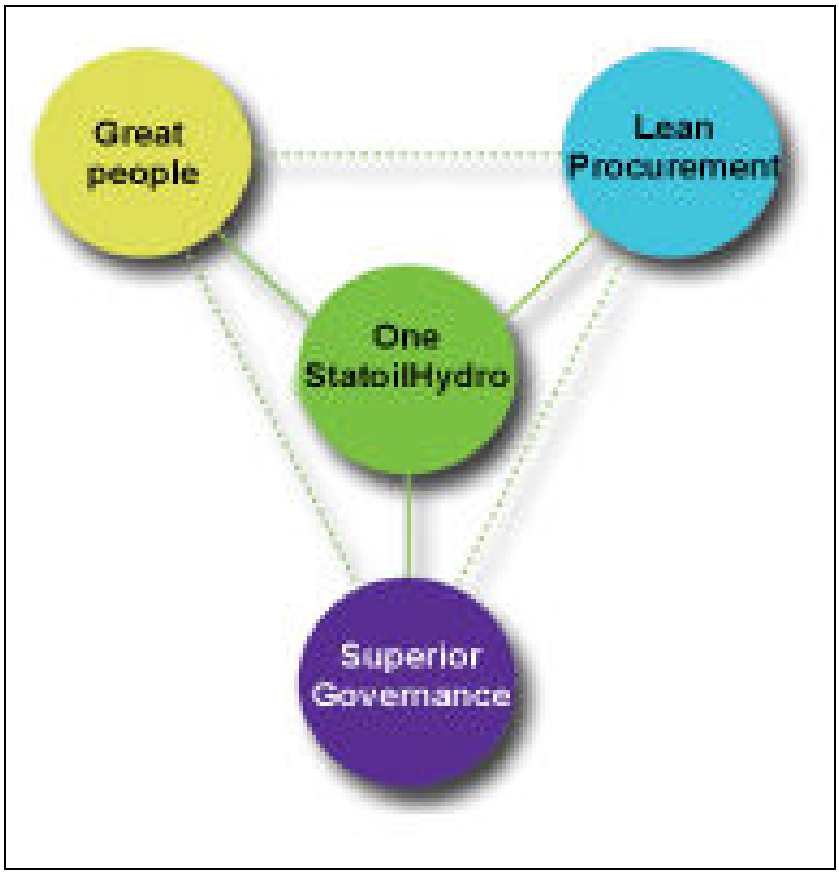
Mapping the inbound logistics of the refineries & terminals (plants) onshore at StatoilHydro, identify main problems and issues and suggest quick wins and possible solutions



Universitetet
i Stavanger

DET SAMFUNNSVITENSKAPELIGE FAKULTET,
NORSK HOTELLHØYSKOLE – INSTITUTT FOR ØKONOMI OG LEDELSE

MASTEROPPGAVE

STUDIUM:	OPPGAVEN ER SKREVET INNEN FØLGENDE FAGOMRÅDE:
Master i økonomi og administrasjon, foretaksledelse	**OPTIMERING AV VERDIKJEDER** ER OPPGAVEN KONFIDENSIELL? (**NB**! Bruk rødt skjema ved konfidensiell oppgave)

TITTEL:

Mapping the inbound logistics of the refineries & terminals (plants) onshore at StatoilHydro, identify main problems and issues and suggest quick wins and possible solutions.

ENGELSK TITTEL:

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OPPGAVEN ER LEVERT I TRE – 4 – INNBUNDNE EKSEMPLARER

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Executive Summary

The aim of this paper is to identify main problems and issues in the supply chain of the inbound logistics at StatoilHydro's onshore plants. The identification will be based on a mapping of the chain, where value added activity is in focus. The problems and issues will be evaluated and prioritized according to suggested quick wins and possible solutions will be identified. The recommended solution will be based on the elaborated theory of *muda* and the principle of lean thinking.

The research was conducted by the leads of Action research and resulted in a comprehensive mapping of the supply chain and the procurement process, with a definition of customer value, value stream, costs and risks. Through the analysis of the chain with the seven wastes of lean thinking as a reference point, several problems were defined. These problems had all in common that they were inhibiting flow of goods or information through the chain. As not all the wastes were just as easy to eliminate, they were categorized and prioritized due to: quick wins, which problems that contributed most to increase flow if they were eliminated and the problems that could not be eliminated because they are not in the hands of StatoilHydro.

By eliminating the different problems and issues derived, StatoilHydro may increase the reliability and efficiency of their supply chain. As these factors were the ones valued by the customer, an effort should be made to increase flow so the information and goods may move faster through the chain. The alternative solutions to how StatoilHydro may accomplish this have been evaluated in this paper. Through this evaluation, following recommendations were made due to their ability to add to customer value:

- Increase flow by organizing for focus on process rather than task, by appointing a responsible for the whole purchasing process, including arrangement for transport. Quick wins may be gained.

- Strive to better communication between the different steps in the chain

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1 Introduction

1.1 Background

After the merge of xStatoil and xHydro the 1st of October 2007, the purchasing and logistics department have gone through an excessive analysis to obtain the as-is situation of the different processes of this unit. These analyses have been undertaken by a project called Processes for the Future (PROFF), with the goal of reaching a better compliance between the xStatoil and xHydro processes. As a part of this project an examination of the inbound logistics at the onshore plants was needed.

1.2 Purpose

The purpose of this paper is to map the inbound logistics of the refineries & terminals (plants) onshore at StatoilHydro, identify main problems and issues and suggest quick wins and possible solutions. The elimination of *muda* by the principle of lean thinking and the effort of becoming a lean enterprise, will be applied in order to suggest how StatoilHydro may move closer to their goal of lean procurement.

1.3 Scope and Limitations

The scope of the paper is the Norwegian terminals and refineries. This means the terminals of Kollsnes, Kårstø, Sture, and Tjeldbergodden and the refinery and terminal at Mongstad and leaves out the terminal of Kalundborg in Denmark. Additionally, the above mentioned plants are defined as terminals and refineries on land. These plants are all subordinated to the department of *Manufacturing & Marketing (M&M)*. The last terminal onshore is the Hammerfest LNG plant in Northern Norway. However, this plant is defined as a natural gas (NG) plant, and is accordingly not under *M&M*. Additionally the mapping will be limited to the supply of goods required by the department of *Operation & Maintenance*.

Furthermore, the purpose of the paper stated that the mapping is limited to the inbound logistics at the plants. According to Peppard & Rowland (1996), the inbound logistics may be defined as "activities to receive, store and distribute inputs to the product, such as material handling, inventory control, warehousing, and contact with suppliers" (Peppard & Rowland, 1995, p. 10). The focus of the paper can be illustrated like this.

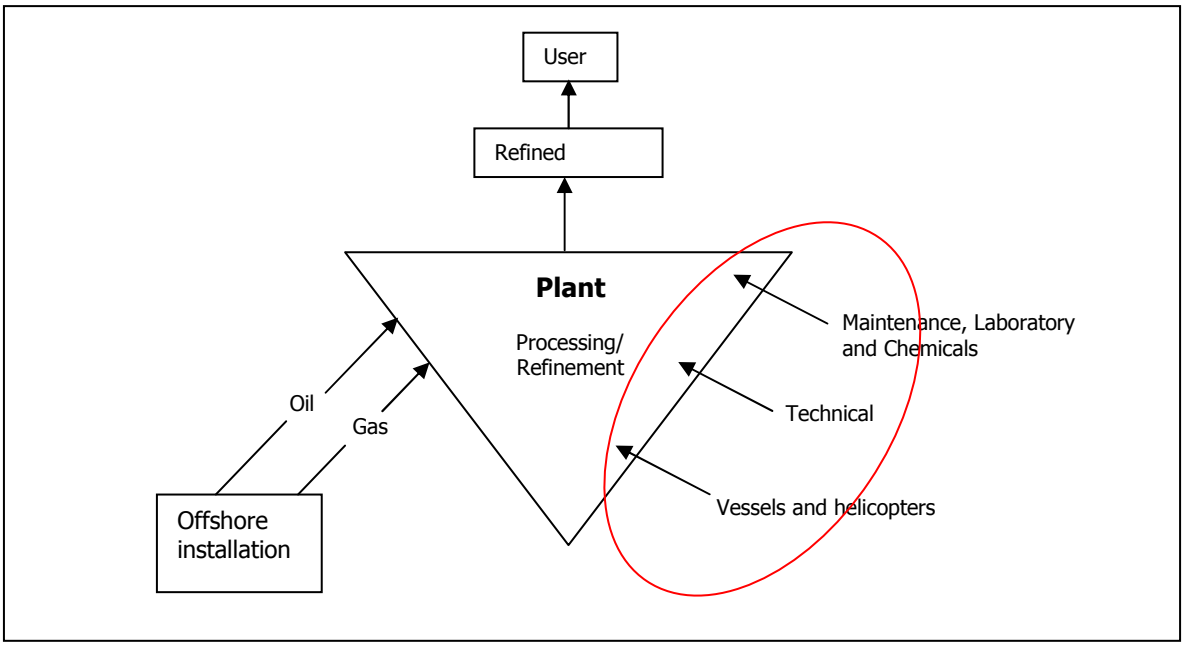


Figure 1.1: The process in focus.

1.4 Outline of the Paper

In the following, a summary of StatoilHydro, its business and history will be presented. Next, an introduction of the theories of lean thinking and business process re-engineering will be follow. These theories are the basis of the analysis and will be used in part three, to uncover any possible problems and issues. The second part will contain an overview of the research design, method and data gathering.

In the third part of the paper, you will find the analysis. This is based on *The Case Analysis Framework* (Taylor, 1999) shown in the following figure.

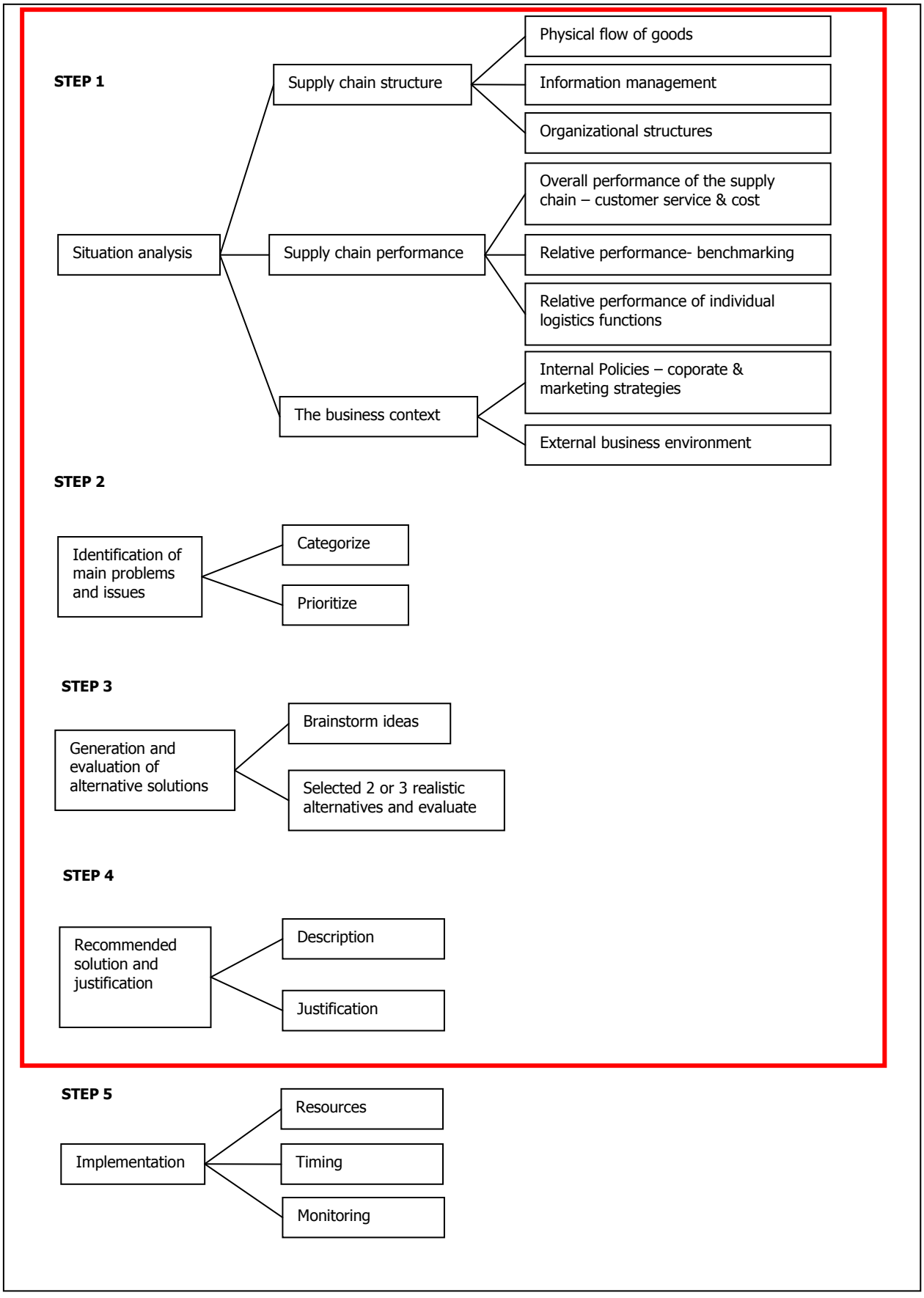


Figure 1.2: The Case Analysis Framework (Taylor, 1999)

The framework outlines a process of five steps that can be used to map a supply chain. The different steps consists of a situation analysis, identification of main issues and problems, a generation and evaluation of alternative solutions, a recommended solution and justification, and implementation. As a combination of the limitations of the thesis (see chapter *1.3 Scope,* p. 6) and the method used (see chapter *2 Method,* p. 21), the last step of the framework is not undertaken. The outline of the paper is therefore illustrated by the red frame in Figure 1.1.

To gather the information needed in each step of the framework, the method of Action research is used. The relation between Action research and the case analysis framework is that they both give the scientist great liberty in customizing the research process. As a process and a problem solving tool, Action research gives the scientist a possibility to let the research develop in different directions, dependent on what shows up along the way. By using the action research approach, the scientist can be a part of the process he or she studies because the goal is to improve the current situation. The case analysis framework and Action research also follow the same path through observing and identify issues, evaluating possible actions before implementing the change.

The framework of Taylor (1999) defines a structure around the purpose of the paper and gives directions on what needs to be explored in the different steps. Through the use of Action research, the information needed in each step can be gathered, through conversations with people close to, or in the situation, studied. This way of doing research gives great liberty in the sense that the scientist is not restricted by the boundaries of social sciences.

To serve the purpose of this paper, a specification of the framework follows on the next pages. Because the framework will serve as an underlying guideline, the outline of the paper will follow the same path.

After the method is presented in the next chapter the first part of the analysis, **the situation analysis,** is presented. The situation analysis serves the purpose of outlining an overview of the situation today. This part will say something about the supply chain structure, the supply chain performance and the business context.

The ***supply chain structure*** will show an overview of the chain, what parts are included and how information flows. Taylor (1999) mentions three aspects to evaluate in this step. The first is *the physical flow of goods.* The physical flow of goods means the different steps and stops the goods move through to get to the end user, all the way from the supplier. This part of the chain will be illustrated with the notification used by Grønland (2002) in his book *Logistikkledelse*. This is done to make the illustration more perspicuous. The second aspect is *information management,* which serves the purpose of finding out how information flows through the chain, if the information needed is communicated to the person that needs it, and if the right information is provided. In this part of the mapping, ordering systems is also a part to consider. Last, the *organizational structure* is mentioned. Naturally, the organization structure affects the efficiency of the chain (Ballé, 1995; Peppard & Rowland, 1995; Womack & Jones, 1996). The mapping therefore needs to contain an overview and description of how the organisation around the logistic function is structured.

The ***supply chain performance*** is the second part of the as-is analysis. In this part, the purpose is to uncover if the performance of the chain is measured. For the elimination of waste, measurements may be an efficient way of uncovering if any effort has been made to improve current processes. According to Taylor (1999), one should look at *overall performance of the supply chain.* This implies if the performance of the supply chain as a whole is measured. To be able to measure the performance, the wanted performance has to be defined, it be efficiency, cost saving, punctuality or maybe flexibility. Further, Taylor (1999) mentions *performance of the individual logistic functions.* In this case, the goal is to find out if the plants do any local measuring. Together, these measures sum up to the overall performance of the plants..

The third part of the situation analysis is the ***business context.*** To eliminate waste, the business context will play a role because in order to do so, it has to be something StatoilHydro has control over. Additionally, *internal policies, corporate and marketing strategies* influence the focus of the operating logistic units. To remove all activities that do not add value, it needs to be a part of the corporate plan. The *external business environment* is the factors outside the company that may influence the supply chain. This is also factors that StatoilHydro cannot or

has minimal control over, and may be a cause of waste that can be hard to eliminate. As a part of the analysis, these factors will be brought forward.

Next, the second step of the framework will be presented. The fourth chapter; **identification of issues and problems** covers the analysing of the overview from step 1. The analysis will evaluate the chain from the perspective of lean thinking and identify any of the seven wastes present in the supply chain. Based on these wastes, the issues and problems will be ***categorized*** by using an affinity diagram. Further, a cause-and-effect diagram will be presented, to clarify the relationships between the problems and the wastes they cause. In the end, the problems will be ***prioritized*** according to possible quick wins, based on what type of *muda* they represent.

The next part of the paper will present alternative solutions to the issues and problems revealed in step 2. These solutions will be based on the recommendations of lean thinking and how to banish waste that prevents flow. Taylor (1999) has called this third step in his framework; ***generation and evaluation of alternative solutions***, and suggests that two or three realistic alternatives should be selected.

