when the crane should be completed is defined, hence it is planned backwards, and the activities for producing the offshore crane are executed. The technical division is responsible for defining and planning when each of the components has to be available and ready for production. Such plans bases on the lead-time for the component. Thus, the technical division does not execute plans before the customer places the order of an offshore crane. The engineering process and the design of the crane commence when the contract of a crane is signed.

4.3 Purchasing Model in ETO-Projects

When a project is established, the purchasing process takes place. The activities that are conducted when the customer places an order can be displayed as a stepwise purchasing model, illustrated in figure 5.

Figure 5: Purchasing Model in an ETO Production Strategy

1. *Identify Needs, Request and Place Purchase Order*

The first step in the purchase model for an ETO offshore crane is to review requisitions. The purchasers are responsible to obtain bids from several suppliers, in order to select the most suitable supplier for the product that is set for production. The supplier selection bases on a list of specifications of the products, where the fabrication purchaser determine “address-ID´s” in NOVM´s ERP system, so all participants in the project know where the project is produced. The “address-ID´s” is identification of the products, for obtaining control and to know where things are at any time during a project. When the supplier is selected, the purchaser has to prepare a purchase order (PO) that contains all information and specification that is needed for the product. Further, the purchaser creates item-numbers for each individual purchased components of an offshore crane. The component purchasers send requests to the suppliers, and when it is conducted, the PO is sent to the respective supplier. Furthermore, all documentation and drawings should be sent to the suppliers about one month prior the production start-up.

2. *Follow up Purchase Order, and Handle Non-Conformance*

The purchaser is responsible to follow up the sent PO, to assure that the supplier has received and understood the contents of the PO. The supplier replies by sending an order confirmation to the purchaser when the PO is received and understood. Furthermore, the reception of an order confirmation from the supplier is a critical phase within the purchasing model. The replied confirmation from the supplier has to be registered, and

verified to ensure that the suppliers understood the specifications and assignments. Moreover, it is important that the purchaser handles existing non-conformance, which is deviations from the PO that has been sent to the suppliers. A non-conformance occurs when there is a deviation in requirements or the specifications that is set by the purchaser.

3. *Receive Goods*

Receiving goods takes place at either NOVM's warehouse, or at an external warehouse. The purchased components are received and further divided into containers, which are sent to NOVM's suppliers for production. This is conducted by NOVM, to ensure that all components belong to the correct project, and to maintain control over the purchased components.

4. *Carry out Fabrication*

The most important step is to prepare the start up for the production for the intended project. It is important to be fully aware of the production progress in such an extensive project, with such a high value end-product. Due to mixed production times for the different components, and their significant to the end-product, the purchasers has to be aware of changes in specifications or design as early in the project as possible. While production takes place, it is conducted several tests to ensure that the components contains all defined specifications, as well as the agreed quality. Further, a status report of the production process of the component is conducted, and the purchaser verifies the progress of the process.

5. *Follow up Assembly and Test*

When the components are completed at production, assembly is the next stage of the project. Therefore, the next stage for the purchaser is to follow up the assembly stage of the project, hence the installation and the composition of the components. During follow-up, third parties might be involved, to verify parts of the manufacturing process. This is done by "*Det Norske Veritas*" (DNV), that are responsible for safety in the offshore industry. After follow-up, the crane is tested, and the purchasers are still involved when the offshore crane is tested, but has not the main responsibility in regards to the testing

stage. Further, if any components are missing or broken during production, the purchasers are responsible to replace it. Testing is either conducted at NOVM´s installation and testing site in Korea, or at Hjelset in Norway. An internal test of the components is conducted in the beginning of the process, and when all components are assembled to a final offshore crane, a final acceptance test (FAT) is performed. Finally at this stage, all the documents from the suppliers are collected, and then the invoice is created.

6. *Carry out Transportation*

An ETO offshore crane produced by NOVM is usually transported in one piece. Therefore, it is an extensive process to plan and conduct transportation. It is important to specify needs of transportation, in accordance to when the transportation should be conducted, but also the extent of the process. Transporting an offshore crane is viewed as a special shipment, and there are limited suppliers available to conduct such type of transportation. A supplier should be selected early in the planning stages of the project, and the purchaser has to finalize all documentations that are in consideration to the transportation. In case of deviations, these should be managed immediately to avoid delays in planned delivery date.

In relation to purchasing, the purchase of steel for NOVM is the most critical phase as of receiving the steel in time for production. Steel, the steel grade and thickness has to be purchased at an early stage in the purchasing model. NOVM has a “long-lead items” list, which contains critical components to purchase that are critical to receive in time, such as slew bearing, cable trace, diesel engines and gears. Long-lead items are defined at an early stage in a project, and frequently updated throughout the project. However, when the project has started, follow up assembly and testing stage then becomes the most critical phase in the purchasing model, where most of the problems in the project occur. A challenge for NOVM in relation to purchasing in an ETO context is to receive technical specifications and designs by engineers in time for purchase. Especially the designs from the engineers are often delayed.

It emerges from the interviews that a challenge regarding purchasing with an ETO production strategy is the uncertainty related to the variety among each project, since each crane is a unique, individual project. One of the respondents stated: "*New varieties, new components, new production solutions and new assembly*", as some examples of the variety of creating an ETO offshore crane from time to time. Further, a respondent stated that: "*there is no other challenges than they we are creating ourselves, but we are good at that*", to a question about challenges when doing purchasing within an ETO strategy. The relation to this statement is the design stage, which is performed after the customer has placed an order, and purchasing can not begin until the engineers has sent their specifications of the products.

4.4 Purchasing Model in MTO-Projects

The purchasing model for the standardized offshore crane is not yet defined by NOVM. However, NOVM has some ideas of how the purchasing model for a MTO offshore crane will appear when selling their first MTO offshore crane. As this is a new project for NOVM, the purchasing process in context of the MTO production strategy will be developed over time. The purchasing model for the MTO offshore crane, presented in figure 6, bases on the respondent's answers from the interviews, meetings and conversations, gathered during the data collection stage.

Figure 6: Purchasing Model in a MTO Production Strategy

The main difference with the purchasing model for the standardized offshore crane is that the technical specifications and the purchasing list are already predefined when a customer orders a crane, in contrary to an ETO context. The pre-designed drawings from the engineers, will now be retrieved from an internal system, and then sent to the suppliers. The main design of a MTO offshore crane will be the same from time to time.

With pre-defined drawings, there will be wasted less time to ensure that the updated version of the drawings is used of all instances in the project. Furthermore, time previously spent on changes in an ETO context will now be reduced.

1. *Review requisition and place purchase order*

The first step in the purchase model for an MTO offshore crane is to review requisitions, further to contact the supplier. The suppliers are pre-defined for each component with frame agreements, and there is clearance with the suppliers, rather than negotiations. With use of frame agreements, it is easier to negotiate over prices or lead-time with suppliers. The address-ID´s are set, to plan the project schedule. Further, the PO needs to be prepared and sent to the suppliers. New for a MTO offshore crane is the pre-defined item-numbers, which is already set for each component. When the supplier receives the PO, the supplier should be able to retrieve the necessary documentation and drawings for the crane for NOVM´s database.

2. *Follow up PO*

The follow up phase in context to a MTO production is related to assure that suppliers has the documentations and drawings needed for producing components. Further, follow up bases on existing agreements with the suppliers. There is necessary of the suppliers to acknowledge the receipt of PO, further to respond with an order confirmation to NOVM.

3. *Receive Goods*

This stage in the purchasing process for a MTO project will be the same as in an ETO project, where NOVM are gathering the components into containers before it is sent for production. In the long term, it could be an opportunity that the suppliers are purchasing more of the goods they are using in the production, and there will be no need for NOVM to receive the goods, collect and forward it to the suppliers.

4. *Carry out fabrication*

Within this stage, the suppliers are starting up with the production of components. The purchasers ensure that this is accomplished. Testing of the components is not that crucial

in a MTO context, as in an ETO production, since the production stage is routine based and replicated.