Finally, chapter 6 will present a **recommended solution** based on the evaluation in chapter five. As the five principles of lean give directions on how to improve a value chain, the recommended solution will be based on these principles. Further, the solution will be ***justified*** by the analysis and a conclusion will be drawn up. This final chapter may serve as a starting point of **implementation**, the fifth and last step. However, implementation will not be handled in this paper. This is further explained in chapter *2.1 Research Design* (p. 21).

1.5 About StatoilHydro

In this chapter a brief presentation of StatoilHydro will be presented. As StatoilHydro is a merge between two companies, the chapter will first give an overview of how these two companies became StatoilHydro. As the research is confined to the onshore plants, the chapter will contribute to give insight in the business of the production facilities served by the purchasing and logistic department of *Operation & Maintenance*.

In 1972, Statoil was established by the Norwegian government to protect the country's petroleum resources. In the beginning, Statoil was completely owned by the Norwegian state and played an important part in regulating the development of the fields. Additionally, the state decided who could search where, and through Statoil the government secured that they had a 50 % share in all the awarded licences. About ten years before Statoil was founded, the American company Phillips Petroleum applied to the Norwegian government if they could search for oil in the North Sea. The government decided that if they should allow a search, several companies should be involved; they did not want to give one company exclusive rights. One year later, the government opened for search and 22 production licenses in 78 blocks were distributed ("Norsk oljehistorie på 5 minutter," 2008).

Around the same time, another Norwegian company decided that it was about time to get involved in the search for oil. Through the Petronord group, Hydro got a share of the first round of concessions in 1965. Even though many companies lost faith of finding oil and gas after a while, Hydro and Petronord continued to search. However, the doubt had got its hold on this group as well. They wondered if it was the right decision to go for gas when everyone was looking for oil. As a consequence Phillips and Petronord gave the other 20 % in each others blocks to better exploit the rigs that were used to search for oil and gas. In 1969 Phillips concluded that they had stuck oil. The field was called Ekofisk and showed to be the largest find of oil and gas in the North Sea. Hydro renegotiated the agreement with Phillips to a 2, 5 % ownership in Ekofisk with options of 6, 7 %("1969: Ekofisk serveres på juletallerken," 2007).

The merge of StatoilHydro was announced 18th of December 2006. The merge consisted of Statoil ASA and the petroleum business of Norsk Hydro (Hydro) and was a reality 1st of October 2007. Statoil and Hydro brought respectively 39 and 13 oil and gas fields in to the

merge. This also implied that the processes of the four onshore plants of Statoil (Mongstad, Tjeldbergodden, Kollsnes and Kårstø) and the one of Hydro (Sture) should act as one company ("Our History," 2008).

Today StatoilHydro is the largest operator in the world in waters deeper then 100 meters, one of the worlds largest supplier of gas and crude oil and a world leader in deepwater technology with 29 500 employees in 40 countries (as of 2007) ("StatoilHydro in brief," 2008). The largest shareholder in StatoilHydro is still the Norwegian Government with 67 %. This implies that the government covers its part of the expenses and is given dividend in return.

StatoilHydros' business consists of the extraction, processing and selling of crude oil and gas. Their clients are businesses that use the products in production or for resale. The processing takes place in refineries or terminals on land, where the oil and gas goes through different stages to make the final products. The refining of crude oil can very simplified, be compared to boiling water. As the water will vaporize when heated, the oil will separate when heated and the different fractions can be extracted (Leffler, 2000). The process is illustrated in the following figure.

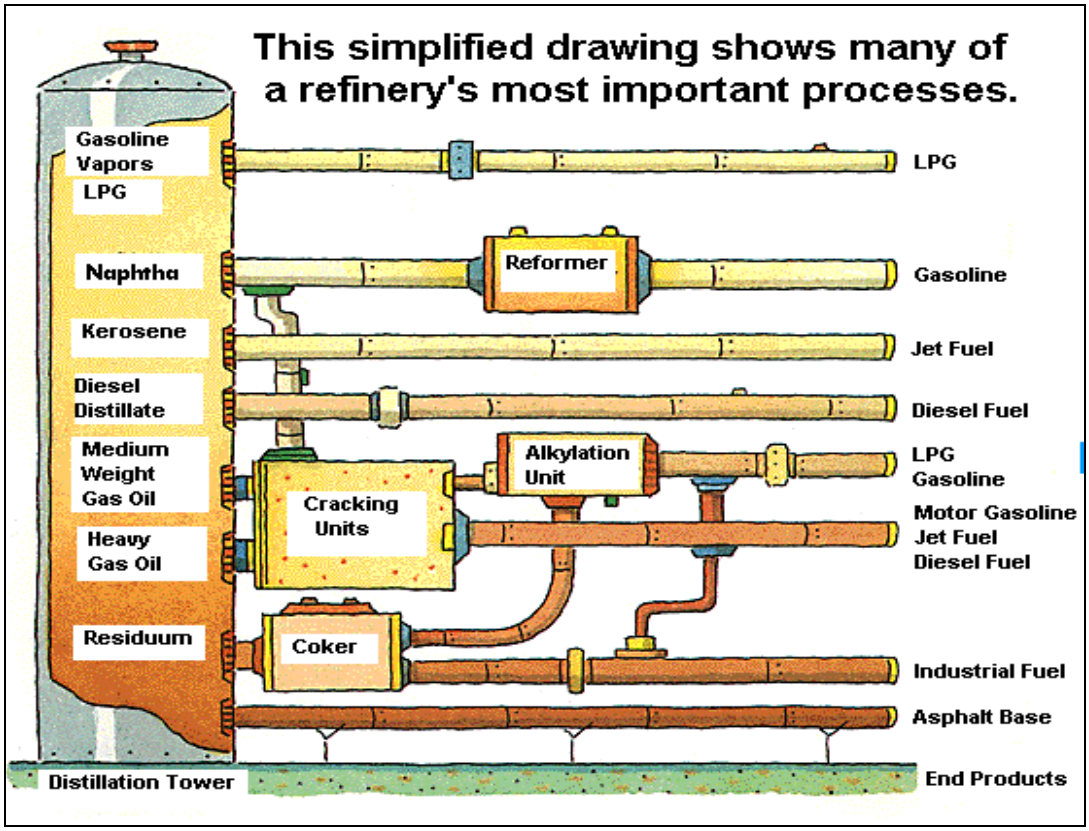


Figure 1.3: The Oil Refining Process

To make the final products like aviation petrol, gasoline and diesel different processes are used, like cracking and alkylation to give the product the quality that is wanted ("Petroleum (oil) - Refining," 2006).

Further, one can say that the processing of gas happens when the natural gas is cooled down and compressed. This causes some of the gases in the natural gas to liquefy. These are called Liquefied Petroleum Gases (LPG) and consists of among other gases butane, ethane and propane ("Propane - A Fossil Fuel," 2008). Additionally the natural gas contains a large part of Methane, which is used in the production of Methanol.

The refining on the different onshore plants included in this report, results in different end-products. Kollsnes is a gas plant and processes the gas that comes in from the fields Troll, Kvitebjørn and Visund. The plant extracts the Natural Gas Liquids (NGL) from the rich gas, and transports it to Mongstad for further refinement ("Kollsnes gas processing plant," n. d). Mongstad consists of a refinery and a crude oil terminal. At the crude oil terminal, the oil is stored for export, while the refinery produces among other products, petrol, petrol coke, diesel oil and jet fuel is produced ("Crude oil terminal," n. d). The terminal at Sture exports crude oil and condensate, and is the only xHydro plant. In addition to Naphtha and a blend of propane and butane (LPG mix), the plant processes fuel gas used for heat in the terminal process. At Tjeldbergodden, methane is produced from the natural gases. This terminal also works as a gas receiving plant, in addition of doing air separation and gas liquefaction ("Tjeldbergodden industrial complex," n. d). The last plant included in this paper is the Kårstø processing plant. This plant processes rich gas into butane, ethane, isobutene and naphtha and storage it for export ("Kårstø processing plant," n. d).

All the different plants at StatoilHydro, and all the operational processes they perform, create a huge need of spare parts, chemicals and consumables. These goods are bought from countless suppliers, before they are transported to the plant, where they are passed on to the person that needs it, or stored. All these processes are comprehensive and time consuming. When xStatoil and xHydro merged, two companies with two different organizational histories, environment and demands was being melted into one entity. This was also a challenge for the Procurement & Logistic (P&L) department. To reach the goal of becoming one unit, three main aspects are defined as the focus; great people, superior governance and lean procurement.

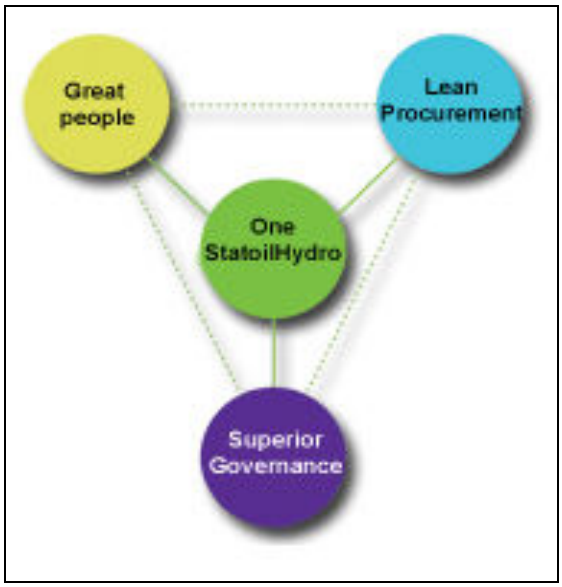


Figure 1.4: The Goals of Procurement & Logistics

As stated in the purpose of this paper, the paper looks into the latter, lean procurement through lean thinking.

This chapter has elaborated on StatoilHydro's history, from being two separate companies, extracting and refining oil and gas, to becoming one of the largest suppliers of crude oil and gas in the world. A short explanation of the process of refining oil and gas was given, and the five plants included in the research were presented. In the end, the goal of the procurement & logistic unit was presented.

1.6 Theory

The theory which the analysis is based on will be introduced in this chapter. The principles of lean thinking and Business Process Re-engineering (BPR) will be presented and tied together with the purpose of the paper, to show its relevance. However, the chapter will only give an account of what these theories say on a general basis. Throughout the paper, the more specific parts of the theories will be included to throw light on the research and its result.

The starting point of the paper is to give an overview of the current situation of the inbound logistics at the onshore plants. This process can be defined as a *supply chain*, which implies the movement of goods, from a supplier to a customer. The objective of a supply chain according to Govil and Proth (2002) is to improve the information and material flow between

the suppliers and their customers, with the highest speed and to the lowest cost. This implies that the supply chain ends when the company is paid. However, a supply chain is a part of a bigger chain, the *value chain* (Feller, Schunk, & Callarman, 2006). A value chain is more than a supply chain in the matter of what it includes and in this case; how it is analysed. While the supply chain ends when the company receives its money, the value chain continues until the final product is at the end user. In that way the value chain is not just about getting the goods from A to B fastest and cheapest, it focuses on the value each step of the chain is adding to the customers need (Feller et al., 2006). This is also one of the basic principles behind Lean thinking; to let the customer define value and pull the product through the chain (Womack & Jones, 1996).

As a way of becoming more lean, organizational change may be needed. As the principles of lean thinking imply the focus on flow in the organization, so does business process reengineering. These two theories are intertwined because a change in the organization is often needed to accomplish elimination of waste.

The principles of lean and business process re-engineering are based on the same focus, namely value-adding activity. BPR is described in many ways; as an improvement philosophy (Peppard & Rowland, 1995), a management hybrid (Ballé, 1995) and a project tool for radical improvement (Lund, Mygind, & Bennike, 1996). However, what all the definitions have in common is that they describe BPR as a way of redesigning the business to focus on process rather then tasks.

According to Willoch (1996), a focus on process equals focus on value-added. A company can be seen as a collection of different work processes. These processes serve one goal; to get a product out to the customer, which the customer is willing to pay for. According to BPR, this is done by reorganize the business from functional hierarchies, to processes view, where the business is seen as a series of operations (Peppard & Rowland, 1995). By focusing on production as a process, the company will be able to extract the part of the process which actually add value, and eliminate the parts that does not. Accordingly, BPR does not necessarily imply a company-wide change; it can well be incremental changes of small parts of the company at the time, improving flow and eliminating non value-adding activity (Ballé, 1995).

The focus on process and value-added is also the main principles of lean thinking. This way of structuring production emerged as an alternative to the assembly line production, pioneered by Henry Ford (Womack & Jones, 1996). While the assembly line could produce a large scale of equal products, the lean production opened for customized products. Taiichi Ohno and Toyota realised that instead of focusing on pushing the product to the customer, they should let the customer pull the product through the process. That way, the products value is defined by the customer. As BPR, lean focuses on the activities that add to customer value. To accomplish this, lean thinking brings forward the concept of *muda*. *Muda* is defined as any activity that does not add value to the customer. The term can be translated as waste, and the theory defines seven of them. The seven wastes are:

1. wastes of *overproduction* (to make or deliver too much),
2. waste of *waiting* (when time is not used effectively),
3. waste of *transporting* (when parts are moved between processes without adding value),
4. waste of *inappropriate processing* (for example using a central process over several lines),
5. waste of *unnecessary inventory* (this implies interrupted flow),
6. waste of *unnecessary motions* (for example moving of parts from one container to the other, or walking between processes), and
7. waste of *defects*

(Harrison & van Hoek, 2005)

In the same way as lean strive to reach a process only consisting of value-adding activity, BPR strive to obtain ideal processes, either by starting with a clan sheet or by reorganizing existing processes to minimize non value-added activity (Peppard & Rowland, 1995). By rearranging the organizational processes, decision-making may be delegated down the organizational structure to the workplace. As Ballé (1996) claims, a focus on work processes implies constructing teams to be responsible for a whole value-stream and completing of entire processes. This meets the terms of lean thinking. However, as a process will not become lean by itself, it needs to be developed (Gordon, n.d). A way of developing a lean process is therefore by using business process reengineering.

As mentioned in chapter *1.5 About StatoilHydro* (p. 15) the procurement & logistics department has a goal of pursuing lean procurement. The concept of lean procurement includes moving from "push" to "pull" supply chains, develop a flexible and responsive supply chain, and eliminate waste in the procurement cycle (Despress, Monahan, & Lukez, 2006). All these aspects are to be found in the theory of lean thinking, where Womack & Jones (1996) explain that the process of becoming a lean enterprise is by specifying value, find the value stream, make the value-adding steps flow and arrange for the customer to pull the product through the chain. As stated through this chapter, the definition of value should rest on the needs of the customer. Because it is only the customer who know what is to value for them and what they are willing to pay for, their needs have to be the basis of the chain. When the value is defined the company should analyse their chain to find the value stream. This implies identifying the actions that the product needs to go through to reach the customer. This is done to bring forward what activities that actually add value to the product, and what activities do not. It is in this phase the different types of *muda* becomes visible. When the value-adding steps are identified, the challenge is to make the value flow continuously, without any unnecessary abruptions or obstacles. The next principle in the lean process is to let the customer pull the product through the chain. According to Womack & Jones (1996), the time from supplier to end-user will fall dramatically ones the organization is structured to make value flow. As a consequence, the products may be delivered on demand. The supply chain also becomes more responsive, as it only brings forward products that are ordered for someone to have. By letting the customers pull the product they are satisfied by getting a product they actually want rather then a product that is offered to them with less value. The last aspect of lean should emerge naturally as a consequence of the principles mentioned above; perfection. As the business become leaner, the process is continuously evolving and improving. As a consequence, hidden *muda* is exposed and dealt with in order to make the chain perfect.

Because of the purpose of the paper and the goal of the procurement & logistic department the research will identify any hidden *muda* in the inbound logistic process at the onshore plants. This implies that the processes need to be evaluated with the purpose of uncovering non value-adding activity, which can be done by analysing the chain based on the seven wastes defined above.

However, not all the wastes are relevant for onshore plants' inbound logistics in its original form. The wastes are therefore modified and explained, to fit the purpose of the paper.

Even though the complete value chain contains a production step, the procurement & logistic function does not have control over the actual refining at the plant. The wastes of overproduction and inappropriate processing are therefore not relevant without modification, because they are not affected directly by the actions of P&L. If these wastes are seen from a procurement & logistic point of view, they may be translated into the waste of *purchasing wrong quanta* and *inappropriate ordering*. *Inappropriate ordering* implies that the problems identified impede the ordering-process from running smoothly.

The next waste of interest is *transporting*, when goods are moved between processes without adding value. This may be a problem because the chain involves many stops and steps before it is in the hand of the person requiring it, and need to be explored.

The waste of *waiting* is relevant because it delays delivery, causes frustration and money. An example of this type of waste could be if the goods are at the warehouse, but the requirer is not notified.

When it comes to the waste of *unnecessary inventory*, it has a more vague definition in this case. Because the inbound logistics is on the input side from the production facility, the inventory is seen as a security against break-downs and unforeseen incidents. In one way, the purpose of the inventory is therefore not to be as small as possible, but to contain the things needed, when needed. However, waste of unnecessary inventory may still be present, and it is included in the analysis.

Next, *unnecessary motion* is of interest. An example of this waste is if the goods are moved unnecessary five times, or when the same paperwork has to be done several times. This may cause the supply chain to be longer or slower than wanted.

The last waste, *defects*, is relevant in the sense that wrong or badly handled purchasing, may result in a defect supply chain which does not live up to the customers demand. Because of the purpose of this paper, defect may also imply warehouse management strategies not complying with the principle of lean. As the waste of defects is defined as production of

imperfect *products*, actions that result in a shortcoming *process* will in this case be a waste of defects.

In a value chain, there will also be a focus on cost and risk in addition to value-added. When it comes to strategic supply chain management, focus on these factors is important to gain long-term advantages. By placing the risk and cost where it is in the chain, a company is able to evaluate its volatility level and consider where or if to act (Harrison & van Hoek, 2005). As a consequence, the analysis needs to identify these factors and where they belong. By drawing parallels between the seven wastes, cost and risks, a cause-and-effect relationship may be revealed.

This chapter gave a short introduction of the theory-base of this paper. As BPR and lean walks hand in hand, a process-view is needed to be able to identify waste and maximize value-added activity. The seven wastes of lean thinking have also been presented, and will be a key feature through the rest of the paper. Additionally, the importance of placing cost and risk where it belongs is stated. However, before the present situation is mapped, the method will be specified.

2 Method

Generally, method is said to be the chosen approach to gather or test knowledge (Dalland, 2007). In this chapter the research design will be elaborated, together with the method of Action research. Next the data gathering, sample and interview guide is presented.

2.1 Research Design

The design of the research is a blueprint that serves as a guide for the collection and analysis of data in a research process (Churchill, 1995). The design is based on the purpose of the research, if it is exploratory, descriptive or causal. The exploratory research design serves the purpose of gathering *insights* and *ideas* about a phenomenon and is used when the scientist knows little or nothing about the object he or she wants to study. When using this design the researcher does not base the research on existing models or theories because there might not be any relevant existing knowledge about the phenomenon studied (Routio, 2007a). The descriptive design is concerned with seeking *knowledge* about a defined question. This implies to find out how things are or have been, by explaining or describing the situation or object studied (Routio, 2007b). By choosing causal design, the researcher wants to determine a *cause-and-effect relationship*.

Even though the research designs have different purposes, a research process often contains aspects from several of the designs. The relationship among the three is shown in the Figure 2.1. The illustration implies that the designs can be seen as steps in a continuous process where the research may go from exploratory, through descriptive, before it ends up with a causal design. The other way around, causal design may lead to an exploratory research, as can descriptive (Churchill, 1995).

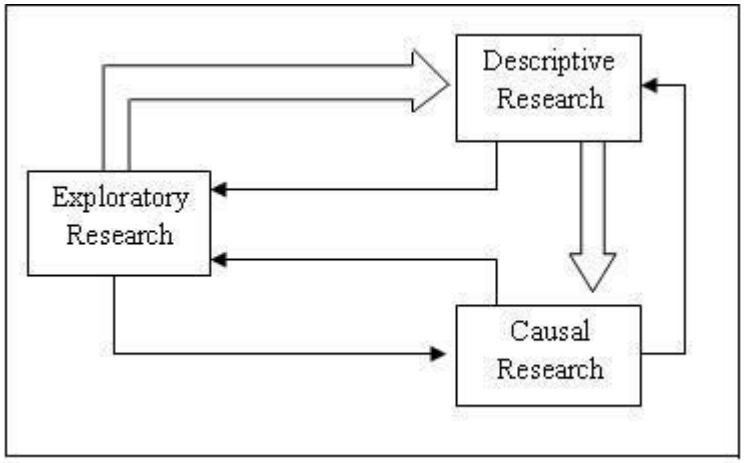


Figure 2.1: Relationship Among Research Designs (Churchill, 1995, p. 146)

The design chosen to guide the research process of this paper is the descriptive design. This choice was made due to the purpose of the research, to map the chain of inbound logistics at the onshore plants at StatoilHydro. This process is well known, and how it *should work* is stated in the governing documents. This is documents available at the StatoilHydro's internal web page, giving directions and explaining how different processes, like the purchasing process or warehouse management, should take place. However, the as-is situation has not been mapped after the merge of Statoil and Hydro in 2007. The descriptive design therefore opens a possibility to map the situation and find out how the process actually proceeds. Additionally, the objective is not to implement possible improvements to the situation of research, but to suggest what these improvements may be. As the descriptive design does not include any implementation or planning of improvements, this design reflects the purpose of the research. As a part of the descriptive design the logistic chain is illustrated by using a flow diagram. A flow diagram is used to present, describe and analyse a process. The specific presentation involves drawing boxes that represent different steps of the chain of interest ("What is a flow diagram?," 1999). In addition, the illustration is based on the notation used by Grønland (2002) (for reference see chapter *3.1 Situation Analysis*, p. 29).

The paper will also analyse the chain based on the seven wastes of lean (presented in chapter *1.5 Theory,* p.15). As the wastes may be a cause of the problems and issues, the relationship between these factors will be brought forward. This implies that the research of this thesis also had a causal part. The result of this cause-and-effect relationship is presented in a cause-and- effect diagram (also called fishbone diagram). This diagram has the purpose of

illustrating what wastes are a result from the problems and issues identified. In addition, to make the results more comprehensible, the different causes (problems and issues) will be categorized together with the waste they represent by using an affinity diagram.

To collect and analyse data, an Action research approach was chosen. This way of collecting data complies with the descriptive design by opening for the possibility of finding out how things are in the present. To seek knowledge about the present state of the inbound logistics and to identify which problems and issues that may exist. Action research open for a more freely and investigating research process then the social science. This will be elaborated on in the next chapter.

2.2 Action Research

According to French & Bell (1999), there are many variants of Action Research. Primarily, action research can be seen as a process and as a problem solution approach. As a process Action research is illustrated by McNiff & Whitehead (2006) and the action-reflection cycle.

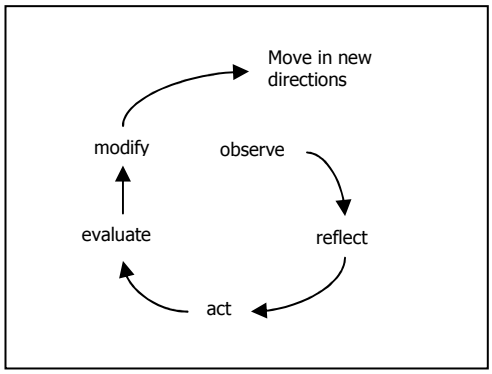


Figure 2.2: An Action-Reflection Cycle (McNiff & Whitehead, 2006)

The process starts by collecting data about an ongoing system that the scientist wants to look deeper into. The data collection is based on some defined goals or needs of the specific system. The data gathered are then put into the existing system, where the researcher reflects on the changes that happens and make adjustments due to the goals and objectives of the process development. The results of the actions are evaluated and more data are gathered so that further modifications are possible if needed. In this way, the Action research process is an iteration of data collection, feedback and taking action based on the data gathered, where

taking action may cause a need of going back to observe or reflect on the change, before moving on the new actions (French & Bell Jr, 1999).

Action Research as a problem solving approach is when the researcher applies scientific methods to find facts and experiment with existing, practical problems that need action solutions. To find the facts, the researcher involves and collaborates with practitioners, laypersons and scientists. Through the fact-finding, the researcher can find the information needed to map the current situation, and find goals for the action to help guiding present and future actions (French & Bell Jr, 1999).

According to French & Bell (1999), Kurt Lewin proposed two categories; *investigation of general laws*, where the researcher contributes to theory and practice, and *diagnosis of specific situations*, where the researcher should act as a consultant by helping to solve practical, immediate problems. They also bring forward Chein, Cook and Hardings' four varieties, called *diagnostic*, *participant*, *empirical* and *experimental*. In this case, the *diagnostic Action research* is the most interesting, where the scientist is put into a problem situation, diagnose it and recommend actions to improve the situation. The recommendations are not pretested and are derived from the scientist's own knowledge. The negative side of this variant is that the researcher is not putting the recommendations to life, which makes the change process more abrupt then when using a *participant approach* where the researcher is following the change all the way.

French & Bell (1999) also mention that because Action research is a cyclic process, where the desired outcome is to find solutions on immediate problems, while contributing to scientific knowledge and theory, the researcher also gets a different position then in social science. In social science, the researcher is normally a third party that observes the body of research, conducting interviews, enquiries or experiments. This indicates that the researcher is taking a spectators view (Frankfort-Nachmias & Nachmias, 1996). In Action research however, the researcher is a part of the process he or she studies, using their knowledge to help improving a system, process or management method.

The studies of this paper follow the Action research as a problem solving tool. This stems from the fact that the suggested improvements to the existing situation will not be tested in real life, which complies with the descriptive design. The research will also include aspects

from the diagnostic action research. However, the recommendations presented will not be based on the researchers own knowledge, but on the principles of Lean thinking and Business Process Reengineering.

As a part of the Action research data on the as-is situation had to be gathered. This implies the use of primary data collection. Primary data is according to Churchill (1995) information collected for the purpose of the specific investigation. Additionally, as stated above, the analysis will be based on profound existing theories which are acknowledged as guiding theories of organizational change. The paper will therefore also include secondary data, which is said to be information that is not collected for the specific problem, but for other purposes. Secondary data is however often used to put the primary data in perspective (Churchill, 1995).

2.3 Qualitative Data Gathering and Presentation

In social science, a qualitative data gathering means collection of empirical data based on words (Jacobsen, 2000). In this case the two methods used were telephone interview and personal interview. A personal interview may be defined as "…a face-to-face, interpersonal role situation in which an interviewer asks respondents questions designed to elicit answers pertinent to the research hypothesis" (Frankfort-Nachmias & Nachmias, 1996, p. 232). As a consequence of the action research, focused interviews were used. This implies that the interview is conducted on people that is or has been involved in the situation you want to study (Frankfort-Nachmias & Nachmias, 1996). Furthermore it is based on an interview guide, which included open questions around the different subjects under investigation. The open questions were chosen to let the conversation progress in different directions, dependent on the respondents and their knowledge. Even though the research is not based on a specific hypothesis, all the respondents were involved in the supply chain on a daily basis and could contribute to the mapping with their knowledge. A focused interview also allows respondent to express personal experiences around the situation studied (Frankfort-Nachmias & Nachmias, 1996). This could therefore give directions on step 2 of the underlying framework, where problems and issues would be identified.

In addition to the personal interviews, several telephone interviews were undertaken. A telephone interview is a "semipersonal method of collecting information" (Frankfort-Nachmias & Nachmias, 1996, p. 242). The telephone interview was chosen because it allows

the researcher to conduct many interviews in short time at low cost when a limited timeframe is set. Both telephone and the personal interviews were based on the same interview guide. However, the interviews of Bring and Grieg were only based on questions around the transportation.

As mentioned introductorily in the paper, *The Case Analysis Framework* (Taylor, 1999) gives guidelines of what information is needed to reach the purpose of the paper. Because the framework is of a qualitative nature, the presentation of the data gathered is also presented in a qualitative matter.

2.4 Sample

The sampling unit is meant to be a representation of the sampling population that the researcher wants to say something about (Frankfort-Nachmias & Nachmias, 1996). However, the definition of sampling population and sampling unit that is presented in the social science research methods does not fit the purpose of this paper. The reason is that the aim is not to say something about a population, but to see how the processes work, and if the problems and issues can be generalized to all the plants. In action research, the sample is not set in forehand, it develops along the way (McNiff & Whitehead, 2006).

However, because the focus is on the inbound logistics to secure operation and maintenance onshore, the interviews are conducted on people from the from the department of *Operation and Maintenance* (O&M) and the product groups of *maintenance, laboratory and chemicals*, and *technical*. The *vessels and helicopters* category is not included because it involves purchase in relation to the offshore installation, not maintenance and operation of the actual plant.

2.5 The Interview Guide

The interview guide was structured by the lead of David Taylor (1999) and the aspects brought forward in the outline of the paper. As stated in chapter *1.5 Theory,* the questions were constructed with the purpose of giving input on the seven wastes of lean thinking. The guide included questions from three main areas; the supply chain structure, the supply chain

performance and the business context (with reference to the knowledge of the strategies of procurement & logistics).

In all, ten telephone -and five personal interviews were conducted. To find out who to talk to, head of operational procurement onshore was contacted. Further, to schedule the telephone interviews, an e-mail presentation (for reference, see appendix 2) was distributed. It included a short presentation of the purpose and the reason for the assignment. The e-mail asked for permission to call and schedule the interview. The guide was added as an appendix, and the interview was said to last up to two hours, dependent on what the respondents had to contribute.

Not all the e-mails generated positive answers, and some referred to other persons that were more suited to answer the questions. After a few days nine interviews were booked, where two was with Bring and Grieg representatives. The personal interviews were undertaken during a day visit at Kårstø. These interviews were conducted after the telephone interviews, so that the researchers understanding of the supply chain could be verified.

The respondents had different organizational backgrounds. However, they all worked in operation & maintenance, it be warehousing, inventory management, purchasing or transportation. By talking to different people of different parts of the inbound logistics chain, the as-is situation would be more comprehensive and give insights to a wide range of issues regarding their work day. For more details on the respondents, see *Appendix 3: Respondents*.

The interviews were held in Norwegian of the simple reason that it was easier to communicate in native language. However, since StatoilHydro has English as company language, the terminology concerning purchasing & logistics was presented in English if it was commonly used in English. This was done to secure a common understanding of the terms and avoid the problem of wrong translation.

With the interview guide as a reference, the interviews were constructed as a conversation. This allowed the respondents to express other opinions then those covered by the interview guide, while the guide ensured that the conversation moved in the right direction. As a consequence of the action research, opening for this opportunity let the researcher follow up

on these other issues that emerged and ask follow-up questions outside the interview guide if needed.

2.5.1 Validity and Legitimacy

The validation of the measuring instrument is done to evaluate if it is actually measuring what it intends to measure (Frankfort-Nachmias & Nachmias, 1996). In Action research, two aspects should be considered; validity and legitimacy. Validity implies to secure the trustworthiness of the researcher's claim. To ensure this, the researcher should arrange for critique (McNiff & Whitehead, 2006). In this case, the interview guide was validated by supervisors from the university and the *PROFF*-program. This brought about some insight on how to improve the guide, before the interviews were carried out. It was also modified along the way, whenever the interview moved in different directions. In addition, McNiff & Whitehead (2006) mentions the internal validity of a research. This is accomplished when the researcher has produced authentic evidences, which implies that when a supply chain is illustrated and issues and problems are identified, the internal validity is satisfied.

Legitimacy of the research means "…establishing its acceptance in the public sphere" (McNiff & Whitehead, p. 166). This means that the researcher has to make others see the value of his or her work so it is accepted. In this case, the research gains legitimacy if StatoilHydro and the *PROFF*-project recognize that the research is useful to improve the inbound logistics at the plants onshore by eliminating the identified *muda*.

This chapter has elaborated on the method of the research, which is a combination of several methods. The overall design of the research process has been descriptive. This implies that the research seek information about an existing situation, process or object. The action research has been the base, while the qualitative approach is a part of the action research and is used as a tool to gather the data. The interviews were conducted by using focused interviews, and the interview guide is based on the framework of David Taylor (1999). It was constructed to uncover the supply chain structure, in addition to shed lights on possible wastes based on the lean principles of *muda.* In the end, what it takes for the research to be valid and legitimate was defined.

3 Situation Analysis

Throughout this chapter, the as-is analysis will be presented. It will focus on the state of the supply chain today and explain how the different parts are connected and how information flows. The base for the mapping is the interviews conducted during the research process, in addition to StatoilHydros' internal documents. A scheme of the chain will be presented, and value-adding activity will be identified together with cost and possible risks. The goal of the chapter is to give a detailed background so that different problems and issues may be derived and seen together with the seven wastes of lean.

3.1 Supply Chain Structure

As mentioned, a supply chain is a partnership between different actors that work together to convert materials into a final product that is valued by the customer (Harrison & van Hoek, 2005). At the plants, the end customer is defined as the refining station. This implies that everything that is needed to keep the process running either should be in stock or ordered. Before the results of the data gathering are presented the terminology of the illustrations will be defined.

With reference to Grønland (2002), the notation used is defined below. The triangle represents storage, in the sense of manufactured goods, goods in production, storage when transporting and storage of spare parts to use for maintenance, overhauling and reparation. The arrow symbolizes transportation between storage, work place, waste, load, unload and reload. In this simple overview, the transportation merely refers to the transportation of the goods from one place to another, for example from the supplier to reload to warehouse. The more specific movements will be handled later. The last notation is the circle. This implies transformation of the product, either by producing, processing, assembling or refining (Grøndal, 2002).

According to Grønland (2002), there are external transport and internal transport. The external transport is when the goods are moved from the supplier and to the company, while the internal transport is when the goods are moved inside the company. Grønland also mentions that companies often need to balance between the different qualities of the transport and the different qualities of the entire logistic system. For the purchasing & logistic unit, the customer is the mechanics and people working in operation and maintenance of the plant. To secure a steady and continuous running of the plant, it is vital that the goods are delivered when promised. They have to be available when needed, dependent on criticality. Reliability and efficiency is the key.

3.1.1 The Physical Flow of Goods

The physical flow of goods implies the different stops and steps the goods move through, from the 1st tier supplier, through the warehouse and out to the production facility (Taylor, 1999).

The inbound logistics at the plants is mainly handled by Bring Logistics or Grieg Logistics dependent on if the plant is xStatoil or xHydro. The contracts were transferred with the merge, both to secure competition and independence in the sense that StatoilHydro is not dependent on just one carrier. While Grieg Logsitics is a coordinator with partners that handle the actual transport, Bring Logistics has its own distribution network in addition of being a coordinator. According to Arne Morken, the use of Bring and Grieg as logistic partners is about having a focus on core competences (A. Morken, interview 23.03.2009). By outsourcing the logistics, StatoilHydros' purchasing function can focus on what it knows best; to monitor and map the market, instead of handling the transportation. However, they wish to have control of the logistics even though they do not handle it (B. S. Christiansen, interview, 19.03.2009). Through the agreement with Bring and Grieg, they can do it without handling all the administration.

The organization for transport is handled in four ways:

- The supplier contacts the local office of Bring, if the plant is xStatoil.
- The supplier contacts Bring or Grieg centrally and the jobs are transferred to the local departments and carriers.

- The purchaser at the plant contact Bring or Grieg to schedule for transport.