5. *Follow up assembly and test*

When all components are completed, they are ready for assembly. The purchasers are involved during assembly, as to follow up assembly and testing. The follow up phase will be less time and resource consuming, due to less need of controlling than for an ETO project. At this time, the testing will be done in Korea or at Hjelset, like for an ETO project. This stage in the process is ending with a FAT, and the collection of document and inspection of the final product with the customer before the invoice is created.

6. *Carry out transportation*

As emerged from the interviews, the MTO offshore crane is set to be transported in two separate containers. One container will contain the A-frame, which is the frame of the offshore crane, machinery house and the cabin. The boom will be transported in a separate container. Thus, there is an opportunity for transporting the MTO offshore crane in more than two containers, hence it will be at the customers expense.

One of the respondents indicated that the major difference between purchasing in an ETO and MTO context, is that within MTO, everything is predefined. This means that *"everything will go smoothly in a MTO process",* as one respondent said. Another respondent mentioned that the order process differs between purchasing within ETO and MTO. Technical specifications should be quicker to create within a MTO context, and should not create any delays in the project, like they often do within an ETO project. Furthermore, for an ETO crane, it is nearly impossible to purchase components to stock, while for an MTO crane, it should be possible to order more to stock or in larger quantities.

During the interviews, a question in relation to the disadvantages with standardization of cranes was proposed. One respondent said that standardization would have some negative impact on the innovation ability, where the focus changes from an evolving organization to a standardized organization. Another respondent talked about risk in such

a context. Since purchasing in MTO should be based on volume, the suppliers should be able to produce some components to stock. This involves some risk in terms of bounded assets. Contracts and agreements with the suppliers can thus avoid this, and if not, the risk is situated at NOVM.

Some components or processes in the production are difficult to standardize. One of the respondents exemplified steel as a limitation when implementing standardization. On steel, it exist something called “test temperature”, which is the temperature of testing the steel. It is also temperatures of designing the steel, the design temperature. Theoretical, the design temperature should be minus 20 degrees Celsius. When following the American Petroleum Institute (API) standards for offshore equiptment, the test temperature should be six degrees Celsius below the design temperature. While following offshore certifications and standards defined by the American Bureau of Shipping (ABS), the test temperature should be ten degrees Celsius below the design temperature. Therefore, the requirements within each project are deciding the temperature of the steel design, and need to be regulated for each individual project.

4.5 Suppliers

NOVM´s suppliers are located worldwide, mainly in Europe and Asia. Fabrication is located in Poland and Korea, and components are purchased from Europe, often in Germany. Electrical materials, gear, brakes and critical components are often purchased in Europe. When NOVM sources for new suppliers, some employees of NOVM are has this as their full-time work assignment. Thus, when selecting a new supplier, there are several meetings, negotiations, and discussions before the supplier are approved by NOVM.

NOV Korea (NOVK) is often used as an example from the respondents when spoke about suppliers. NOVK is used to receive drawings of the product they are producing, thus sometimes NOVK conducts changes without following the drawings from NOVM, since they in many situations know what to do. A problem with the suppliers can be that they reply feedback to NOVM that there are some errors on the drawings, without correcting

them. Then the same mistakes occur during the next project as well. It is a system that should be used of NOVK to report errors to NOVM. Here, NOVK are able to report to a common "*Performance and Improvement Management System"* (PIMS), where the suppliers can register which of the drawings that has some mistakes and are done different. When using this system, NOVM is able to correct this error immediately. Instead, NOVK are using something called "*Red Line Mark Up"* on the drawings, where they are writing what is done differently directly on their version of the drawing. Sometimes, this is not easy for NOVM to correct and update, since the errors are not reported in the system, PIMS. For the purchasers, this creates extra work, and the update of the errors will be difficult to discover when purchasing several components within the same project. This can create a chain reaction of errors when purchasing other components.

NOVK has a purchasing department, and are responsible to purchase some of the components. It emerges from the conversations with the respondents that NOVM are purchasing most of the components in-house to maintain the control over quality-level. Further, it emerged from one of the interviews, that NOVK are not allowed to do more purchasing than today´s, when implementing the MTO production strategy, since it is not profitable for NOVM to purchase more components in Asia. The prices of some components are cheaper, but with NOVM´s frame agreements with the suppliers, their prices are often better than the prices NOVK are able to retrieve. In addition, NOVK can exploit this situation to take premiums for this purchase, which results in a more expensive purchase. Some components used for the offshore cranes are only available in Europe, and are difficult for suppliers in Korea to purchase. Due to such limitations, there are few components NOVK are allowed to purchase. Hence, NOVK are purchasing selected non-critical components, specified in the contract, often un-specialized steel, screws and bolts up to size M30. Further, NOVK can purchase some shelf items, like stainless angelbar and cable trays. In some situations, it is easier that for example NOVK are purchasing oil. The exception is when Statoil is the customer, since Statoil requires Statoil-oil on their cranes. This oil is not to obtain in Korea. If this is the situation, the oil needs to be purchased in Europe, and further shipped to Korea. If this is not detected early in the project, it is necessary to ship this oil by plane, which is costly.

4.5.1 Supplier Flexibility

A question from the interview referred to the supplier´s flexibility, and how suppliers react to changes during the ETO process. The respondents agreed that this vary among different projects. If the project bases on a new product development, which is common in an ETO production, it request higher level of flexibility from the suppliers. Suppliers need to be flexible, due to changes of design, and be able to request some changes of the design. Furthermore, the suppliers provide NOVM with feedback regarding the design, if these are difficult to produce in practice.

The flexibility of supplier's bases on the coverage ratio the suppliers have in a project in accordance to costs. All of the changes beyond the set schedule have a cost for NOVM. Most of the suppliers are good at exploiting such situations that requires flexibility, to their own benefits. Therefore, NOVM has to consider if changes in the project are necessary, since some changes could be expensive for NOVM. The overall experience among the respondents is that the suppliers are often flexible, meeting requests of changes and are good at correcting if there are any changes. Often NOVM´s customers require changes according to new requirements, and the suppliers are therefore used to respond to changes.

Flexibility between NOVM and their suppliers is mutual, and works both ways in the relationship. The mutual flexibility between NOVM and their suppliers entails both parties to be flexible. In some situations, NOVM are requiring changes, like an extra hole in a component, other times it is the suppliers that have forgotten something or needs extra time to complete their work.

4.5.2 Supplier Selection

In regards to selecting new suppliers, to expand the supplier portfolio, there were some examples from the respondents that this could be a difficult process. During the interviews with two of the respondents, the conversation entered some cultural differences of the suppliers that could have impact on the relationship between NOVM and their suppliers. NOVM tried to initiate a supplier relationship in Brazil. However, the culture differences made it difficult to cooperate with suppliers located in Brazil. One of the respondents described the cultural differences as *"a kind of mañaña, mañaña culture",* where the suppliers did not commit to regulations and agreements from NOVM. The cultural differences are sometimes a challenge within the relationship with the existing suppliers as well. An example is NOVM´s suppliers in Korea, where the culture bases on hierarchical ranking. With these suppliers, there is in some situations challenging to discuss solutions and have an equal dialogue. However, these suppliers are having a good business culture, and are good to deal with orders. NOVM has some employees that are working with supplier development, and the purchasers are in some situations involved in this process.

4.5.3 Supplier Rating

From the interviews, it emerged that a rating list should be implemented during spring 2015. This is a new system to rate the suppliers. In this system, the suppliers are filling in information to be approved by NOVM. On a quarterly basis, the purchasers and employees responsible for QC give the suppliers scores and characteristics based on the performance of the suppliers, where this rating could be shared with the supplier. NOVM and their suppliers are maintaining a close dialogue, and the employees working with QC has continuous training and feedback of the suppliers.

4.5.4 Suppliers in MTO

From the interview guide, many of the respondents were asked if there would be some changes in the suppliers regarding the standardized MTO offshore crane, were one of the respondents though that the idea of MTO was to have predefined suppliers. Another

respondent indicated that to produce all parts of a crane in the same country, at least in the same continent, would ease the assembly and follow up of the assembly.