These three routines imply the use of FCA. The last is:

- The supplier sends the goods outside Bring or Grieg.

The last way of transportation, where the suppliers transport the goods outside Bring and Grieg is trying to be avoided. This comes from the extra costs that arise and uncertainties about declaration if the supplier is abroad. This will be elaborated on later in the next chapter. To avoid this particular situation, it happens that Bring or Grieg contacts the supplier and offer their services. This is done to secure that the supplier is aware of the possibility.

As a main rule, the supplier is supposed to contact either Bring or Grieg and schedule for transport, so the goods are delivered FCA. Free CArrier (FCA) is an Incoterm, which is standard terms used in international trading to decide the liability of the goods during transport ("Understanding Incoterms," 2009). According to Grønalnd (2002) the Incoterms are regulated by the International Chamber for Commerce (ICC) and also decide who is responsible for risk, documents and insurance during transport. The Incoterms are illustrated and explained in its whole in *Appendix 6: Schema Incoterms,* (p.89). The FCA implies that StatoilHydro is responsible for the good, both the risk and cost, when it is in the carriers' custody. It also states that the seller should arrange for transport on the buyers' behalf or that the buyer should arrange for transport. This implies to contact Bring or Grieg to schedule for transport. If the agreement of FCA is kept, StatoilHydros' carrier picks up the goods at the supplier and transports it all the way to the plant. How the transportation is structured is decided by Bring or Grieg, and some differences occur.

The external inbound logistics at StatoilHydro can be divided in four parts: The logistics from inland suppliers, abroad suppliers, suppliers of chemicals and suppliers of services. These different streams of goods are eventually ending up at the processing step at the plant.

Inland supplier

When a purchase is done from an inland supplier, the inbound logistics take three forms. The first way the transport is handled is when the carrier gather all deliveries to the plant at an own reload station, or "hubs" before it is driven to the plant. At Kårstø, two deliveries are scheduled each day from the hub in Haugesund, which serves as an intermediate storage facility, handled by Bring. All the goods from the suppliers are gathered here, to avoid a rush

at the warehouse with several different trucks from different suppliers (K. R. C. Rossebøe, interview 16.03.2009). At Kollsnes, the same approach is applies, but they organize for one delivery a day (Å. Skjelvik, interview, 12.03.2009). Additionally, the carriers take along any goods that need to be returned to the supplier for any reason. At Sture, an intermediate storage is used in Bergen. This follows the same process of gathering all the deliveries before they are transported to the plant, but this storage is handled by Grieg (M. A. Heggø, interview, 16.03.2009). The chain may be illustrated like this:

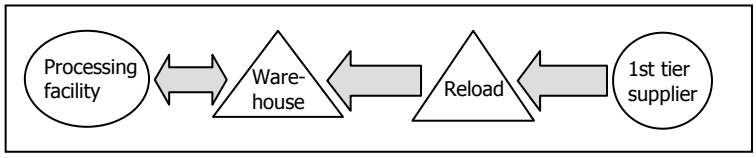


Figure 3.1: Inbound Logistics Inland 1

The second variant of the inland supplier inbound logistics are when several reloads are needed. This is the case at Tjeldbergodden. This plant uses Bring as its main carrier, but the final part of the transport is handled by Brødrene Bakk. Because of the location of the plant, the logistic process towards the plant requires several reloads.

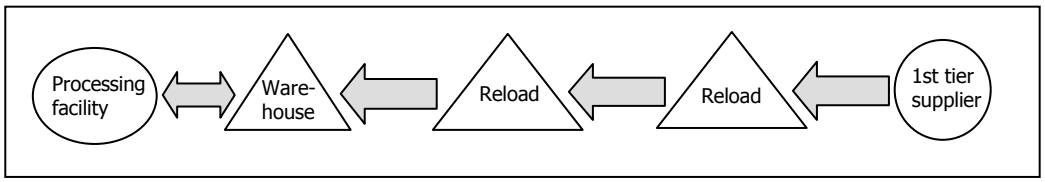


Figure 3.2: Inbound Logistics Inland 2

At Tjeldbergodden there is no defined delivery times for the carriers, but normally deliveries are done twice or three times a week (A. Karlstrøm, interview, 12.03.2009). As a consequence of the several reloads, there may be situations where the goods are not delivered when wanted, because the pile up at the reload station before they are brought out to the plant. To improve this process there is a constant dialogue between Tjeldbergodden and Brødrene Bakk.

Mongstad terminal and refinery is also served by Bring. In addition to its own spare-parts and consumables, the warehouse at Mongstad contains some spare-parts for the Sture terminal. The inbound logistics at Mongstad follows the same path as *Figure 3.1: Inbound Logistics*

Inland 1. However, because the warehouse also includes parts for Sture, a third transport-stage is needed; the transportation between the plants. The supply chain looks as shown in the following figure.

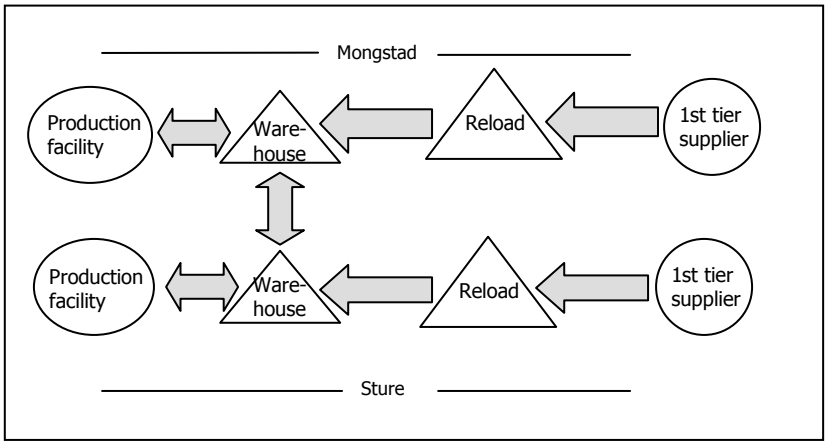


Figure 3.3: Inbound Logistics Inland 3

Even though the supplier is supposed to contact Bring or Grieg for transport to deliver the goods FCA, some get the goods delivered without the use of Bring and Grieg. When this happens, FCA is violated and it cause extra work at the warehouse by extra loading and administration in case of invoicing and security clearance. Additionally, there are often many subcontractors located inside the plant which makes it hard for external carriers to find the company ordering the goods because the name and location inside the plant is hard to find. When the truck arrives, a security issue also arises if it is not cleared. This may cause delays and frustration both for the carrier, warehouse and the requisitioner. This issue will be elaborated in chapter *4 Identification of main issues and problems*.

Abroad supplier

If the supplier is from abroad, the same rules of FCA apply. However, an extra step in the chain arises; declaration. When the goods need to go through a warehouse on land, they need to be declared (G. Meyer, interview, 17.03.2009). As long as FCA is kept, Bring and Grieg handle this part of the chain including the declaration. Some of the services at the plants' processing units, like change of spareparts and daily maintenance, are done by the mechanics in operation and maintenance (O&M).

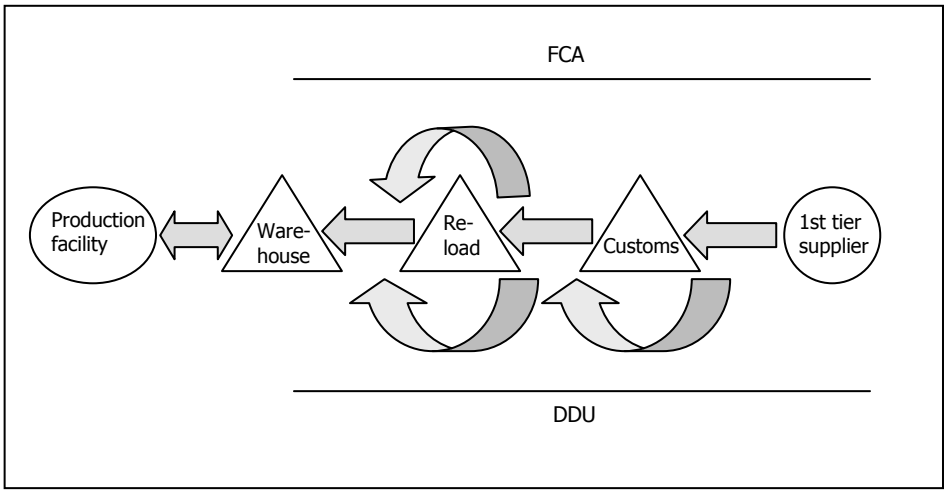


Figure 3.4: Inbound Logistics Supplier Abroad

Nevertheless, sometimes the goods are Delivered Duty Unpaid (DDU). When this is done, the seller arranges for the transport of the goods, but the declaration for import is not taken care of, and the goods are not unloaded at the warehouse. The buyer also bears all the risk and cost of clearing the goods for import ("DDU: Deliverered duty unpaid," n.d). As *Figure 3.4: Inbound logistics supplier abroad* shows, this implies that the transport goes past the customs. This may result in a punitive duty of 60 % if the duty is not paid as it should (G. Meyer, interview, 17.03.2009). According to Gjerdt Meyer in Bring Logistics, this is a result of Norway not being a member of the European Union. As the goods may be delivered without customs inside the EU, not all the producers and suppliers realise that the rules are different for deliveries to Norway. Even though Norway is a part of the European Economic Area (EEA), the papers of duty paid has to be in order when goods are transported over the boarder. When the suppliers demand to deliver the goods themselves, this problem may emerge.

It also happens that the goods are delivered Ex works. If this happens, the seller has minimum obligations and the buyer has little control of the transport. Then the buyer bears all the cost and risk of the transport, from the goods are picked up at a named place or another premises. When this is used, the seller does not load the goods on the vehicle, and does not clear for export ("EXW: Ex works," n.d). The use of this Incoterm violates the principle that StatoilHydro wants to have control of its own logistics, as there is no agreement of who handles what. The only thing established is that when the goods are picked up at the seller's location, the buyer is responsible for the goods and all it includes.

When the goods from the national and international suppliers reach the plant, they are unloaded and signed for. Then, the receiver at the warehouse check the content of the parcel against the packing list, register the goods in SAP and sends out an alert to the person that required it. If it is purchased for stock, the goods are put on storage this process, together with the purchasing process will be explained in chapter *3.1.2 Information Management*.

Some of the services at the plants' processing units, like change of spareparts and daily maintenance, are done by the mechanics in operation and maintenance (O&M). However, sometimes the parts are taken out and sent to the supplier for service and overhaul. If this is the case, the part is taken out of the production facility, through the warehouse where it is registered as temporarily sent away before it is transported to the supplier which performs the service. In this case, the arrows in the figures illustrated above, goes the other way.

Chemical suppliers

The suppliers of chemicals to be used in the refining process are normally delivers directly to the plants refining station, or to the storage tanks, without going through the warehouse.

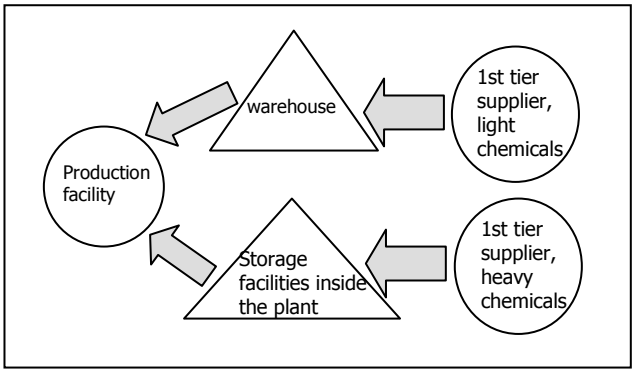


Figure 3.5: Inbound Logistics Supplier of Chemicals

This transportation is not covered by the frame agreement of Bring and Grieg, but by the supplier. Helge Rambjør at Mongstad explains that the crude oil needs different chemicals to reach the quality of for example gasoline and diesel. There are as many as 30 different combinations of gasoline, dependent on where in Europe it is going to be used. The mixing is therefore crucial. About 2 % of the chemicals are transported from the plant on trucks, while the rest 98 % are transported on ships. The mixing of the oil and the chemicals are done directly from the supplier, on the boat, or in the tanks, and the quality is secured by a third person. Because the supplier specialises on the additives, the transport is outsourced to them,

to secure that someone who knows the chemicals and how to handle them has the responsibility (H. Rambjør, interview, 23.03.2009). As a consequence, these chemicals do not physically go through the warehouse, but are registered as received. This also applies to goods that need special transportation.

Except from these heavy chemicals, lighter chemicals like glue and spray cans are ordered to storage, but these are handled like a consumable.

Service supplier

If the plant is going to be expanded or services on special equipment is needed, external subcontractors are brought in. Examples of jobs where subcontractors are hired are among other things if another building is to be made, if new storage rooms and tankers for chemicals are needed or if the plant is going to be painted. The reason for why StatoilHydro does not do these tasks by themselves is because they want to focus on their core competence. The services these subcontractors offer are not brought trough the warehouse per se, but sent straight out where they are required.

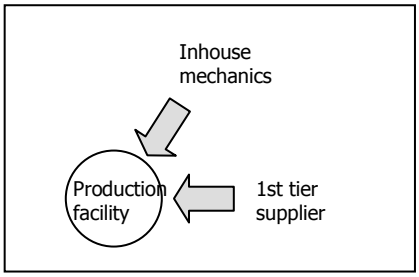


Figure 3.6: Inbound Logistics Supplier of Services

Normally these suppliers are located at the plant as long as the project is running. All the need of spare-parts or any consumables ordered by the subcontractors inside the plant should go through the warehouse. However, this is not always the case, and when subcontractors order goods directly to their location inside the plant, without taking it through the warehouse, it causes the same problems as when the suppliers arrange for transport without using Bring or Grieg. This also causes extra work as mentioned under **inland supplier**. Because these subcontractors all perform a kind of service for StatoilHydro, they will be called service supplier in the following.

If we put these different supply chains together, the whole chain may be illustrated like this:

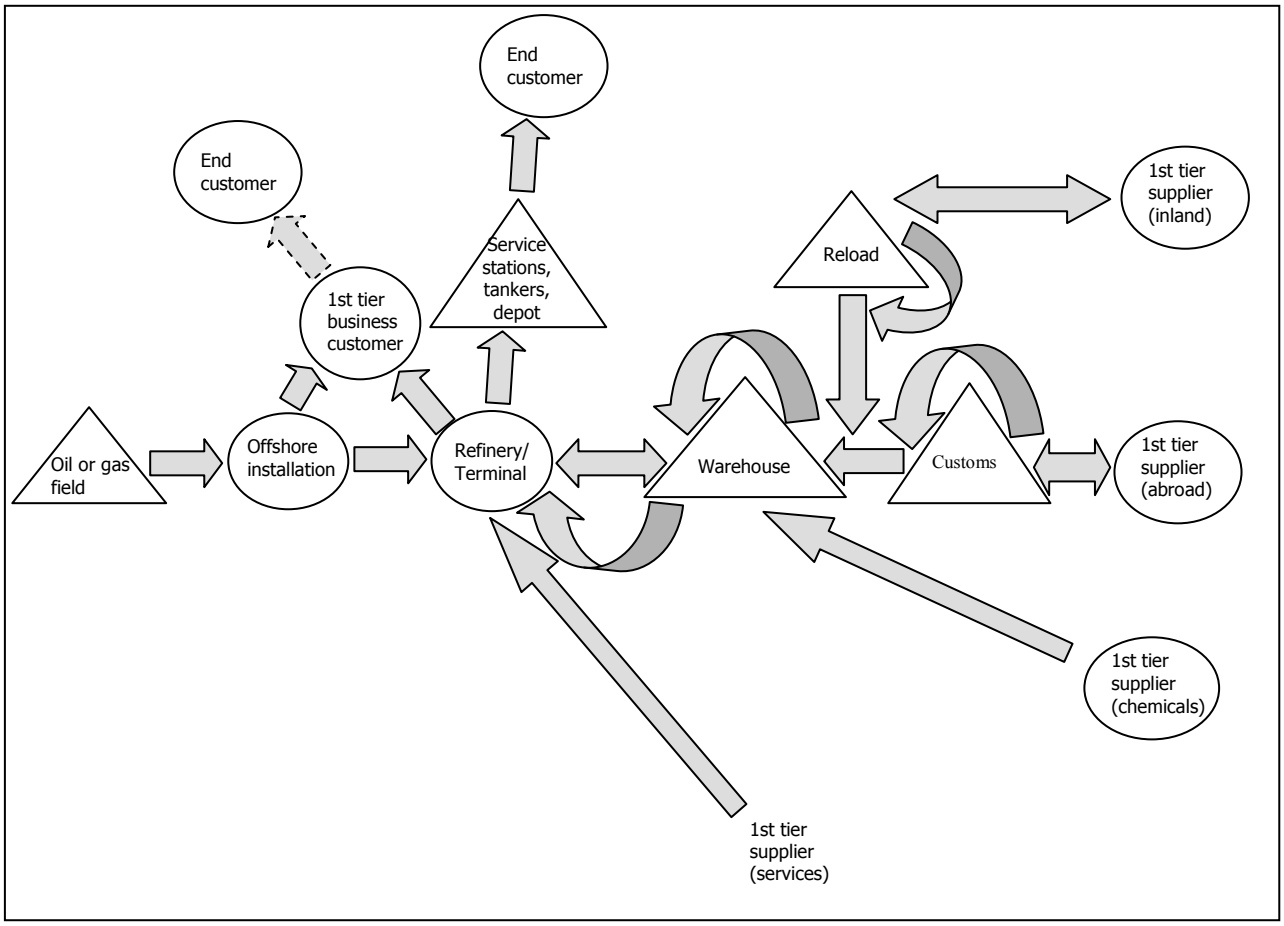


Figure 3.7: External Supply Chain Onshore Plants.

The chain represents a simplified view of the external transportation and how the goods travel from the 1st tier supplier, through the warehouse and further to the production facility. However, since the purpose of a value chain is to show the flow of value all the way to the customer, the other sides of the chain, the outbound logistic form the production facility is included in the illustration.

When the oil and gas is extracted from the field, it is either sent trough pipelines directly to the 1st tier customer where the products are further processed before it is sent to the end customer, or it is sent to the terminal or refinery. At the refinery, the oil and gas is processed (as explained in chapter *1.5 About StatoilHydro*, p. 12), before it is transported to the customers for use or resale, for example gas stations. From this intermediary, the product is sold to the end customer.

When it comes to the internal transport, this happens inside the warehouse and between the warehouse and the production facility. After the goods are received, they are moved to

storage, picked up by the person requesting it, or sent to the end- station. The illustration below gives a schematic view of the process.

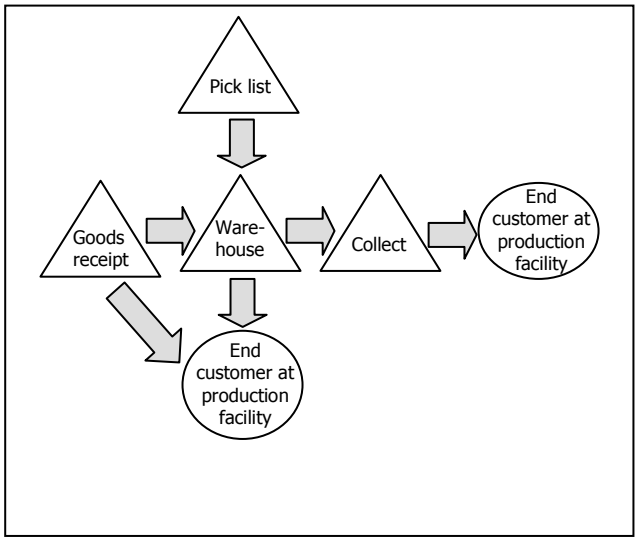


Figure 3.8: Internal Supply Chain Onshore Plants

Additionally, the warehouse handle different picking lists required trough SAP. A warehouse employee puts the order together, and the goods are picked up by the person that requested them.

3.1.2 Information Management

Information management implies how information is handled through the supply chain (Taylor, 1999). As stated in the outline of the paper, this chapter will explain how information flows through the chain and if the right information is provided to the right person. In this paper, the focus is on the procurement of goods needed to operate and maintain the production of refined oil products and gas, which also causes the inbound logistics of the plants.

The procurement at StatoilHydro is divided in two; strategic and operational procurement. The schematic layout is shown in *Appendix 6: Procurement/Supply Chain Management at StatoilHydro* (p.88).

If an investment over 7 million NOK is needed, the purchase is strategic. This process starts by setting a specific strategy for the strategic purchase based on the category and overall

procurement strategy. This is done by the category manager. Next, it has to be decided if the purchase is covered by a frame agreement or if it is not. If this request is outside require a purchase outside a frame agreement, the category manager invites to a tender competition in the market. Normally, at least three suppliers are invited to give tenders. To be able to tender, the supplier need to be registered in the Achilles base. This base is a gathering of suppliers, certified to deliver to the oil industry. To be registered in this base, the suppliers need to go through different tests, among others HMS and social responsibility, to secure the quality of the suppliers. A tender competition is required for all new purchase over 200 000 NOK. However, collection of estimates also cost money, and the gain of tendering has to be compared to the cost. During a tendering all the bidders are given the same information, which means that if one supplier has a question all the other suppliers are given the answer. This is done to make sure that all the suppliers have the same foundation when they give their offer. When large contracts are established, the category responsible should first try to get an agreement that covers StatoilHydro as a whole. If this is not possible an agreement for the specific plant can be made (H. Rambjør, interview, 23.03.2009). If the purchase is inside a frame agreement, normal purchasing process is followed.

Operational procurement is purchases under 7 million NOK. These purchases do not require their own specific strategies. If the supplier has a framework agreement with StatoilHydro, these orders goes out trough SAP. If it is not, the same procedure with tender competition is followed. The terminals also have contracts with suppliers close to the plant where the mechanics and machinists can get different consumables right away if it is not in storage. This is typically goods like screws, nuts, gloves, overalls, oils and specific chemicals. If it shows to be the same items that is bought over and over again, the warehouse managers evaluates if the items should be in storage at the plant. In addition a net-shop is used, where orders can be placed directly on the internet. The next figure gives an overview of how the procurement and contracting process evolves, from request to supplier, before the goods are transported to the plant.

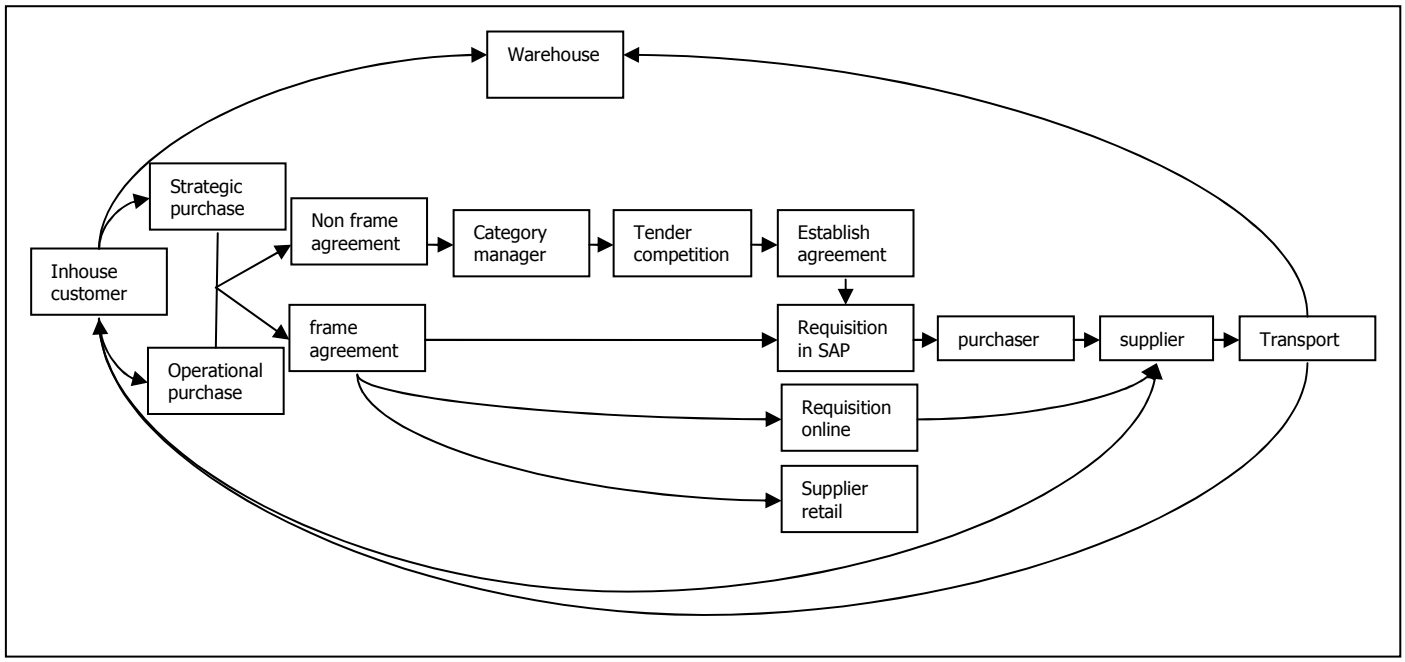


Figure 3.9: Strategic and Operational Procurement

The actual process of procurement mostly followed the governing documents. This implies that the principle of segregation of duties (SOX) is followed. The process starts with a person with a need. This person decides the requirements and places a requisition in the computer-system SAP. Then he finds out if the request can be met from the warehouse, or if there is a need to go out in the market. The stock at the warehouse is regulated by minimum stock registered in SAP. If the stock reaches the minimum limit and a frame agreement is established with a supplier connected to SAP, an automatic purchasing order (PO) goes out and the goods are delivered. The minimum limit is regulated by the warehouse managers to reach the best compliance with the customers needs.

The request is connected to a work order, which is used by the warehouse to invoice the right department, and the material number that controls which purchaser the order goes to (Å. Skjelvik, interview, 23.03.2009). The purchaser then approves the request, contacts the supplier and makes a purchasing order if a frame agreement exists. If not, the contracting process is established.

When the purchase is followed through and the goods are received, the invoice is verified towards the purchasing order. If these match, the invoice is paid.

The procurement system stated in the governing documents is shown in the picture below.

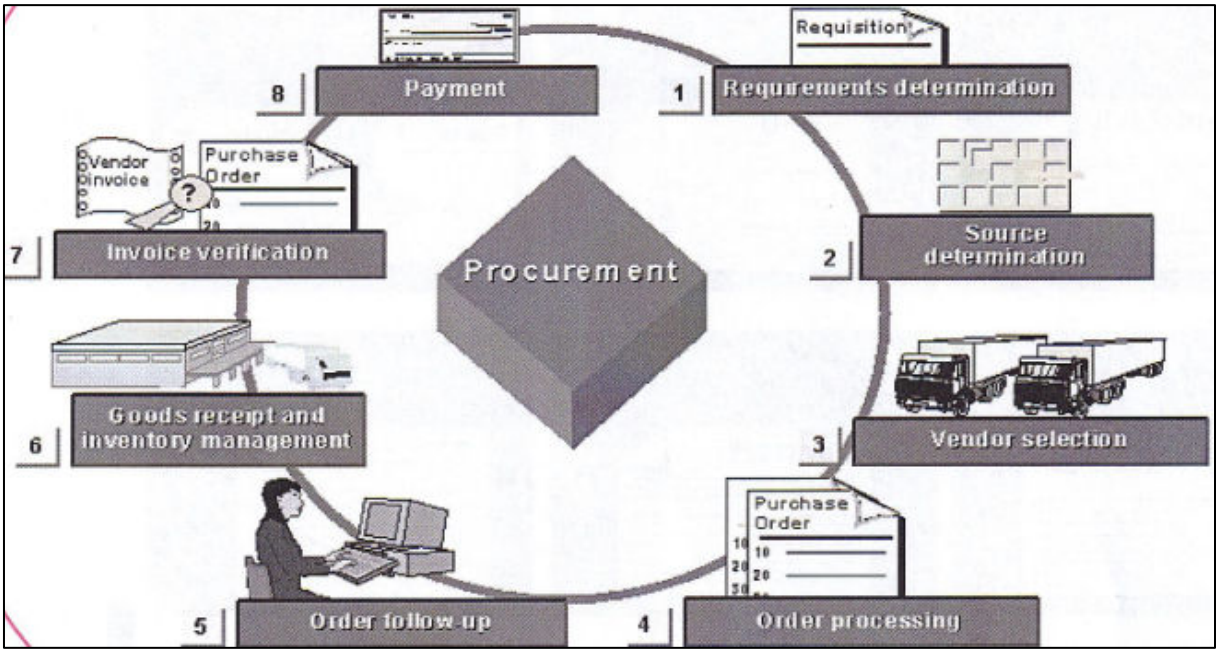


Figure 3.10: The Procurement System

Through Bring or Grieg, the order is followed up through expediting. This means following the goods on its way from the supplier to the plant, in addition to have contact with the supplier to secure that the goods are ready at the agreed pick up time and date. Bring and Grieg is responsible for keeping StatoilHydro updated and to give notice if there should be any changes in the existing plan. To make this process easier, Grieg and Bring are given offices at the plants so they can be near the warehouse. They are then given access to SAP so they can register any change in plans automatically. The person requesting the goods can follow up their order in SAP, as the status of the different requisitions are updated when delivered at the purchaser, and when the goods are ordered. Additionally, they get a message through SAP when the goods are received at the warehouse. However, if they need more information about the status of the request beyond the information found in SAP, for example where the goods are in the supply chain, they need to contact the Bring or Grieg representative, which then again finds out where the good is located. This is also one of the reasons why it is important for StatoilHydro to outsource the administration of the chain to Bring and Grieg. As these companies handle the whole process from pick up to delivery, it is also easier for them to track their own goods and vehicles. The tracking and expediting also

takes a lot of time. This time is now freed for the procurement department to focus on their core competence.

When the goods reach the warehouse, they are signed and controlled for, before they are registered in SAP and tied to the right work order. As the warehouse sees the production facilities as its customer, the different orderings are invoiced the different work orders. Trough SAP a message goes out to the requirer, who picks it up at the warehouse or it is sent straight to the end station where it is used. After the goods are received, the invoice arrives and is checked by comparing it to the purchasing order. If everything is fine, the invoice is paid. If not, it goes back to the warehouse which has to find out why there are differences.

3.1.3 Organizational Structure

According to lean thinking and Business Process Reengineering, the organizational structure is crucial for the performance of a value chain (Ballé, 1995; Peppard & Rowland, 1995; Womack & Jones, 1996). As the focus in this paper is the process from requisition, through supplier to delivery, the focus of the organizational structure is the procurement and logistic department.

The purchasing and logistic function at O&M is split in two, as a consequence of Bring and Grieg handling the logistics, while the procurement is done by StatoilHydro.

The purchasing function is divided in subdivisions dependent on what organizational category they serve. This implies that StatoilHyro has one purchasing unit for the main categories shown in *Appendix 3: Category Wheel Details* (p. 87): Global Business Services (GBS), Projects (PRO), Drilling & Well (D&W), Operation & Maintenance (O&M) and Energy & Retail (E&R) ("The Procurement Process," n.d). These purchasing functions each handle their own processes, which have different customer needs to meet. The structure is hierarchical in the sense that the different purchasing units separately handle their own processes, under the procurement and logistic unit. The category responsible is also only accountable for their own category, even though the contracts should try to cover the organization as a whole. This implies that if the category responsible of technical procurement at O&M, need to find a supplier and sign a new contract, he or she should find out if this is a need throughout all the plants, or if it is a local need for the specific plant.

Underlying the category responsible are the purchasers. This function is decentralised and the purchasers are located at the plant. By being at the location, the purchaser is close to the people requesting the purchases, and has close contact with the warehouse and its management. This is illustrated in the following figure.

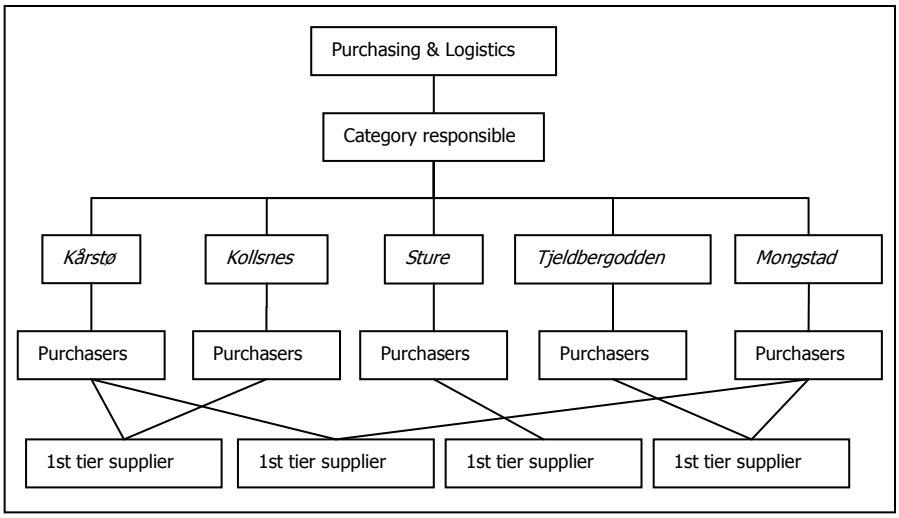


Figure 3.11: Organizational Structure P&L

3.2 Supply Chain Performance

The measuring of the supply chain differs from plant to plant, and the knowledge about the measurements varies among the interview objects. Centrally at StatoilHydro the procurement and logistics function has defined three Key Performance Indicators (KPI's); waste management, degree of automatic purchase and purchase to frame agreement. A KPI is used when a company wants to measure its performance towards specific goals (Reh, 2009). However, the KPI's mentioned above were defined singular by onshore plant, not of the supply chain as a whole including all the plants. Because only a small part of the single chains are measured, no complete overview over the performance across the plants is available. Accordingly, these centrally defined KPI's were not all known to the interview object, even though they all knew that the KPI's existed.

In addition to the central KPI's, the plants had defined local KPI's to measure the performance of some of the supply chain processes on a monthly basis. These KPI's were:

- How many of the deliveries were delivered on time.
- Number of rush orders.
- Lead time from required to delivered goods.
- Number of automatically generated orders.
- Lead time of invoice clearance.
- Lead time for closing of old cases in SAP.

The definition of these measures also says something about what the goal of the chain is, hence what is valuable to the customer. A common feature of the measures is efficiency. This efficiency is measured in the sense of short lead time in all the steps of the chain, from request to delivery and till the process is terminated by invoice clearance. As stated in the beginning of the chapter, efficiency is what is valued for the customers of the procurement & logistics unit.

3.3 The Business Context

As lean procurement is a goal centrally at StatoilHydro, the focus of removing non-value added activity is consolidated in the corporate strategies. This makes it easier to focus on a removal of non-value added activity, when it is a common aim in the organization. However, as mentioned, the goals are not thoroughly known in the organization. When this is the case, a complete organizational turnaround to focus on eliminating waste is difficult. The goal needs to be communicated to all the parts of the organization, to make everyone pull in the same direction (Ballé, 1995).