All the respondents agreed that NOVM want to use suppliers they are familiar with, and use the existing supplier portfolio. One of respondents indicated that the existing suppliers are positive to produce standardized products. Is has been several dialogues between NOVM and several of their suppliers about a standardization of products. Some of the suppliers today are “struggling” when producing customized products. For the suppliers, standardization of products does the production more stable and predictable. This mean that NOVM is able negotiate over prices with the suppliers for the new MTO offshore cranes. A challenge with the existing suppliers is that they are used to produce customized products, where NOVK is drawn up as an example to illustrate this. The respondents indicated that NOVK has to be more conscious of the drawings they receive are correct every time when there is a standardized product, rather than being flexible and make exceptions of the set drawings.

4.6 Customers and Market

The ETO cranes is designed from the customer’s specifications, and furthermore there are different regulations that the offshore cranes need to follow. It is not always easy for the purchasers to discover which regulation that is applicable for each individual crane. Most of the times, it is the purchasers and the employees at the technical division that need to discover such types of regulations and standard it requires. Most of NOVM´s customers in Norway are following the NORSOK offshore standards, but during the previous years, there has been more use of the EN offshore standard. Therefore, it could be some difficulties for the purchaser to identify which of the standards and certifications who is the current for each crane, since this is often a shortcoming in the contracts.

With the new MTO crane, it should be a standardized base of the crane, where customers can choose between pre-defined parts. Several of the respondents compared this with buying a new car, where the design is set and the customer can choose between some pre-defined specifications. Some of the specification that was mentioned is which site of

the crane to have the cabin, color, type of steel and so on, where the main design is the same of each crane. It emerged from the interviews that the number of varieties on the standardized crane is not defined at this time. The challenge of defining options is to define what the market want, and to meet the demand from the market. A greater marked share is one of the goals with the new MTO production strategy. The sales-volume should be higher compared to volume sold in the present marked, since the customers are more cost-oriented in the current market. An example from the interviews is that Statoil urges to buy an ETO offshore crane for the price of a MTO offshore crane. The customer's requests orders for a MTO offshore crane, but during the negotiation, it arises that the customer request several changes on a standardized offshore crane. It appeared from one of the interviews that NOVM at this point approves such requests, to be able to sell a crane.

4.7 NOV Molde´s Future

Some of the questions were in relation to NOVM´s future, and how the standardized crane would work in practice. One of the questions was related to what NOVM would do with the ETO offshore crane, when implementing a MTO production strategy. The respondents had different opinions in regards to this question. Some respondents indicated that it would be challenging to leave the ETO strategy for an MTO strategy. On a long term basis, the respondents though that it would be *"one foot in each site"* between the two strategies, not a pure ETO or MTO strategy.

However, another respondent thought that a pure MTO strategy is the right choice of response to the marked demand, and further stated: *"Our concurrent has standardized cranes, cheap, where the market can take it or leave it, when we have a Cadillac for sale",* which explains NOVM's present situation in the current market.

A respondent said, about the change of production strategy: *"It is very good that they are thinking about the idea of standardization, we need that".* Thus, the respondent thought that a MTO strategy will make the purchasing more like a routine, with less exciting challenges.

"In the beginning, I think this will be very interesting, when everything is new and exciting. After a while when everything becomes very standard it is not certain it will be just as interesting".

A question to the respondents was about the separation of the two product strategies within the organization. The answers here were twofold, where some respondents thought that it is challenging to *"start thinking MTO when you are used to think ETO".* A new department concerning MTO project should not be necessary, but a separation is a possible solution, since this is project-based work. A challenge for the current employees is to not do things unnecessary complicated.

4.8 NOV Molde's Products in Kraljic's Matrix

An offshore crane contains several types of components that are assembled together in order to produce a crane. Revealed from the interviews, there are approximately 4000 to 4500 components in an offshore crane produced by NOVM.

Based on the interviews, it emerged that NOVM has various types of relationships with their suppliers. Strong relationships are limited to suppliers that produce and deliver strategic components. In regards to location, most of NOVM´s strategic suppliers are located in Europe, primarily in Germany and Poland, since this is closer to the customers of NOVM, who are mainly buying offshore cranes for oilrigs in the North Sea. However, the selection of strategic suppliers for NOVM is various. As an example from the interviews, NOVM has acquired suppliers in order to keep them within the organization, especially due to nondisclosure. Further, suppliers are unable to access the completed offshore crane produced for NOVM. Nondisclosure in regards of production and completion of an offshore crane is of particular importance, and to avoid lack of information to NOVM´s competitors, the suppliers only produce a limited number of components for an offshore crane.

NOVM has a strong relationship with suppliers that produce bottleneck products. Hence, the volume of the components is lower, and the supplier availability is limited. The financial aspect on bottleneck products is less within this quadrant, compared with strategic products. In accordance to leverage and routine products, the relationship with the suppliers is balanced in relation to the power in the market.

Furthermore, the analysis and findings consists of a categorization of components implemented in KPM, to shed light on differences of components to purchase in relation to an ETO and a MTO production strategy.

4.8.1 ETO Kraljic Portfolio Matrix

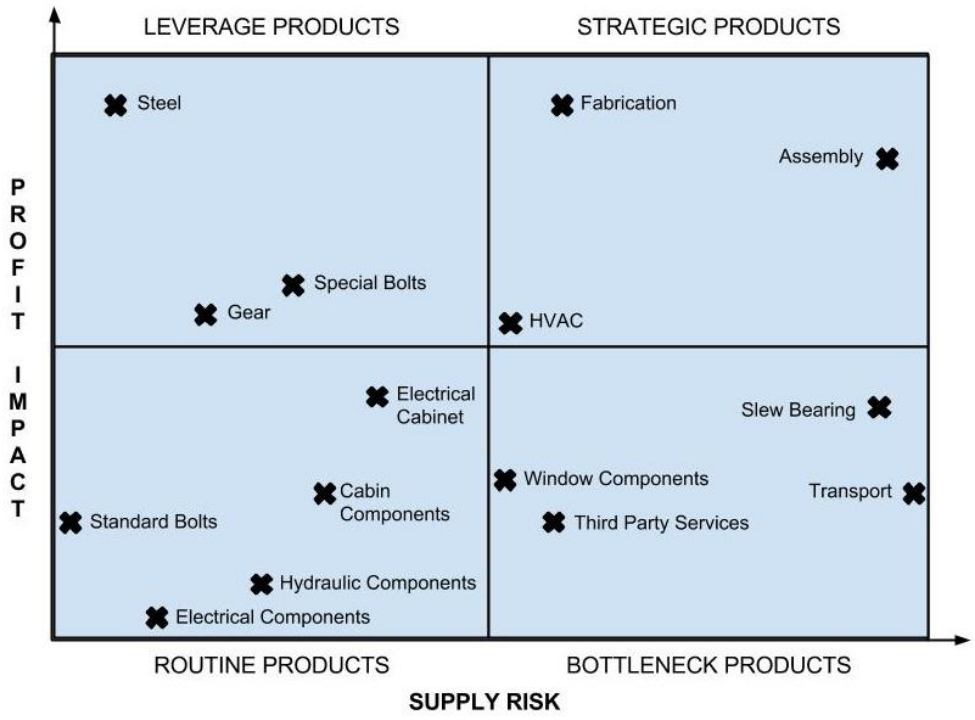

Figure 7: Products in an ETO Production Strategy implemented in Kraljic's Portfolio Matrix

Bottleneck Products

For NOV, the bottleneck products are products or services that has high supply risk, in such way that there are few, might only be one, supplier available. Thus, these products/services does not have the highest financial risk of the total project.

Slew Bearing: This component is one of the core components of an offshore crane. It is placed below the cranes cabin and machinery house, but on top of the pedestal. The slew bearing is designed at NOVM, and contains many hours of designing from the engineers. The slew bearing has various designs, so it differs in accordance to the different types of cranes that are produced for various customers. For NOVM, there are few available suppliers that have the ability to produce a customized slew bearing. As of today, NOVM has only two qualified suppliers for producing their designed slew bearing. This type of component is relatively expensive, in relation to the total cost of a project. Also, a slew bearing is constructed by steel, which has a long lead-time, making the production of a slew bearing a time consuming production. The production for the slew bearing for an ETO crane is completed by machinery, which is a time consuming process. Therefore the slew bearing is placed on the upper right side of the matrix, within the bottleneck product quadrant.