Because of the financial crisis, the focus on cost is inevitable. As the procurement & logistic function also handle the contracting with the suppliers, a renegotiation of prices was initiated. Additionally, the procurement unit needs to be more critical when ordering stock to storage, in addition to being aware of how the processes are handled to make possible changes to minimize cost. In that way, the result of the research conducted in this paper may serve as a contribution to the reduction of cost.

As the business context surrounds all the aspects of the supply chain, the factors that StatoilHydro has no control over and is seen as relevant when it comes to the seven wastes, will be presented throughout the analysis.

This chapter has given a comprehensive presentation of the as-is situation of the inbound logistics at the onshore plants at StatoilHydro, based on the interviews undertaken. The supply chain and procurement process has also been mapped and explained, while a short evaluation of the organization structure and business context has been given.

4 Identification of Main Issues and Problems

The identification of main issues and problems of the supply chain mapped in the previous chapter will follow the five steps of lean. These steps implies identifying value, mapping the value stream, arrange for flow, let the customer pull the product through the chain, and last; seek perfection.

By analysing the supply chain according to these steps hidden *muda* should be revealed. These *muda'*s will then again be possible to eliminate to increase the flow of value. The different *muda'*s may be divided in two; type one and two. These different types will be presented and identified throughout the chapter.

The first part of the chapter will identify the different costs, risks and the value defined by the customer. Next, the analysis of the as-is situation will follow, where different problems will be brought forward and tied to the different waste they represent.

4.1 Cost, Risk and Value Added

The first principle of lean thinking is the definition of value. The theory of lean thinking is based on the successful story of Toyota, where the customers were given the opportunity to choose the properties of the products they were going to buy, instead of being content with the products offered to them by the producers. Traditionally, the definition of value is therefore tied to characteristics of a specific product. In this case however, the value is defined by the properties of a *process*. Even though the characteristics of the specific products purchased are of great importance, the supply chain is also a vital part to obtain the running of the plant. Without the supply chain, the spare-parts, chemicals and consumables would not reach the plant, and the qualities of the products would be indifferent. Even though the supply chain is not a product, it has a customer; the person required the goods. In a bigger picture, this person is only an intermediary as a part of a bigger process with other end-customers. The requirer has different definitions of value than the end-customer of the refined products. As the requirer value that the products are available when needed, the end-customer of the gasoline or LPG mix is first and foremost concerned with the quality of the product. Mainly, this difference stems from the fact that the supply chain itself also acts as an intermediary, just like

the requirer. The chain is the link that ties the customer (the requirer) and supplier together. Additionally, the quality of the product is in this case guaranteed by a third person, the producer. In that way, the *properties of the chain* is the critical parameter for defining customer value.

The value defined by the requirer is therefore mainly that the chain is reliable. If the goods are not available when needed, the consequences may be fatale, not necessarily for the requirer personally, but for the refining process. Another factor that is important is to secure some sense of flexibility in the chain. The flexibility of a chain can have different dimensions, among others design, range, mobility and uniformity (Peppard & Rowland, 1995). In the case of the supply chain, the most important thing when it comes to flexibility is that the volume of the deliveries done by Bring and Grieg may vary according to the needs of the plant, Additionally, variety in the sense of putting together different transportation units to bring the good from the supplier and to the warehouse is important. An example is if a purchase is made from an abroad supplier. In this case the transport may need to go by plane, boat, truck or all three. If this combination is difficult of obtain, it may cause waste for the customer by not complying with his or hers need. If flexibility is not possible, it may cause trouble for the reliability of the chain. Because goods sometimes need to be delivered with a short time frame, efficiency of the chain is also in the interest of the customer. With reference to Peppard & Rowland (1995), this implies that the chain has short delivery lead time. This means the time it takes for the deliveries to reach the plant from the goods are ordered. As a customer realise that he has a need that cannot be fulfilled with the goods at the warehouse, he would want to have it immediately. This implies that the faster the goods can be available, the better.

Womack & Jones (1996) also point out that the value of the chain should to be defined as the whole product. For the end-customer for the refined products, this implies that the supply chain is a very important part of their value. If the supply chain is abrupt, the value of the product to the end-customer may fall because the value added activity is not satisfying. To find the relationship between the value added activity, the value stream should be identified (Womack & Jones, 1996). By recognizing the steps needed to make a specific product (in this case a process), it is also possible to find the activity that is not adding value. According to the theory of lean thinking, the different actions to produce a product can be categorized in three main categories:

13 The activities which actually create the value percieved by the customer
14 The activities which does not create any direct value, but are needed to get the value to the customer
15 The activities that does not create any value appreciated by the customer

With these categories as reference point, two types of *muda* may be identidied. Type one is *muda* when an activity identified as waste have to be maintained for the value adding activity to be sustained. Put differently; necessary waste. The second type of *muda* is type two and is waste that may be eliminated straight away.

The second step of lean is the identification of the value stream. In this case, the supply chain contains four main links. The supplier; who process the goods to be bought for StatoilHydro, the transportation of the goods, which makes the products available, the receiving at the warehouse and the transportation to or by the end-customer. As the situation analysis showed (for reference see chapter *3.1.1 The Physical Flow of Goods,* p. 30), the supply chain consists of several streams of goods, each handled in separate ways. Differences within the different streams also occurred. Even though there is a constant focus on the improvement of the process, if seen through the wastes of lean, some problems and issues may be identified.

As the illustration in chapter *3.1.1 The Physical Flow of Goods* (p. 37, figure 3.7) shows, the transformation of goods are illustrated by circles. These circles represent the actual production, where different parts are put together to make the final product sold to the customer. By using this mapping as a starting point, the stream of value may be identified. According to Womack & Jones (1996), this stream represents all the actions that is required to bring a product to the customer (it be a service, a good, or a combination). These actions move through three management tasks:

- The problem-solving task. This is the process which runs from the concept of the product, design, engineering, test, production and launch.
- The information management task. The process of taking orders and the scheduled and following delivery.
- The physical transformation task. This is the actual making of the product.

All these activities imply some form of value-adding activity. When looking at the external value chain onshore however, only the last two tasks are represented. This is because of the focus of the paper which limits the mapping to the operation and maintenance function. The problem-solving task is typically done in the laboratories which are not served by O&M.

Further, a value stream analysis will according to Womack & Jones (1996) show the three actions mentioned above, where some steps inevitably creates value, some are necessary to secure that the value is actually created, and some steps will show to create no value at all. If the external value chain is to be illustrated only containing the steps which create value, it would look like this:

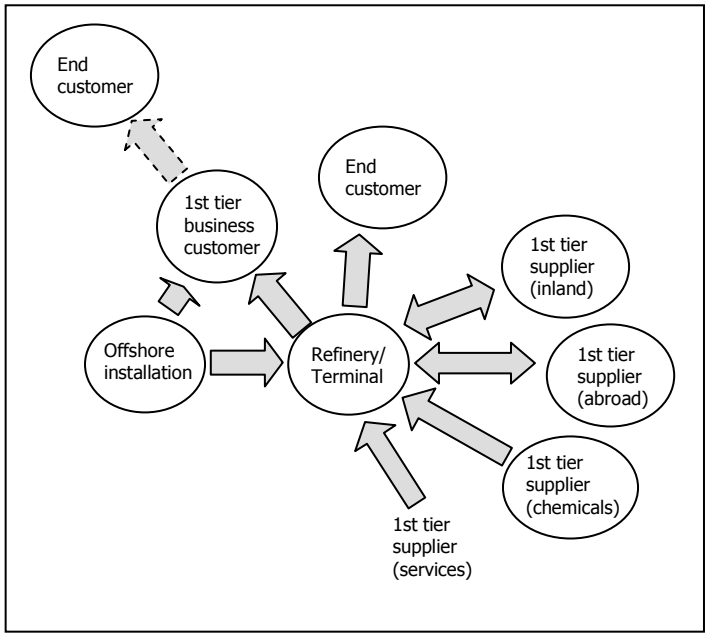


Figure 4.1: Value Stream External Customer

This illustration shows which steps in the chain which directly contributes to customer value when the customer is defined as the user of the refined products. For these customers, the transformation of the specific products is what makes the product useful to them. However, one thing to be aware of is that the service suppliers normally creates value when the services are carried out inside the plant. This supplier is therefore not circled. As long as the service supplier is not located inside the plant, it is not creating any value for the customer. Nevertheless, to create a whole image of the chain, it is included. The parallel to Womack & Jones (1996) three activities, this specific chain illustrates the production activities. For the external customer, this is where value is created.

When it comes to the internal customer, who is the customer of the inbound logistics, the chain may be illustrated in even simpler matter. As the value appreciated by them is mainly reliability, and they are a part of a larger value chain, the activities represented here is the information management task. This is illustrated in the following figure:

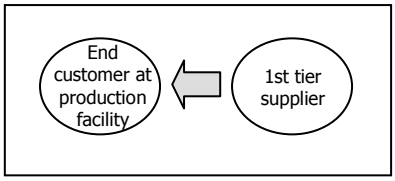


Figure 4.2: Value Stream Internal Customer

What these illustrations enlighten is that the steps including all sorts of storage or stops along the way impede flow and are seen as *muda*. However, not all the steps are type two *muda*. This implies that not all the steps left out from the original illustration in figure *4.1 Value Stream External Customer* may be eliminated. From this value stream the seven wastes of lean may be an illustrative way of identifying specific problems and issues that may be handled to increase the reliability and efficiency of the chain.

The cost issue also needs to be cleared. In this case, the cost may be divided in two; the cost of unnecessary waste, and the cost of money going out. Even though the wastes do not result in money changing hands, they are implicit costs which influence the return of the chain as a whole. The explicit costs in the chain are located in several links. The first cost can be derived from the supplier, where the spare-parts, consumables, chemicals and services are bought. The next cost is located in the transportation of the goods, from the supplier all the way to the internal end-user. These costs include the actual transportation, possible customs, insurance, expediting, goods receipt, warehouse operation and management, and labour. If the chain is seen in its whole, the next cost can be placed at the production facility as the costs of maintenance, labour, quality control and transportation of the goods from the facility to the external end-user, either by truck or boat occur. At last, there is a cost connected to the offshore installation and its activity, including transportation to and form the onshore plants with equipment and people.

Each step in the chain represents a cost, the value-adding activity is important, as it need to compensate for the money going out. As the value-stream identifies, all the steps mentioned

also have some sort of value added connected to them. The only parts which only represent costs are the same as the ones defined as activity that does not create value. Nevertheless, inhabited in the value creating steps, *muda* is hiding. These *muda*'s may influence the value of the chain as a whole and will be evaluated in the next section.

In a supply chain, there are also different risks to consider. As supply risk may be defined as negative outcomes which result in inability to meet customers need (Zisidisin, 2003). This also has a close relation to the waste. When a risk is identified it may result in a waste, either as an effort to avoid the risk, or that it cannot be eliminated and may potentially result in increased costs. Risk may also be a possible threat to customer value. Because of this relation, the different risks in the chain will be pointed out as the different problems and issues are discussed.

4.2 The Seven Wastes of Lean

To recognize the two types of *muda*, the chain has to be analyzed from the customers' perspective. In simplified terms, this implies that as long as the required goods are available when needed, how they reach this state is insignificant. The customer will either pick up the goods at the warehouse, or it will be transported to the location where it is utilized. From the warehouse perspective however, the supply chain and its properties are highly important. A breakdown in the supply chain will put the warehouse in a pressed situation. They will not be able to meet the demands of their customer and the whole logistic process will be abrupt.

As mentioned in the as-is analysis, the inbound logistics from an inland supplier mainly follows three paths (for reference see chapter *3.1.1 Physical Flow of Goods*, p. 30), where all three include at least one reload of the goods. The goods are loaded at the supplier, transported to an intermediate storage, loaded on a new truck, before it is delivered at the plant. All this reloading is an example of unnecessary motion of goods. It adds no value to the end customer. The reason for why the goods are reloaded also differs. Sometimes it is due to the logistics system of the carriers, sometimes it is due to the location of the supplier and sometimes it is done to minimize the delivery frequency at the plant. When the reloads are done to minimize the deliveries at the plant, they include goods from several suppliers. In lean thinking, there is a focus on complete value streams for entire products (Womack & Jones, 1996), and by mixing deliveries from different suppliers, this focus evaporate. In the supply

chain, there is no differentiation between the different goods transported, as long as it is not services or chemicals. The goods are merely picked up at the supplier when ordered, before it is transported, independently of what stream of good the purchase stems from. Additionally, the plants buy goods from the same suppliers, independently of if the plant is xStatoil or xHydro, purchase from the same suppliers. However, the arrangement for transportation is done with the carrier that has the existing contract with the specific plant, due to the different licenses. This implies that both for example Sture and Mongstad may purchase from the same supplier, but the goods are picked up separately by the use of Grieg and Bring. In that way, double effort is put in to gather goods from one supplier, which is going to be transported to the same area. The supplier needs to upload on two trucks, two trucks drive the same route, two drivers need to be paid and the fuel is doubled. It also result in two deliveries at the warehouse, where two separate consignments needs to be signed for and controlled, and two different invoices processed. This is also an example of the waste of transporting, because a process that could be handled once, now need to be handled twice. This is examples of type two *muda*. As customer value is defined as reliability, flexibility and efficiency, this waste of resources will get consequences for the efficiency of the chain. Even though the specific transporting time may be approximately the same, the time of up-and-unloading, reload and delivery takes twice the effort. So does the expediting. Both of these issues also generate costs in the sense of time consuming activities. Instead of letting the product flow uninterrupted through the chain, it is abrupt by reloads, even though these reloads may be done for a reason. Both reloading and double effort imply a cost because it demand a use of extra labour which could have been used in value adding activity, if not value adding activity for the customers defined in this paper, than value adding activity in the value chain at Bring and Grieg Logistics.

When it comes to the supply of chemicals, the sheer transport is handled by the supplier. The transportation is therefore more streamlined without one of waste of unnecessary motion found in the supply chain for consumables and spare-parts, because the different reloads are eliminated. However, both chains are a victim of another waste, which emerges when the chemical trucks delivers to the storage facilities at the plant, or the spare-parts and consumables are delivered at the warehouse. From these locations the amount of goods needed in order to obtain operation or make the final products like petrol and diesel, is moved to the production facility or tankers were the actual maintenance or blend happens. The chemicals therefore have their own intermediary, in the same way as the other products

ordered from inbound suppliers, but it is located inside the plant instead of in the warehouse. These intermediaries are examples of the waste of transportation and can be defined as type one *muda*, because it is a part of the activities needed to make customer value.

When it comes to the supply chain from abroad suppliers, the same wastes of unnecessary motion and transportation as the inland suppliers are found. However, further wastes of unnecessary motion emerge as the issue of customs arises. This activity is also an activity needed to obtain the value creation in the chain, and is a type one *muda.* This process requires paperwork for approval and control of the goods. Additionally, it causes an extra stop for the goods before they can be used in value added activity. If the goods are ordered to be used in direct maintenance and not for storage, the customs represent a waste of waiting. The reason is that the time the goods use to go through customs, could be used to maintain the plant. In that way, the time is not used effectively. Most likely, this is calculated for, but if any obstacles should arrive along the way, it may be a cost tied to this waste as the mechanics that was supposed to carry out the reparations have nothing to do for a period of time. There is always a risk of something going wrong. This goes for all the different supply chains and may result in both extra cost and additional waste. Examples of risks are the risk of confusion around pick up and delivery date, damaged goods during transport or incomplete purchasing orders delivered. All these risks will be evaluated through this chapter.

Another issue to consider which causes waste in the different supply streams is when the incoterm of FCA is not fulfilled. This is also defined as a risk, as it may cause unwanted outcomes(Zisidisin, 2003). If an abroad supplier delivers the goods DDU and Bring and Grieg is not used, it may result in confusion around who handles the declaration and value-added tax. In the case of this incoterm, the sellers should arrange for transport on the buyers behalf, and if Bring or Grieg is contacted, they handle the paperwork of the declaration of the goods. If the seller uses its own carrier the customs may not be paid because the incoterm does not determine the responsibility of this part of the transportation. This result in a lot of unnecessary motion, because the warehouse first need to find out if the customs already handled, if not, all the papers of declaration that is supposed to follow the delivery has to be taken care of in retrospect. As Bring and Grieg handle these things on a regularly basis, they are also used to handle these situations. However, instead of the papers being handed over at delivery, the specification of the product and all the properties has to be obtained before they are sent to the authorities. There an invoice is made, which then is sent to the invoicing

department where so the custom is paid. This process also generates costs because of the extra time consumed to avoiding punitive tax. If the punitive tax becomes a reality, this implies an extra cost of 60-65 % (G. Meyer, interview, 17.03.2009). The expediting of these consignments is also a lot more time consuming, as the goods are not in either Bring or Grieg's logistic system. A lot of administration is needed to keep track of where the goods are located. In that way, the waste of waiting appears in the sense that time is not used effectively (Harrison & van Hoek, 2005). Instead of using their time to follow up deliveries from other carriers and keeping track on the payment of customs, the carriers could use this time to expediting other consignments. Because these wastes may be eliminated without any consequence for the value to the customer they are defined as type two *muda*.

A second incoterm which generates the same wastes as DDU is EXW. As the supplier has no responsibility of the goods, not even the loading on to the truck, it generates higher risks. As the supplier is to arrange for transport on behalf of the buyer, the seller may contact Bring and Grieg. If this is not done and the supplier is abroad, the same issues with declaration and expediting arise. The declaration is avoided if the supplier is inland. Because these two incoterms violate the principle that StatoilHydro want to have control of their own logistics, this problem should be eliminated and is defined as type two *muda*.