Window Components: As for components that belongs to the cabin of a crane, like windshield wipers and window cleaning systems, are also placed within the bottleneck products. These components are made on NOVM's designs, and are therefore not available from various suppliers. Window components for an offshore crane, has to be of great quality, since such components are a part of a crane which has to endure all kinds of weather that it is exposed to offshore. Since these components are designed by NOVM, a few available suppliers that have the ability to produce such sizes and quality are requested from NOVM. The window components are placed, within the matrix, on the left side, meaning that NOVM has some available suppliers for this type of components, but in the middle of the financial risk since it has not most financial risk of the total project.

Third Party Services: These services are available from more suppliers than the other components in the bottleneck quadrant, but still not a various selection of suppliers. Third party services bought by NOVM are services that provide verifications of designs and constructions of an offshore crane and its components. This service, usually bought from Det Norske Veritas (DNV), provides verifications on the designing stage of an

offshore crane, as well as verifications during production and assembly. These are necessary in order to obtain all requested documentation that is mandatory in order to produce and sell an offshore crane. The costs for these services are not in the highest part of the total costs of the project, but since there are limited of suppliers to these services, it is placed in the lower part of the bottleneck product quadrant in the matrix.

Transportation: NOVM purchases much transportation for their components, as well as for the completed crane when it is sent for delivery to their customers. As for transportation for cranes, NOVM purchases a lot of special transportation. For this type of transportation, there are limited suppliers that are able to transport an offshore crane. For the offshore crane transportation, the crane is transported in one piece, therefore this is a high-risk manner of doing transportation. Due to limited available suppliers, the costs are high for this type of service/component. As of today, NOVM has only two or three suppliers that are able to conduct this type of transportations. There are long ordering times for this type of transportation, so it has to be planned and ordered in the early state of the project. This is a support service, and therefore it is not placed within the strategic components quadrant of the matrix. Thus, it is placed just below the slew bearing, due to its high-risk of few available suppliers, and relatively high upon the financial risk, since this type of services are expensive due to the power of the suppliers in this market. However, it is not a major expense in total to the project, and NOVM does not need a close collaboration with their suppliers in this market.

Strategic Products

NOVM´s strategic products contains components and services that have high suppliers risk, as well as a high financial risk of the end project.

Fabrication: Since NOVM has outsourced their production, this contains the physical fabrication of the crane and its components that are purchased from external suppliers. Fabrication is placed in the high top of the strategic product quadrant, since these types of service/component are high on the financial scale of the project. NOVM has few alternatives when it comes to suppliers that are qualified and authorized to conduct work for NOVM. Building components that belongs to an offshore crane is also a time

consuming process, resulting in long lead-times when producing an offshore crane. The total costs of producing an offshore crane are conducted from this type of purchasing.

Assembly: This type of component/service is placed more to the right in the strategic product quadrant. This cause the assembly part of an offshore crane is crucial to the total project. There are few suppliers available for this type of service. Thus, there are several suppliers that capable of welding steel, but due to welding-regulations and international standards, the available suppliers that are qualified of this type of production are reduced to only a few. There are three types of assembly: mechanical, hydraulic, and electro. These three categorizes are all working on different types of components that are assembled together for the offshore crane, and are purchased from NOVM. Due to its limited availability of suppliers, assembly is placed to the far left in the strategic product quadrant. To be able to assembly an offshore crane for NOVM, there are several standards and qualifications of the suppliers that has to be achieved, and it is therefore a time consuming process to educate and train suppliers so they are qualified for a such type of operation. NOVM has two assembly stations, located in Hjelset and Korea. Therefore, the assembly process is strategically set to the nearest station in regards to where the end customer is placed.

HVAC: The ventilation systems that are produced to the cabin are specially designed from the engineers at NOVM. Customers of NOVM has various specifications and standards of what are expected to be in the Heat Ventilation and Air Conditioning (HVAC) system, therefore the designs will vary from each crane that are produced. This type of component is placed in the bottom left side of the strategic product quadrant, since there are more than a few available suppliers, thus has not a high percentage of the costs of the project. However, it is a strategic product due to its customized appearance, and has high importance for NOVM customers.

Routine Products

For NOVM, the routine products are often referred to as the “milk and bread” components, which have no significant impact on the total cost for the project, which can be purchased from, usually, several suppliers.

Standard Bolts: There are several types and dimensions for bolts that are used for an offshore crane. Therefore, standard bolts are placed on the left side of the routine product quadrant, due to its availability of suppliers that are capable to produce such types of bolts. However, there are certifications requirements on such types of bolts, therefore not all suppliers available are qualified for producing bolts that are used. In regards of the purchasing costs of these standard bolts, it is not significant compared to the total cost of producing an offshore crane.

Electrical Cabinet: To produce an electrical cabinet for NOVM are not a complicated process, since NOVM designs and provides the wiring diagram for their suppliers. Therefore, electrical cabinet is placed within the routine products quadrant. There are various suppliers available for conducting this process. Thus, the costs of these products are slightly compared to the total cost of the project, but again greater than costs of the standard bolts.

Hydraulic Components: There are several suppliers available for NOVM when purchasing hydraulic components, like hoses and valves. The total cost spent on hydraulic compared to the total cost on an offshore crane project, is minor. Therefore hydraulic components are placed at the lower mid-side of the routine projects quadrant.

Electrical Components: These components are described by NOVM as standard components, which are available from various suppliers. Due to its availability, the costs are low on these components. One of NOVM new developed ETO crane is now produced all electric, giving them advantage in their positioning when purchasing electrical components, due to purchasing high volume.

Cabin Components: NOVM purchases several components that are to be placed within the cranes cabin, like windows and pilot seats. The market for pilot seats is narrow, and there are few available suppliers for such a component. However, there are several other components that are placed within the cabin, which leads to the placement of cabin

components in the routine product quadrant. In total, the costs for cabin components are minor compared to other components, and there are suppliers available for NOVM.

Leverage Products

NOVM leverage products are components that have significant impact on the total cost of a project, but have several of suppliers available.

Special Bolts: NOVM purchases packages of bolts from their suppliers. Thus, for special parts on an offshore crane, there is need for customized bolts designed by NOVM. By purchasing special bolts in packages, NOVM are able to negotiate on deals, placing this component in the lower right side of the leverage product quadrant.

Steel: Steel is one of the core components for an offshore crane, and NOVM uses a major quantity of tons to be able to produce a crane. There are several suppliers worldwide that provide and casts steel, therefore NOVM are able to purchase in large volume. Thus, it depends on the contract if there is NOVM or the suppliers that are responsible for purchasing the steel. Steel is expensive, and due to NOVM high volume needs, steel is placed in the upper left corner quadrant.

Gear: The market for purchasing gear is fairly wide, but some of the gears that are used in an offshore crane are customized and designed by NOVM. Therefore gears are placed in the middle within the strategic product quadrant. Costs of purchasing gears are not major, compared to the total cost of the project.