All arrangement of transportation outside the frame agreement of Bring and Grieg, or the use of all incoterms besides FCA also brings about some kind of cost. The price of the transportation varies with the weight of the goods, which goes down the fuller the truck. Additionally, an administrative charge is invoiced for the expediting and there are different charges for different transportations, like plane or truck, normal or rush order. Every delivery outside Bring and Grieg are invoiced StatoilHydro separately from Bring and Grieg. This is normally more expensive then by using these two. Additionally, the deliveries result in a rush at the goods receipt with many trucks from different carriers. This makes the receiving of goods less predictable. When the pace is higher, less time is also available to register in SAP, put the goods in stock and alert the requirer. Things may pile up and cause unnecessary wastes of waiting and motion as other assignments are put on hold. Further, this may continue down the chain and cause delays in the maintenance or operation of the plant.

A misunderstanding between pick up and delivery date may also occur if it is not thoroughly specified. If this happens, a waste of transport may arise as the goods that should be ready for

pick up is not and the truck need to return empty handed. The other way around, the supplier may arrange for transport in a specific day, but this is not registered at the carrier and the goods are not picked up. This result in unnecessary motion, as the goods that are ready for pick up need to be brought back to its storage location and the employee handling them has moved with the goods unnecessarily. In addition to cause waste at the supplier and carrier, this misunderstanding may cause problems for the customer if what is registered as delivery date is actually pick up date. Planned work need to be put on hold and waste of waiting occurs.

The waste of waiting also occurs when deliveries are not made on time, as delay in the other part of the value chain may emerge. As the goods are not delivered when expected, the planned work of maintenance have to be put on hold. To avoid this waste and misunderstanding between pick up and delivery date, Bring and Grieg do expediting. This implies keeping contact with the suppliers and forward any necessary information to the warehouse or if possible to the requirer. By doing a thorough expediting, this problem can be minimized.

By eliminating the wastes mentioned above, the goods may be delivered more efficiently to the end-customer and is therefore defined as type two *muda*.

Delays may also arise if the risk of goods being damaged during transport is realised. In a situation where a good is damaged during transport, the incoterms in the contract decides the liability. If the goods are delivered FCA, the responsibility is in the hands of StatoilHydro, and the process of handling insurance and a new purchasing process is initiated. Then, new arrangement for transport is done and the new good is on its way. When a good is damaged during transport it may also cause accumulated costs in the organization as it may put planned work on hold so time is not spent efficiently. This results in a waste of waiting. However, as it is difficult to eliminate waste caused by external factors StatoilHydro has no control over. The wastes mentioned above are therefore characterized as type one *muda*.

Additionally, spare-parts are sometimes taken out from the production facility and sent to the supplier for overhaul. These parts also go through the warehouse, are registered as sent for repair before it is transported. The registering in SAP represent a waste of motion as the part also need to be checked out of the system when it comes back. In that way, double processing

of the paperwork is needed. Further on, the supplier need to receive the part, overhaul it by the use of his equipment and people, before the part is transported back to the production facility and put back in its place. This implies a waste of transport because the part could be fixed by the supplier coming to StatoilHydro. However, if the overhaul requires the use of heavy machinery which is difficult to move, transporting the supplier to the plant together with the equipment may be more wasteful than sending the part to the supplier. As parts need to be overhauled to secure the operation of the plant, these wastes are characterized as type one *muda*.

When it comes to the supply chain of services, this chain also inhabits *muda.* The delivery of services is different from the other chains as the services are executed at the plant. The services can also take different forms because they may be performed by the mechanics employed by StatoilHydro, or by external suppliers of services. As the service supplier normally is located inside the plant together with the other customers of the supply chain, two risks may be identified which cause potential problems. The first one is when the service supplier order goods outside the warehouse-system. When a subcontractor orders a good to be delivered at the onshore plant, the delivery address may not comply with the address at the location. If this is the case, the carrier may use a lot of time to find the location which result in inefficient use of time, if Bring or Grieg is not used. This can be seen as unnecessary transportation, when the products are transported around without reaching its end-location because the carrier is not known in the area. Additionally, the security in the gate may not be aware of all the subcontractors at the plant and reject the truck by a mistake. Second, the delivery might not be known of at the warehouse, and when they arrive it generates time consuming activities in registering and forwarding the goods. As a result, the waste of waiting emerges, because the subcontractors are not able to do their work, as a consequence of missing delivery. However, the goods may be delivered at the warehouse, but since the employees at the warehouse has to find out how to get the goods to the right customer, it is put in storage until the requirer is located. This results in an intermediate waste of inventory and unnecessary motion. The unnecessary motion is the excessive effort made by the warehouse employees in finding the requirer as it may entail involvement of different departments or people. Further, the truck which delivers the goods may not be security cleared. If this happens, it will not be able to pass through the gates at the plant. This also goes for all the external carriers outside Bring and Grieg. When a truck is not security cleared a process of clearance is commenced with all the effort of approvals and paperwork it may

imply. This is also pure *muda* in the sense that it could have been avoided if the goods were delivered FCA. This problem also generates the waste of inappropriate ordering, as it is an issue that should be avoided.

Second, there is a risk of an internal customer employed by StatoilHydro, order a good outside SAP. This causes several of the same problems as above, like the delivery not being known to the warehouse and if the supplier does not deliver by using Bring or Grieg, a security clearance problem may emerge. Additionally, the same effort of finding out who ordered the good is needed, however, as the consignment may only be marked with the address of the warehouse, this process may be even more time consuming than finding a subcontractor. In addition to finding the requirer, the purchase outside SAP does not generate a purchase order tied to the right work order and the warehouse does not know who to invoice. As a consequence, a waste of unnecessary motion occurs, because there is no work order to attach the invoice to when it arrives. The purchase also needs to be approved in hindsight and papers are moved back and forth. As these purchases are done by the requirer taking direct contact with the supplier, the principle of segregation of ownership is abused. By purchasing goods outside SAP, the price of the goods may also increase if the supplier is not a part of a frame agreement. A frame agreement guarantees StatoilHydro the best price on the products, but there are no such agreements with suppliers without. When buying from a frame agreement, the prices of the products are held in an own database. This is not the case when the supplier is not a part of a frame agreement. Then the supplier is free to set the price he wants, and as the requirer may not know the specifications of the agreement existing with other suppliers, he or she may accept a higher price than a purchaser would. Because the process of finding out who owns the requisition a waste of waiting occurs because the requirer may not use his or her time effectively as long as the goods are not in their hands. When purchase is done outside SAP, it also give birth to an additional waste; the waste of inappropriate ordering. As no purchase is to be done outside SAP, and the principle of segregation of ownership is to be kept in all purchasing situations, this way of ordering goods are not accepted.

Even though the prices in the frame agreements are to be updated continuously in the database, it sometimes arise lag as the updating is not done as quickly as the suppliers change their prices. Accordingly, the price on the purchase order may not be the same as the price on the invoice. This result in waste of unnecessary motion, because the invoice need to be

followed up manually, and the waste of waiting with the cost of personnel using their time ineffectively on non-value adding activities. These problems also lead to a waste of inappropriate ordering.

All the problems mentioned above generate waste because they are of no value adding character. As a consequence, they are defined as type two *muda*.

When it comes to inappropriate ordering, another waste is in close relation; the purchasing of wrong quanta. The procurement process is designed to obey the next step of lean, which is to let the customer pull the product trough the chain. However, this is only partly obtained. By letting the person that needs the goods, requires them instead of pushing spare-parts and consumable on them, the customer decides what is delivered to them. The reason for why the products are not pushed at the customer is because the demands are very specific when it comes to quality and area of utilization. A push technique from the warehouse would therefore be totally malfunctioned. Additionally the purchasing & logistics unit does not act as salespersons for the parts they forward. They only act as an intermediary. However, even though the goods are required by the customer, the requisitions are often fulfilled directly by the warehouse where the goods are available on stock. In that way the "pulling" stops when the order is placed, because the goods are already in StatoilHydro's possession. The supply to the customer therefore happens from stock, not from pulling the product through the chain, all the way from the supplier. Further, the governing documents require the warehouse managers to estimate the future need of inventory. In that way the procurement is based on predictions of customers need. This violate the principle of pull (Womack & Jones, 1996). By estimating the needs of a customer, inventory tends to pile up because estimation is rarely accurate. At the onshore plants, the governing documents require the estimation of stock with reference to use. This self-contradicts the goal of lean procurement set by the procurement & logistic department. By using estimates, an abruption in the chain will eventually happen as the estimates do not represent the actual need of the customer. A confirmation of this statement is easy to obtain by looking at the size of the warehouses at the plants. Another side of the estimation is ordering of goods for planned downtime of parts of the plant. This is done approximately every second year (H. Rambjør, interview, 23.03.209) to change wear out parts and do an overall service of the plant. The downtime is also done as a preventive action to avoid the cost of unplanned closing. The ordering of the products needed during the downtimes is done based on the knowledge of the warehouse managers and the know-how

from previous downtimes. Parts that might be needed are purchased, just in case. This results in unnecessary inventory.

When downtime is planned, the mechanics know in advance what is to be changed and can require the goods. However, unforeseen problems may occur if the requirer does not know the lead time of the product needed. If this is the case, a purchaser may have to go out in the market during the downtime, find a supplier that may deliver the part immediately, and get it to the plant as a rush order. This accumulates waste in the sense of unnecessary motion (the search in the market) and waiting (as the mechanic cannot do his job before the good is delivered). Cost also accumulates, as the expense of generating a purchasing order is about 1000 NOK with the time spent on purchasing, goods receipt and invoicing (K. R. C. Rossebø, interview 16.03.2009). Additionally, there is also a risk that the service during downtime reveals unforeseen wear that need to be handled as soon as possible. This is hard to foresee and may require the same as unknown lead time; rush orders if the part is not in storage and extra personnel. These problems are all results of the chain not being designed for flow. From the lean perspective, this implies *muda*. However, as the customer knowledge of lead time may be increased so the waste may be eliminated, the unforeseen wear revealed during downtime is hard to foresee. Accordingly, the problem of customer not knowing lead time is seen as type two *muda,* while the unforeseen wear may be both. As some of the unforeseen wear may be anticipated, some parts may be worn out sooner then expected and this cannot be predicted. Because the problem with doubt could be removed by an enormous effort on keeping track of all the different parts and their lifetime, this is seen as giant time consuming solution which serves little purpose. The wastes tied to this problem are therefore classified as type one *muda*.

When mentioning the cost of purchasing, another problem may be presented; the risk of several purchasing orders being created to the same supplier by the same plant. As it is costly to create several purchase orders this problem generate the waste of unnecessary motion, as the process is done over and over again when it in fact could be done once. It also implies a double handling as the purchase orders reach the supplier separately and are handled that way. As the interviews showed, the suppliers do not do any gathering of purchase orders as they invoice per order. When many PO's are received, they are normally sent out immediately, which also result in the waste of transportation as the goods maybe could have been picked up all at once. If, nevertheless, the supplier gathers the purchasing orders before sending them

together to the plant, the purchasing orders need to be handled separately at the goods receipt. They need to be put separately into SAP, where each PO is tied to a work order and invoiced. Additionally, each PO will generate an invoice from the supplier, which then has to be handled by the invoice department. When one plant generates several purchasing orders to one supplier, this process has to be repeated for each PO. This results in the waste of motion. As this problem does not increase customer value, it is seen as type two *muda*.

For the warehouse, the same waste of motion is created if one purchasing order is sent to the supplier, but only a part of it is delivered and the other part is in rest. The same purchase order then need to be handled twice. If the order is for stock, the goods are put in storage, but if the goods are for immediate use, the requirer need to be made aware of that the order is delivered incomplete. If the products delivered may not be used without the other part of the consignment, the expediter needs to contact the supplier and get a rush order, or find out when the goods may be picked up. When the rest of the order is delivered, the remaining of the PO is processed in SAP. This causes unnecessary use of time, which is waste of waiting. This is a type two *muda* and should be eliminated.

Another problem in the purchasing process is when a requirer cannot find the goods needed in SAP. As the warehouse stock should always be updated, the requirer will be able to see if his or hers product is available in stock, and if it is not, a request may be sent to the purchaser. However, delays at the warehouse may cause problems when the goods are at the warehouse location, but not yet registered in SAP. If this happens there is a risk of the requirer requesting a rush order, despite that the goods are already at the warehouse. This may cause unnecessary inventory (if the goods are not purchased for storage but exclusively for the request) and unnecessary motion (the new purchasing process). In this case these wastes are possible to remove, and are therefore identified as type two *muda*.

Another problem identified connected to SAP is if the purchaser forgets to close the request when the purchasing order is sent to the supplier. When the case stated as open, the requirer will not be able to know the status of the request. The purchasing process may not be started, or it may be terminated without the requirer being updated. This may cause unnecessary waste of waiting as the requirer may need to use time on finding out if the purchasing is on time instead of doing other value-adding activity.

According to Harrison & van Hoek (2005), the waste of unnecessary inventory is a sign of flow being interrupted and that there are problems inherent in the. An example of interruption of flow is when goods not order for storage are not gathered by the requirer at once. This may stem from different reasons, for example that the requirer is on holiday, is busy with something and do not have the time to pick up the goods, or that the employee at the warehouse has forgotten to send out an alert through SAP. However, when the goods are left at the warehouse, they take up space that may be planned for other inventory. If the goods are not purchased for storage, an accumulation of stock may be seen as unnecessary inventory. If this is the case, this situation may result in unnecessary motion because the goods not ordered for storage need to be moved to another location when products for storage are received.

Both of the issues above should be able to eliminate without jeopardizing customer value and are therefore defined as type two *muda*.

All articles at a specific warehouse are tied up capital with no specific value added before they are utilized. This is also the case at the warehouses at the onshore plants. However, as inventory tends to decrease as the goods are sold, at the onshore plants the inventory is steadily rising. One of the reasons for this trend is the delivery time of specific spare-parts. Some parts have lead times of one to one and a half years and gets obsolete before they are used (K. R. C. Rossebø, interview, 16.03.2009). If these parts are seen as critical, they are ordered for storage. As mentioned in chapter *3.1.2 Information Management* (for reference see p. 38) a minimum limit of stock is set for most critical goods because they are always to be available. When a part classified as critical is used and has been on storage for several years, the price of the new, same part has risen. When the part is ordered for storage again, the value of the inventory rises. In that way, the cost of inventory is continuously accumulating. As Harrison & van Hoek (2005) claim, the keeping of stock may come as a consequence of other problems in the chain. In this case, the problem is that the risk of not having something available when needed, have the potential of being much more expensive then keeping it on storage. However, what is seen as necessary or unnecessary will vary from business to business.

In this case, the warehouse has a vital function in the securing of external customer value, as it is kept as prevention against unplanned downtime. Even though inventory usually should be

minimized, there are some reasons why this *muda* might not be able to be eliminated just yet in this specific case.

Some of the parts may be hard to get a hold of from the supplier. Since only a part of the complete value chain is analysed in this paper, it is not possible to determine whether or not these products are available constantly at the supplier. However, as the interviews expressed a concern about vital parts having long lead time, an assumption is made that these parts are necessary to keep in storage. This implies that the definition of what is unnecessary varies. If a company only need spare-parts that are standardized and may be derived from a numerous of suppliers, a minimum or no storage is necessary, because the parts can be ordered when needed and delivered right away. If it is not available at one supplier, it is available at another. In this case, the only thing to consider is the time it takes to transport the goods to the production facility. At the production facility which normally serves as the main value adding part of the chain, it is important to secure that it runs as smoothly as possible. If the production facility breaks down or the production is hindered, the customers on the other side of the supply chain may suffer. Accordingly, the cost of unplanned production downtime is severe; both in forms of lost income, rush order to require the parts needed and extra man-hours to resume the production. If the production facility fails, much of the value-flow is also interrupted, as the refining will not be done. Naturally, it is unlikely that the whole plant should break down at once, but only closing of a part of the plant may have a large impact on the cost factors above. In that way, having crucial parts to secure a continuous running of the plant on storage might be a waste of unnecessary inventory, however, it is defined as type one *muda*.

The turnover at the warehouse should be as low as possible. Normally, a high turnover is seen as positive as it indicates a healthy stock, while a low turnover is seen as negative as it may be a consequence of dead stock. However, in this case a low turnover implies that the production facility runs smoothly, while a high turnover means that there is a lot of maintenance needed. This implies that the necessity of different products suddenly is highly relevant at one plant, but not at another. What is necessary inventory is therefore plant specific.

The warehouse also handles different picking lists from their internal customers. These picking lists are generated in SAP, and the warehouse employees gather the specified items so the customer may pick them up all at once. A problem that emerges connected to this issue is

when several pick lists are generated from the same requirer. This typically happens if the requirer forgets to put something on the first list, or if a list is generated every time the requirer think of a need, without gathering them before sending one singe list. For the warehouse, this implies less efficient time spent as the employee putting together the request need to handle several pick lists. As a consequence, wastes of unnecessary motion occur, as the employee needs to handle several lists at the same time instead of one.

The last issue that was identified through the interviews was that many people involved in the same process makes it less efficient. This can in a way be compared to what happens when an organization is organized to focus on functions rather then process. When this is the case, the flow of value is inhibited. As the different functions focus on their own tasks, the whole picture may fade. Some of the same problems arise when many is involved in the same process. As different people have different opinions and different ways of handling the same activity, many people involved in the same process may result in the focus being on getting their way across instead of securing flow. Additionally, when many people are involved in the same process, knowledge transfer may be more difficult and the information has to be told several times. This result in a waste of waiting and unnecessary motions, as the tasks could be handled by one person all the way from start till end. When many people are involved in the same process, misunderstandings are more likely to occur. This does not only go for the employees at StatoilHydro, the supplier may also be a victim of this problem. However, when thinking of StatoilHydro, the principle of segregation of ownership may be violated, if the handling of one process is done by one person. This makes this problem hard to eliminate and the above mentioned wastes are therefore characterized as type one *muda*.