4.8.2 MTO Kraljic Portfolio Matrix

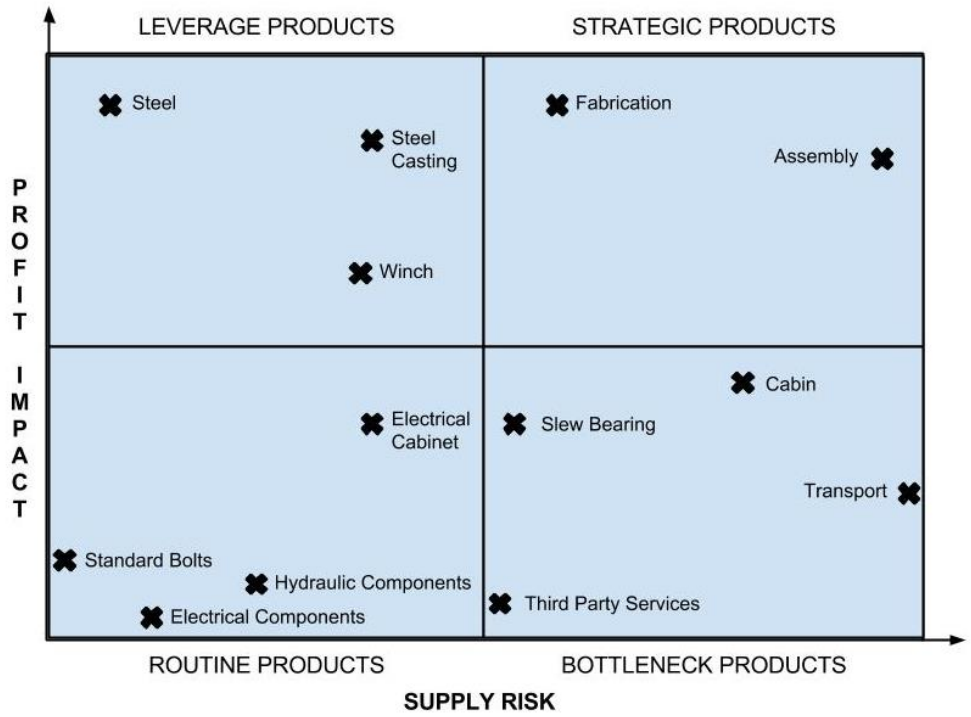

Figure 8: Products in a MTO Production Strategy implemented in Kraljic's Portfolio Matrix

Bottleneck Products

Slew Bearing: For the new MTO crane, the slew bearing will be more standardized. The production will no longer be conducted by machinery, but the slew bearing will now be casted. Since the MTO crane will have limited options, the slew bearing will be standardized after what size of crane the customer purchases. Therefore, the slew bearing will shift in the bottleneck product quadrant, now being more on the left-hand side. The costs of steel and production will continue to be the same, but there will be more available suppliers that will be capable for this type of production.

Cabin: For the standardized crane, NOVM will now purchase the cabin as a total product. Window components, HVAC, and cabin components will now be merged into the product "cabin". It will be expensive to purchase a cabin, and the contents will be complicated. NOVM will outsource this production to an external supplier, which has a close cooperation with NOVM. There are more suppliers that are capable of producing a cabin, but due to NOVM close relationship with an external supplier, and their cooperation on

the design of the cabin, NOVM will now select this supplier. In the bottleneck products quadrant, cabin will be placed in the upper right side, meaning that there is a significant cost of this type of component.

Third Party Services: NOVM urges to implement a new type of approval for third party services on their standardized offshore crane. Implementing a "one-time" approval for the designs and products, means that DNV, or other third party services, will have to approve the designs only one time for one crane so that the designs can be reused when producing the next crane of same standard. This will reduce costs spent on third party services, giving third party services a shift in the bottleneck product quadrant more to the left.

Transportation: The transportation for the new standardized offshore cranes will remain as the previous ETO crane. Thus, there are still few suppliers that have the ability to transport a crane at one piece. However, for some of the standardized crane options, the transportation will be conducted in containers. Thus, in the bottleneck product quadrant, transportation will remain at the same place for the standardized crane.

Strategic Components

The strategic components will remain the same in the standardized crane, as in the previous ETO crane. *Fabrication* and *Assembly* will contain the same purchase assignments, and the suppliers and costs will remain at the same level. *HVAC* is now merged into the *cabin*, which is positioned in the bottleneck product quadrant.

Routine Products

For the routine products in the new standardized crane, these will remain at the same place in the quadrant as for the ETO crane. The only difference is that *cabin components* will be cleared from routine products, since these components is now included in the *cabin*.

Leverage Products

As displayed in figure 8, *steel* will continue to be placed in the upper left side of the quadrant, since steel still are various suppliers available. NOVM will still need to purchase a high volume of steel, which will remain the high costs purchasing of steel requires.

Steel Casting: For the standardized crane, NOVM will design components and modules that will be used for steel casting. The modules that will be designed are owned by NOVM, which means that NOVM can use these modules at several suppliers. Steel casting is positioned at the upper right side in the leverage product quadrant, since steels and steel casting process is expensive. Even though different suppliers can use the modules, there are not as many steel foundries available.

Winch: A new component for the standardized crane will be the winches. NOVM are planning to produce more standardized winches, which will be designed in-house. This means that NOVM will provide design details, like the weight the winch needs to be able to deduct, and the quality of the winch (how much the winch can withstand). NOVM anticipate that winches will be at greater costs, even though there are several suppliers that have the ability to produce winches. Therefore, winch is positioning in the right hand side of the quadrant.

4.9 Reflection of Findings and Analysis

Purchasing of components is commences after an order becomes a project, where the technical division at NOVM has set the technical specifications and a list of components. When an order becomes a project, the needed resources within a project, the documentation and planning is done. The purchasers are purchasing some of the components in parallel with the engineering process.

One of the findings in this study is the proposed purchasing model in an ETO-project. On the basis of the developed purchasing model in ETO-project, the first phase is selecting suppliers within the established project, due to the technical specifications of the components and the customer requirements. The major findings within the purchasing

model, and a difference between the purchasing model in an ETO-project compared to the general purchasing model, is that follow-up and the maintenance of control within the project and the project progress are important within each of the sequences in the entire purchasing model. There are several specifications and requirements that need to be followed up and verified before the customer receive the end-product. Another difference is that the purchasers are responsible for purchasing transportation and other operations, like assembly, fabrication and third-party services.

The proposed purchasing model in a MTO-project has some of the same characteristics as an ETO purchasing model, and could be useful for NOVM, when defining their purchasing model for the new standardized offshore crane. The findings from the analysis indicate that there are few major differences between the performance of purchasing in an ETO project and a MTO project. There will be a less need for follow-up and maintenance of control, but since there is some components, which is difficult to standardize, the ease of purchasing some components are not enhanced.

Uncertainty due to the variety of products and demand are a factor that emerged from both the theoretical framework and the data collection of NOVM as crucial within an ETO production strategy. The flexibility of the suppliers within ETO and MTO production strategies is as expected from the theoretical framework, where the analysis are supporting the theoretical findings here.

Comparing the components in a MTO-project to the components within the present production strategy, some of the components will be merged together into one component. The idea of this is to have fewer components to purchase.

For NOVM, the amount of qualified and approved suppliers is limited for the major components. As mentioned for steel, several suppliers are able to produce steel. However, suppliers that are qualified for machinery and casting steel are limited. This due to strict documentation and quality measures set by third-parties, particularly aimed for the offshore market. For the slew bearing, NOVM has one to two approved suppliers, which make this product a critical product. The slew bearing can take as long as a year to

be completed. NOVM has defined some long-lead items, which has to be purchased in the beginning of the project, due to its long lead-time. NOVM are often purchasing slots for steel machinery even though the production of steel components does not have a set design when it is purchased. Therefore, it is important to forecast when and how much steel, is set for production.

NOVM are dependent on having a balanced buyer-supplier relationship within the suppliers serving the strategic components. The expectations before the data collection on the basis of the literature were an easier supplier development within the MTO production strategy for NOVM, compared to the ETO production strategy. It emerged from the data collection that NOVM intends to use their existing suppliers, although they are accustomed to produce customized products. In addition, NOVM want to have pre-defined suppliers for the various component, when implementing the MTO production strategy.

	Prediction of findings		Findings	
	ETO	**MTO**	**ETO**	**MTO**
Purchasing and Purchasing Model	Complicated to forecast what to purchase Requests detailed technical specifications	Easier to purchase products Less follow up during the stages in the model Less detailed technical specifications	Complicated to forecast what to purchase Requires follow up during purchasing Requires detailed technical specifications	Easier to purchase some products, but some products are complicated to purchase Requires detailed technical specifications
Flexibility	High level of external and internal flexibility	Reduced internal flexibility	High level of external and internal flexibility	Reduced internal flexibility
Products in KPM	Several strategic and bottleneck products	More leverage and routine products More standardized products	Few strategic products	Few changes within the quadrants Some standardized products
Suppliers	Few suppliers available Difficult to find new suppliers High degree of supplier development	More suppliers available Easier to find new suppliers Low level of supplier development	More suppliers available than expected Each supplier are producing only one component, due to nondisclosure Lower level of supplier development than expected	Few suppliers available Difficult to find new suppliers Using the same suppliers as in ETO Low level of supplier development

Table 3: Actual Findings compared to Predicted Findings

The data collected during the research are presented together with the expected findings in table 3. During the analysis of the data collection, it revealed that some of the predicted findings do not reflect the actual findings. As an example, the difference

between purchasing within an ETO production strategy compared to a MTO production strategy, is not as major as first expected. Another example is that there are less changes of the position of the products within KPM than anticipated. There are still few suppliers within the MTO production strategy, and there are more suppliers available for purchasing in ETO than the authors had forecasted on the basis of the theoretical framework.

Furthermore, it turns out that the customers are demanding customized offshore cranes with the price of the new standardized offshore crane, and NOVM has not sold their first standardized offshore crane.

5. DISCUSSION

NOVM is recognized for their high-quality and innovative offshore cranes, which are produced by an ETO production strategy. However, the current oil and gas market has undergone extensive changes during the past years, which has led NOVM to readjust and respond to changes in the market by implementing a MTO approach to their present production strategy in order to produce more cost-effective offshore cranes. The discussion sheds light on how a change in production strategy will affect the purchasing process for NOVM, with support from the theoretical framework and the data collected in the field.

NOVM's present production of an ETO offshore crane commences after reception of a customer order. Such order contains specifications and requirements determined by the customer, and is the basis of NOVM's production and design of an offshore crane. As the design and production stages are in parallel, purchasing of components in an ETO production strategy is challenging. Based on the theoretical framework, it was predicted that it is complicated to forecast what to purchase within an ETO context, as products is unique and one-of-a-kind within such a context. Contrary, purchasing in a MTO production strategy was predicted to be an easier process, as the components will become standardized with pre-defined design. Findings of purchasing in an ETO production strategy proved to be correct, as the respondents verified that there is challenging to pursue purchasing, as design and production is in parallel. Further, parties involved in an ETO production has only assumptions of how an offshore crane will appear when the production commences, not the finished design of the product, which complicates purchasing. In a MTO context, it emerged from the data collection that it will be challenging to standardize all components for an offshore crane within a MTO context. As one respondent indicated, requirements of certifications and standards set by NORSOK, ABS and API, makes standardization of strategic components almost impossible. Previously described, there are limitations of standardization in relation to the temperature when testing and designing steel, were the temperature differs due to set requirements. Such requirements will remain in both the ETO and MTO production

strategies. However, it was verified that it would become easier to purchase general components for an offshore crane produced by the MTO approach. As designs of the offshore crane are pre-defined, a list of components that belongs to the specific offshore crane will be available for the purchasers, making purchasing easier.

Based on the findings, the difference between purchasing within an ETO and MTO production strategy implies minor amendments. Even though components will become standardized, it will not significant ease purchasing. The authors questions how NOVM should handle the challenges in relation certification of products, and offshore regulations set by NORSOK, ABS and API, as these challenges will occur regardless of the production strategy. To implement a MTO production strategy does not eliminate these challenges, nevertheless they will be included when purchasing components for an offshore crane regardless of production strategy.

In the theoretical framework, it is presented a general purchasing model that is not specified for either an ETO or a MTO production strategy. The general purchasing model indicates that follow up arises at the end of the stages in the model. However, in an ETO context the needs for follow up is crucial since design is in parallel with production and varies for each offshore crane as of its uniqueness. Therefore, follow up is performed in several stages of the purchasing model. Follow up in relation to a MTO production strategy will still be required throughout the purchasing model, thus with reduced necessities for follow up compared to an ETO production strategy. In contrary, a MTO production strategy contains pre-defined designs and components for purchase. The purchasers have greater degree of prior knowledge of what to purchase, and the quantity of components are pre-defined.

In addition, the theoretical framework in regards to the purchasing model focuses on contract agreement and selection of suppliers, to ensure the ability to negotiate over prices. Since NOVM produces customized offshore cranes in an ETO production strategy, they have limited opportunities to negotiate over prices due to fewer suppliers available, and lower volume of components purchased. However, a MTO production strategy aims

to reduce costs by purchase higher volumes of components, as to have a possibility to negotiate over prices.

The purchase model appears to be nearly equal for an ETO and MTO production strategy. However, the conduction of activities in the purchase model is less time consuming in a MTO context, as components are standardized and the engineering processes are eliminated due to pre-defined designs.

There is high uncertainty in relation to purchasing in an ETO context, due to the lack of knowledge of the end-product and uncertainty of the demand. As the customers are able to require changes and add specifications for the end-product throughout the projects life-cycle in an ETO production strategy, the purchasers faces challenges in relation to their ability to reply on changes of specifications. Furthermore, the supplier's ability to respond to changes during production of an offshore crane is as important.

The prediction based on the theoretical framework, indicated that there would be a high degree of internal and external flexibility in context to an ETO production strategy. In contrary, a MTO production strategy were expected to contain a reduction of internal flexibility, which means that the suppliers reduces their ability to do changes in the production. These predictions were verified during the research of this study, and are proved to be true. NOVM has a greater degree of internal and external flexibility in an ETO context, compared to what they are able to achieve with a MTO production strategy. The internal flexibility are reduced with a MTO production strategy, due to a decrease of the suppliers opportunities and needs of being flexible in conjunction with changes of the specifications of the components, as the components is standardized. The authors are questioning if this reduction of internal flexibility is a great loss for NOVM, or if NOVM are not dependent on the internal flexibility when the products are standardized.

The products in an ETO and MTO production strategy is analyzed with use of KPM, to display potential differences in relation to the products to purchase. The assumptions were that NOVM had several strategic and bottleneck products in their present ETO production, while components included in the MTO matrix would be dominated by

leverage and routine products. However, as illustrated in figure 9, implementation of components in KPM displays that the assumptions was incorrect.

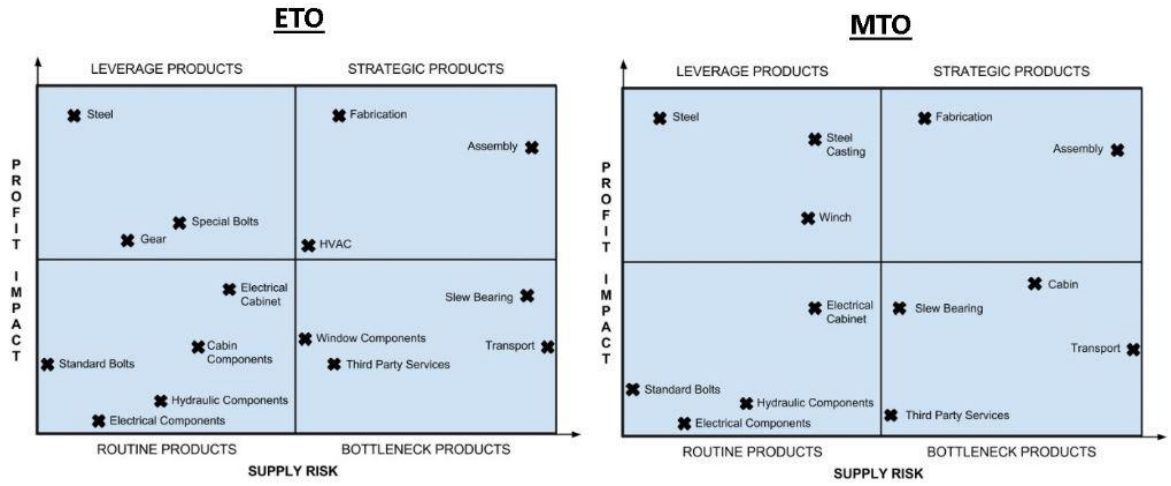

Figure 9: Comparison of ETO and MTO Products in Kraljic's Portfolio Matrix

As illustrated, some of the components are eliminated from the matrix, hence other components shifts positions when implementing a MTO production strategy.
This includes the components related to the cabin, where a change in production strategy causes HVAC, window components and cabin components to be merged into one component; "*cabin*". Such merging of components results in a simplification of purchasing, since there will be fewer individual components from different suppliers to purchase. None of the components shifts quadrants by moving from an ETO to a MTO production strategy, thus it reduces the categories of components as merging components arises.

The use of the KPM demostrates the occurred changes when implementing a MTO production strategy. Some of the other components will shift places within their quadrants. This is because of the financial impact of the components, as well as the availability of suppliers between the different production strategies

An example of a change in the matrix, is the position of third party services in a MTO production strategy. In relation to an ETO context, the third party services has a higher profit impact, and a higher supply risk than in a MTO production strategy. This change

correlates to the reduction to the necessity for follow up in the purchasing process, and is in connection to the nature of the characteristics of MTO. The design of the product is in a MTO context pre-defined, which leads to more repetitive productions for the suppliers.

From the theory presented in chapter 2, in context to KPM, may a shift between quadrants in the matrix assist to achieve a reduction of supplier dependency, lower purchasing costs, greater efficiency and competitive advantage through a strategic partnership. Based on KPM of components, it indicates that NOVM are less likely to achieve benefits in context to an ETO and MTO production strategy since there are few changes between the quadrants within the KPM.

The main finding from KPM is few shifts within the quadrants, when comparing ETO and MTO products. Further, some of the components are merged together, causes a simplification to purchase respective components. Another finding that occurred during the analysis, is the authors question the use of KPM in context to ETO and MTO. It has emerged during this research that the matrix are not adapted to fit all products in an ETO and MTO context. It arose that NOVM purchases operations, like fabrication, assembly, transportation, and third party services, in addition to components was not envisaged by the authors. Furthermore, the authors questions the implementation of these operations within KPM, and if it is possible to use this matrix to analyze ETO and MTO components. The operations were implemented in KPM by the authors, as it is a part of NOVM's purchasing.

For an ETO production strategy it was predicted, based on the theoretical framework presented in chapter 2, that NOVM would have few available suppliers, as an offshore crane is a unique one-of-a-kind product, it emerged that NOVM has more suppliers available than predicted. Further, there would be more suppliers available for a MTO production strategy, since it contains standardized components that are easier to produce among the suppliers. However, it appeared to be fewer suppliers available for a MTO production strategy than anticipated, verified by the respondents during the research. NOVM intends to use their existing suppliers, when implementing a MTO production strategy. Furthermore, predictions on the possibility to find new suppliers in a

MTO production strategy proved to be difficult, according to the predictions based on the theoretical framework. NOVM´s suppliers are not allowed to produce multiple components for an offshore crane within their ETO production strategy, as nondisclosure is essential for such products produced by NOVM. Such nondisclosure will remain for the MTO production strategy, and indicates that the process to expand the supplier portfolio will become challenging. In such way NOVM manages their suppliers, indicates that there is a lack of confidence related to the supplier relationship. It is questionable if NOVM could accomplish greater benefits of purchasing by improving their relationships with the suppliers of strategic and bottleneck components.

NOVM intends to use their existing supplier portfolio when changing production strategy from ETO to MTO. Furthermore, the overall control of purchasing will still be located at NOVM. Respondents verified that suppliers is not be able to pursue more purchasing for components, as NOVM wishes to obtain the overall control of purchasing within their organization.

By implementing a MTO production strategy, NOVM implies to provide a catalogue with two standardized offshore cranes, with a possibility of additional pre-defined options. A frequently repeated example during the interviews, the process of purchasing a car were presented an analogue for NOVM's intended catalogue. When a customer decides to buy a new car, the customer is able to select a certain model and is further presented for a series of pre-defined options to choose between.

By offering their customers a selection of pre-defined options, a challenge for NOVM is to reduce the total number of provided options to avoid numerous of combinations. A catalogue that includes numerous of combination, could lead NOVM to lose their intended benefits by implementing a new production strategy.

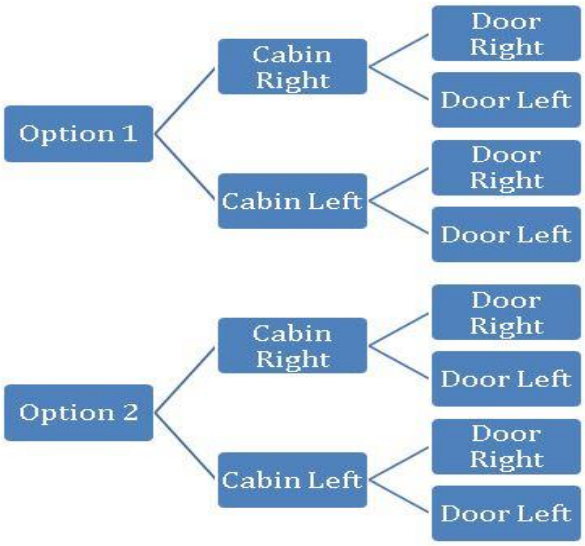

Figure 10: Options for a Cabin in a MTO Production Strategy

An example illustrated in figure 10, where the customer has the opportunity to select between two types of cabins. Each of the cabins includes the option of whether to position the cabin on the right- or left side of the offshore crane, and further to position the cabin-door on either right- or left side of the cabin, results in eight possible combinations. In addition, the customer can select various options like color, if the crane should be powered by diesel, hydraulic, or electronic, which leads to a numerous options available for each offshore crane. Therefore, an offshore crane with pre-defined options can end up with a huge number of combinations. In relation to purchasing, this will entangle the ability to purchase greater volume of components. It will also lead to greater uncertainty, as NOVM will offer several combinations of an offshore crane to their customers, which will make it difficult to forecast intended sales and volume of components to purchase for stock.

If the provided number of options are major, NOVM will suffer reductions in lead-time, furthermore a reduction of cost savings. Therefore, the authors are questioning if such a solution can be performed in practice, in order to maintain the intended benefits of changing to a MTO production strategy.

During the research, it arose questions of why a change of production strategy is the best solution for NOVM to readjust to the current market situation, as there are some limitations to how a MTO production strategy should work in practice for NOVM.
In the current oil and gas market, the customers are demanding a customized offshore crane with prices of a standardized offshore crane. With implementation of a MTO production strategy, NOVM provides their customers a standardized offshore crane, which intends to reduce costs and lead-times. It emerged from the respondents, that lead-time were not the main desire when demanding standardized solution, rather a cost effective solution. Since current customer's desires for customized solutions, it arises a question if the present ETO production strategy should be enhanced, instead of changing the overall production strategy?

Furthermore, it emerged from the interviews that NOVM intends to produce both a customized and standardized offshore crane as parallel activities. The respondent's opinions on whether NOVM should transform into a pure MTO organization, or continue as an ETO organization that also provides MTO offshore cranes, were twofold. Based on the interviews, some of the respondents indicated that it could be necessary to separate the present purchasing department at NOVM, when implementing a standardized offshore crane, if NOVM are providing both ETO and MTO offshore crane. The authors questions such a separation, due to challenges related to costs, competence and administration of these departments. Such a separation can also influence the culture of the organization. Since the purchasing process in MTO, compared to ETO, not differs in a greater extent, is this separation necessary for NOVM, or is the separation of purchasing departments a differentiation of the two purchasing processes?

In context to these challenges of the implementation of a MTO production strategy, there is a lack of conviction for the authors if this is an optimal solution for NOVM. A modularization of components, and an implementation of these modularized components into the present ETO production strategy, is a suggested by the authors as an improvement, to achieve a cost effective solution that meet the customers demand. An implementation of modularized components will ease the purchasing process for

NOVM, in relation to a pre-defined design of critical components, together with the opportunity to customize the main components by the customer's specifications.

6. CONCLUSION

The oil and gas market has undergone major changes during the past years, and the market is now urging for more cost-efficient solutions for the offshore cranes. In order to respond to the market changes, NOVM has decided to implement a standardized offshore crane, in contrary to their present customized offshore crane. As of the changes in the market, the authors therefore desired to look further at how such changes may influence organization with outsourced production as NOVM, especially in relation to purchasing. This thesis aims to explore and conclude if a change in production strategy, in order to meet changes in the market, will have an impact on the purchasing process for NOVM.

In order to respond to the research question, relevant theoretical frameworks has contributed to a broader insight in relation to theory, and how NOVM as an organization operates. Furthermore, analytical tools, such as KPM and a general purchasing model has been applied to analyze and explore possible changes and affects.

Throughout this research, it has emerged from the data collection and analysis that there are ***limited effects*** on the purchasing process when changing from an ETO production strategy to a MTO production strategy for NOVM.

Customer's requirements will remain, which will maintain customer´s desires despite NOVM´s change of production strategy. Obtained information from the interviews, shed light on Statoil, as one of the customer´s that has difficulties to readjust to the changes in the market. Even though Statoil desires of a more cost-efficient offshore crane, they still desire customized solutions.

The contribution for NOVM from this study is a suggested purchasing model to be used when implementing the MTO production strategy. The empirical contributions are the ETO purchasing model and purchasing within an ETO production strategy and the finding of the difficulty of using Kraljic´s Portfolio Matrix concerning the classification of customized products.

7. LIMITATIONS AND FURTHER RESEARCH

During the research for this thesis, it has been discovered areas that need further attention for research, as well as areas that need research due to its gap in the literature. The aim of this chapter is to display limitations of the research, and propose further research on suggested areas.

7.1 Limitations

A limitation of this study is the lack of theory and previous research of the purchasing process for organizations with an ETO production strategy. Nevertheless, there are limited research available of an organization that changes production strategy, from ETO to MTO.

In addition, the authors of this thesis were given restrictions of not to use a similar organization with a similar case, as a benchmark firm due to confidentiality. If the authors would have used a benchmarking firm, there would not have been possible to retrieve in-depth data from the case study organization NOVM, due to nondisclosure. This case study is also difficult to generalize, due to the nature of this study, which is an exploratory, single-case study.

At present time, NOVM has not sold any offshore cranes based on the MTO production strategy. Due to the ongoing implementation of a MTO production strategy for NOVM, some of the data obtained in this study bases on predictions and assumptions of how this will affect the organization when the new production strategy is fully implemented. Further, how NOVM will manage the new production strategy in practice is not yet defined.

Further, there has not been acquired data based on NOVMs suppliers' point of view, to be able to explain how suppliers reacts to an implementation of a MTO production

strategy. Hence, if the suppliers could have an impact on NOVMs purchasing process. This is not conducted due to limitations of time, geographical restrictions and costs.

7.2 Further Research

Some of the suggestions of further research are developed based on the limitations of and issues that was discovered when conducting this study.

Based on the shortcomings in the literature, there should be completed further research of organizations that is changing production strategy from ETO to MTO. Another suggestion is how a change in production strategy could influence the suppliers within an outsourced production, and the supplier's ability to change from producing customized products to standardized products. Also, the cultural and geographical issues in a buyer-supplier relationship with outsourced production could be researched.

Kraljic´s portfolio matrix should be further investigated further developed, to improve the adaption of strategies that contains customized products.

Today's change in the oil and gas market, as mentioned in the introduction of this thesis, is a fresh topic to do further research into, and see how this change will impact the future in this market. The research should further investigate how the suppliers could be more effective in order to respond to market changes.

The aim of this study was not to generalize the findings. However, similar case studies within the same problems should be conducted to support the findings from this study.

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9. APPENDICES

9.1 Interview Guide: Purchasing Manager for Fabrication Purchasing

General Questions

1. What position/role do you have in NOVM?
2. How long have you worked for NOVM?

Components in an ETO Offshore Crane

1. How would you categorize the different components for an ETO offshore crane?
2. Which suppliers are used for the different components?
3. Do NOVM have several suppliers for the different categories for an ETO offshore crane? – Where are these located?
4. How long lead-time has the different categories of components?
5. Which purchasing department is responsible for purchase of the different groups of components? – Can NOVK purchase some of the components?

Purchasing Process in ETO

1. When does the process of producing an ETO offshore crane for NOVM?
2. How is the purchasing process for an ETO offshore crane, based on your knowledge and experience?
3. When an offshore crane is completed, do NOVM conduct an acceptance test?
4. Does NOVM have a supplier-rating list? – Is the list available for the suppliers?

Components in a MTO Offshore Crane

1. How would you categorize the different components for a MTO offshore crane?
2. Will NOVM use the same suppliers from the ETO production, or will there be new suppliers for different categories of components?
3. Will there be any reductions in lead-time for different categories of components?
4. Will NOVK be able to purchase more components in a MTO production?

Purchasing Process in MTO

1. What role do you think you will have in a MTO project?
2. How do you think the purchasing process will be for a MTO offshore crane?
3. What are the challenges when conducting a MTO project?

General MTO

1. Do you think it will become easier for NOVM to select suppliers for a MTO project? – Why/Why not?
2. Do you think NOVM will provide a catalogue with pre-defined options for a MTO offshore crane?

Comparison and NOVM's Future

1. Would it be necessary to establish separate purchasing departments for MTO/ETO offshore cranes?
2. What do you think will become the main difference, in regards to the purchasing process, comparing ETO and MTO?
3. What do you think about NOV Molde's future? How will the future situation of MTO and ETO cranes be?

9.2 Interview Guide: Senior Purchaser and Advisor

1. General Questions

1.1 What position/role/title do you have at NOV Molde?

1.2 What type of work implies in your position?

1.3 What does component/fabrication purchasing constitute?

2. ETO Offshore Crane

2.1 When NOV Molde are selling an ETO crane to a customer, where and when are you entering the process/project?

2.2 What types of tasks do you have in an ETO project?

2.3 What kind of challenges do you have regarding your tasks as a purchaser in an ETO project?

2.4 What stages do you perform in the purchasing process for an ETO crane?

2.5 What do you mean are the most critical part of the purchasing process?

2.3. Products/Components

2.3.1 What types of components are most critical?

2.3.2 What types of components are the least critical?

2.4. Suppliers

2.4.1 How flexible are your suppliers? How do they react to changes in the project?

2.4.2 Does NOV Molde outsource parts of the purchasing process to their suppliers for the ETO offshore crane?

3. MTO Offshore Crane

3.1 How do you think the purchasing process will be for the MTO crane?

3.2 What kind of tasks do you think you will have on the MTO crane, comparing to your present tasks on an ETO crane?

3.3 Where in the purchasing process do you think there will be changes by offer MTO cranes? What changes in the procedures of purchasing?

3.4 How will an implementation of MTO cranes affect the workload of purchasing?

3.5 What do you think will be the biggest differences in the purchasing process for a MTO crane, compared to the ETO crane?

3.1 Products/Components

3.1.1 How do you think there will be to purchase components to the MTO crane, comparing to the ETO crane? Easier? Faster?

3.1.2 What type of components will become most/less critical to purchase?

3.2 Suppliers

3.2.1 What about the suppliers, do you think there will be specific suppliers to specific components of the MTO crane?

3.2.2 Would NOV Molde be able to outsource parts of the purchasing process on the MTO crane?

4. Customers & Market

4.1 What do you mean are the advantages of implementing a MTO production strategy?

4.2 What do you mean are the disadvantages of implementing a MTO production strategy?

4.3 What kind of challenges will a MTO crane create for the purchasing department?

4.4 Would it be necessary to establish an own purchasing department for the MTO cranes?

4.5 What do you think about NOV Molde's future? How will the future situation of MTO and ETO cranes be?

Most relevant additional questions:

- Have NOVM decided on the amount of options a customer can choose between for a MTO offshore crane? Additionally, what are the challenges by narrow the options?
- Do you think NOVM will achieve a better market share with the MTO offshore crane? Moreover, will this increase the competition within the market?
- Do you think that NOVM have an advantage, due to present reputation in regards of their production of an ETO offshore crane?
- What about your customers, will they be able to readjust from a customized crane to a standardized crane?
- Do the market demand shorter lead-time for an offshore crane?