4.3 Categorization of the Problems and Issues

To categorize the different wastes, an affinity-diagram may be used. This diagram serves the purpose of structuring different ideas that appears in random order ("Affinity Diagrams: Organizing Ideas Into Common Themes," n.d). However, as there is a lot of information that need to be structured, the problems are presented in a. affinity table together with the consequences they may cause. As the table shows, one problem may cause several types of waste, which makes it hard to structure the problems under one waste. Additionally, the table attaches the different problems to what type of *muda* they represent. As the type of *muda* have a strong impact of the possibility to banish the identified waste, this relation is important to

illustrate. As an aim of this research is to propose quick wins which StatoilHydro, the differentiation between the types of *muda* is very important, as type one may not be eliminated as easily as type two. Below, the affinity table is shown.

Table 4.1: Categorization of problems and issues

Problem	Type of *muda*	Consequence	Waste
Warehouse	ONE	♦ Extra labour ♦ Time consumed on paperwork which need to be handled several times	Unnecessary motion, defect
Customs	ONE	♦ Time consumed on paperwork	Unnecessary motion, waiting, defect
Spare-parts with long lead time	ONE	♦ Stock obsolete before use ♦ Purchas of new good more expensive than value on the existing part ♦ Increase in inventory value	Unnecessary inventory, defect
Goods damaged during transport	ONE	♦ Depends on incoterm used; paperwork insurance, new purchasing process and arrangement for transport, planned work on hold and time not spent effectively	Transport, unnecessary motion, waiting, defect
Moving parts for service	ONE	♦ Time used to dissemble part ♦ Processing and movement through warehouse ♦ Transportation of good ♦ Receiving at supplier and overhaul	Transport, unnecessary motion, defect
Unforeseen wear revealed during service	ONE	♦ Rush order if part not in storage ♦ Extra personnel needed to repair the wear	Unnecessary motion, waiting, defect
Plants with different carrier licences purchasing from same supplier	TWO	♦ Double effort ♦ Paper shuffling	Transporting, unnecessary motion, defect
Reloads during transport		♦ Chain less streamlined ♦ Time-consuming	Transport, defect
Iincoterm DDU used	TWO	♦ Customs not paid ♦ Punitive tax may occur if other carrier than Bring and Grieg is used ♦ Paperwork in handling customs ♦ Work on hold ♦ Time to sort out misunderstandings when customs not paid	Unnecessary motion, waiting, defect
Incoterm ex works used	TWO	♦ Extra time consumed on expediting ♦ If abroad supplier same problem with customs as DDU	Unnecessary motion, waiting, defect

Problem	Type of *muda*	Consequence	Waste
Supplier scheduling transportation outside frame agreement, Bring or Grieg not used	TWO	♦ Rise in price of transportation ♦ Rush at goods receipt ♦ Less time to handle goods when delivered ♦ Goods piling up at goods receipt ♦ Other assignments put on hold ♦ Delays in other parts of operation and maintenance	Unnecessary waiting and motion, defect
Misunderstanding between pick up and delivery date	TWO	♦ Truck return empty ♦ Goods made ready for transport moved back to primary location ♦ Planned work postponed	Transporting, unnecessary motion, waiting, defect
Goods not made on time	TWO	♦ Planned work postponed ♦ Time used for obtaining new delivery information (expediting)	Waiting, defect
Service supplier ordering goods outside the warehouse-system	TWO	♦ Delivery address not equal to plant address so the carrier does not know where to deliver ♦ Security personnel not knowing which subcontractors are located at the plant and the truck is rejected ♦ Truck not security cleared ♦ The warehouse does not know of the order and need to use time to find out who the order belong to, while the goods need to stay at the warehouse ♦ Subcontractors not able to do their work because the goods are not delivered when expected, as they are held up at the warehouse	Transport, waiting, unnecessary inventory, unnecessary motions, inappropriate ordering, defect
Internal customer ordering goods outside SAP	TWO	♦ Delivery not known to warehouse ♦ If Bring or Grieg not used the truck may need security clearance ♦ Time spent on finding out who required the goods ♦ No purchasing order ♦ Unknown work order to attach invoice to ♦ Principle of segregation of ownership violated ♦ Rise in price of good ♦ Requirer not using time efficiently	Unnecessary motions, defect, waiting, inappropriate ordering, defect
Estimate of customer need	TWO	♦ Risk of estimate not accurate ♦ Inventory rising	Purchasing wrong quanta, unnecessary

Problem	Type of *muda*	Consequence	Waste
			inventory, defect
Requirer is not aware of lead time	TWO	♦ Goods not available when expected by the requirer ♦ Purchaser need to search for alternative supplier in the market place ♦ Rush order may be needed	Unnecessary motions, waiting, defect
Several purchase order to same supplier by same plant	TWO	♦ Increased cost in purchasing process ♦ PO's handled separately by supplier ♦ PO's sent separately to plant ♦ PO's handled separately at the warehouse as they are generated by different requirers with different work orders ♦ Separate invoices sent and need to be handled	Unnecessary motions, transportation, defect
Incomplete PO delivered from supplier	TWO	♦ Same PO handled several times at warehouse ♦ Time spent communicating partial delivery to requirer ♦ The order may only be useful complete ♦ Double transport	Unnecessary motions, waiting, transporting, defect
Requirer cannot find the goods needed in SAP	TWO	♦ Additional purchasing process ♦ Rush order ♦ Increase in inventory if good is actually at warehouse, but not yet registered	Unnecessary inventory, motion, defect
Purchaser forget to close case in SAP	TWO	♦ Requirer does not know the status on the request	Waiting, defect
Goods not picked up by requirer at once	TWO	♦ Goods not purchased for stock located at the warehouse ♦ Space used may be planned for different purposes	Unnecessary inventory, motion, defect
Several pick lists generated from same requirer	TWO	♦ Extra time spent to handle several pick lists instead of one	Unnecessary motion, defect
Many involved in same process	TWO	♦ Inefficient chain ♦ Too many personalities ♦ Making chain less streamlined	Unnecessary motion, defect

4.4 Prioritising of Quick Wins

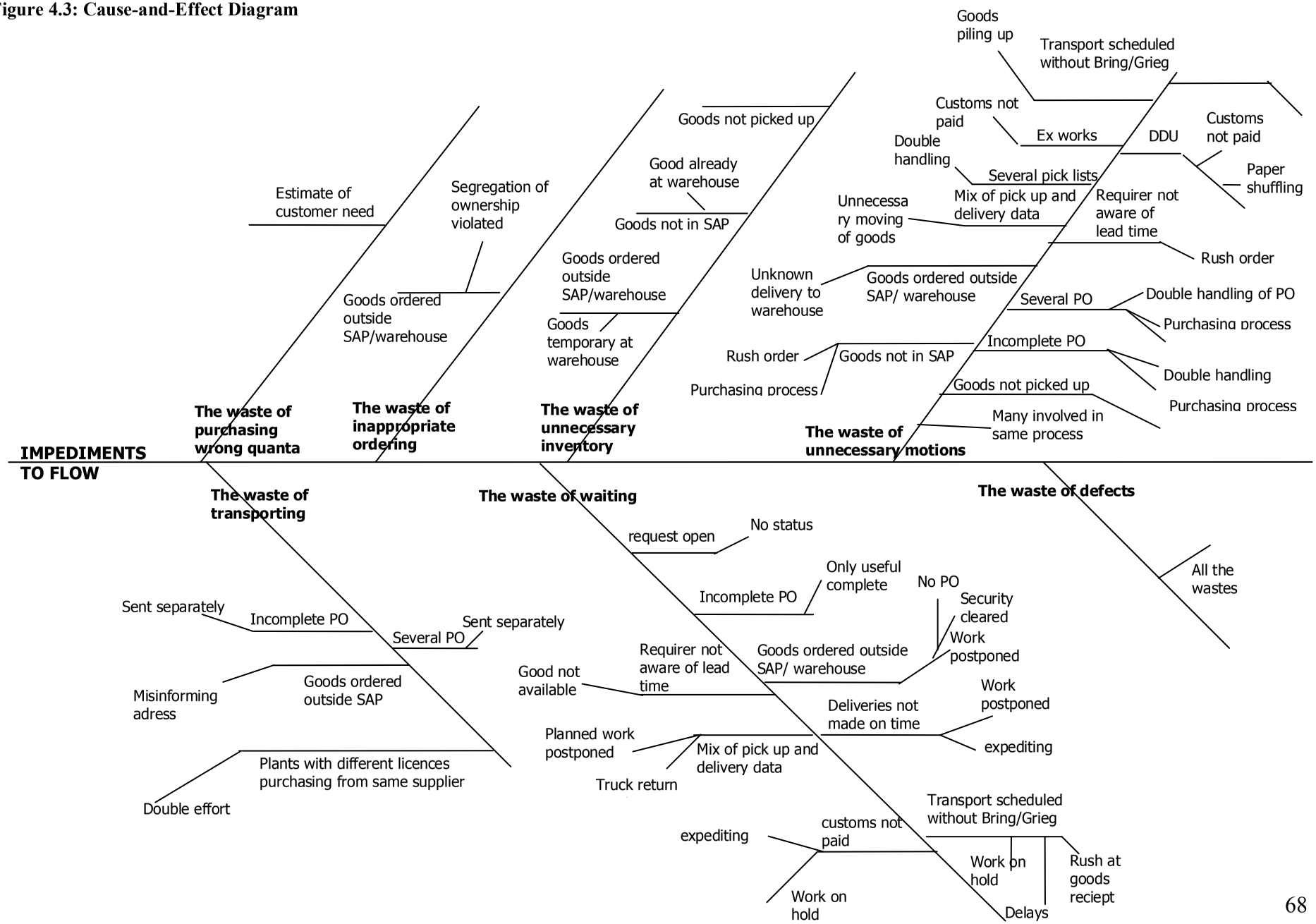
The different problems and issues identified above represent some sort of gain if they are eliminated. If some of these gains may be realized with as little effort as possible, they can be characterized as quick wins. However, when it comes to deciding which wins to focus on, the purpose of eliminating the wastes need to be in focus.

As the starting point of all effort in lean thinking, customer value is in focus. To increase this value, the third step of lean; flow, may guide the way. According to Womack & Jones (1996), flow means to "concentrate on managing the value stream for the specific service or good, eliminate organizational barriers by creating lean enterprise, relocate and right-size tools, and apply the full complement of lean techniques so that value can flow continuously" (Womack & Jones, 1996, p. 64). This implies that the prioritizing of the quick wins should strive to better flow in the supply chain, to make it more reliable and efficient.

As the categorization show, both type one and type two *muda* was found. The different type one *muda*'s were put in this category because they either cannot be eliminated like the customs and some because they cannot be eliminated immediately but maybe changed to increase flow. One example in this case is the warehouse. As stated earlier in the paper the warehouse cannot be eliminated, however, some of the type two wastes are in close relation to the operation of the warehouse. If these wastes are eliminated, the warehouse may cause less obstruction for flow. The type two *muda*'s will be the focus in this section, merely because these are the wastes that has the most potential of being quick wins.

Before the different quick wins are evaluated and put in prioritized order, the relationship between the wastes and which problems cause them, may be illustrated in a cause-and-effect diagram. This diagram is used to identify and think through possible causes of a problem ("Cause and Effect Diagram," n.d). In the following illustration the different problems and their consequences are put together with the waste they represent. As mentioned in the previous chapter, one problem may cause several wastes and is therefore placed under all these wastes. Additionally, as the type one *muda*'s may be hard to overcome, these are left out of the diagram. The illustration is shown on the following page.

Figure 4.3: Cause-and-Effect Diagram



The most distinctive wastes due to this illustration are the wastes of waiting and unnecessary motion. Some of these wastes are also the ones that may be eliminated with small adjustments. However, as StatoilHydro's purchasing & logistic unit is a large organization in itself, even small adjustments may be of a comprehensive nature. However, if resources are invested to eliminate the waste, flow will be increased and the way to perfection begins.

According to Womack & Jones (1996), the key to perfection is transparency. To accomplish this, communication is the key. If the wastes are seen from this perspective, most of the problems of unnecessary waiting and motion are a result of lack of communication. This issue emerges as a final consequence of the wastes. By opening for better communication, these wastes may be eliminated.

As better communication may result in a more reliable and efficient chain, this is a good base for prioritizing the quick wins. The realization of the quick wins will most likely result in an improvement of the communication between the different parts of the chain. Additionally, small grips may be taken internally at StatoilHydro, to avoid unnecessary waste of waiting and motion. These problems will also be included in the prioritizing. Because of the different levels of the problems, the prioritizing is divided in three; quick wins, which problems that may contribute the most to flow by being eliminated and the problems that cannot be eliminated because they are not in the hands of StatoilHydro.

Below the first group of problems are presented in prioritized order, based on the degree of how difficult they are to obtain (from least effort to most), in addition to what they require to be realized:

1. *Purchaser forget to close case in SAP*
    - Better routines at the employees.
2. *Requirer cannot find the goods needed in SAP*
    - More efficient goods receipt
3. *Several pick lists from same requirer*
    - Better information about the consequences for the warehouse
4. *Goods not picked up by the requirer at once*
    - Better information about the consequences for the warehouse

5. *Misunderstanding between pick up and delivery date*
    - More thorough expediting to avoid misunderstanding
6. *Incomplete PO delivered from supplier*
    - Better communication about consequences for goods receipt and that the goods may not be used separately. Demand delivery of complete PO.
7. *Several PO's to the same supplier by the same plant*
    - Gathering of PO's at purchaser before they are sent to supplier
8. *Internal customer ordering goods outside SAP*
    - Better information about the consequences of this way of purchasing
9. *Service supplier ordering goods outside the warehouse-system*
    - Better information to the suppliers about the consequences of this way of purchasing
10. *Requirer not aware of lead time*
    - Better information from the supplier around the lead time of their products
11. *Plants with different licences purchasing from same supplier*
    - Communication between carriers about pick up locations.
12. *The use of the incoterms DDU and EXW*
    - Better communication with the supplier about the terms of the contracts
13. *Supplier scheduling transportation, Bring and Grieg not used*
    - Stress the use of FCA, better communication with supplier.

The second group of problems is not defined as quick wins because they are much more comprehensive. As a consequence, these wastes may be the ones that can make the most difference when it comes to increasing reliability, flexibility and efficiency. The prioritizing of these wastes is therefore done with the grounding of which of the problems could contribute most to increase flow by being eliminated (including the type one *muda*'s):

1. *Estimate of customer need*
    - Require an arrange for pull further than the warehouse
2. *Warehouse and other storage intermediaries*
    - If pull is induced, the problem of unnecessary inventory may be minimized.
3. *Many involved in same process*
    - Might require a restructuring of the organization to a more process based view

4. *Deliveries not made on time*
    - Require a better communication with supplier. However, if the supplier cannot live up to the standards StatoilHydro require the agreement may be reconsidered.

The last category of problems is the ones that cannot be eliminated only by the effort of StatoilHydro alone, and some cannot be eliminated by the simple cause that they are required by the authorities. These problems are therefore prioritized after the influence StatoilHydro has in order to eliminate them:

13 Goods damaged during transport
- May be calculated for by the use of stock, but the risk will always be present.

14 Goods not delivered on time
- Expediting may be done to minimize the consequences of this problem, but it cannot be eliminated by StatoilHydro alone.

15 Unforeseen wear revealed during downtime
- Regular maintenance may minimize this problem however there will always be a risk of unanticipated wear.

16 Spare-parts with long lead time.
- This is the supplier's issue and to create better flow this part of the chain need to be analysed and arranged for flow.

17 Moving parts for service
- Difficult to eliminate if the service requires machinery for overhaul.

18 Customs
- Cannot be eliminated.

When looking back at the definition of the waste of defect, all the problems mentioned above actually represent this waste, because they make the chain less efficient. This is also highlighted in the table *4.3: Categorization of Problems and Issues* as all the problems are defined as waste of defect. To illustrate this, the problem of an internal customer doing purchasing outside SAP makes the chain defect because it violate the principle of segregation of ownership in addition to causing a lot of extra work leading to even more waste. An estimate of customers need is also a waste of defect because it does not encourage flow

through the principle of pull and if the goods are not delivered on time it makes the chain less reliable. As a consequence, by eliminating the causes that result in the waste of defect, the other wastes will be reduced.

Even though not all the wastes may be eliminated immediately, Womach & Jones (1996) states that the process of becoming a lean enterprise is not done over night. To reach the final principle of perfection, the processes need to be analysed again and again, altered to eliminate new waste that was not detected during the introductorily analysis. In that way, as the different problems and issues are eliminated one by one, the reliability of the chain will increase, causing customer value to rise.

This chapter has given a thorough analysis of the inbound logistics at the onshore plants. By following the principles of lean thinking, the customer value has been identified and the values stream illustrated. Additionally, the costs and risks were placed where they are generated. The actual analysis strived to identify which of the seven wastes of lean the issues represented and categorize the problems according to what type of *muda* they represented. The most comprehensive wastes showed to be the wastes of unnecessary motion and waiting and the wastes. The last section of the paper presented a cause-and-effect diagram, illustrating which problems that result in the different wastes. Hence, the cause and effect showed that the wastes as a whole represented the waste of a defect process. In the end, the problems and issues were prioritized according to three levels; the prioritizing is divided in three; quick wins, which problems that may contribute the most to flow by being eliminated and the problems that cannot be eliminated because they are not in the hands of StatoilHydro

5 Generation and Evaluation of Alternative Solutions

The generation and evaluation of alternative solutions to the problems and issues identified are based on contribution from the respondents in the interviews. As the main goal of both BPR and lean is to focus on customer value, the alternative solutions will be based on the possibility of making the chain, first and for most, more reliable. During the chapter, the solutions will be evaluated due to which gains in the terms of which problems they eliminate. As the previous chapter showed, the problems cannot be put into one waste-category only, additionally, to make the chain more reliable it has to be constructed for flow. As a consequence, the focus in this section will be on eliminating the identified problems by increasing flow, it be the physical flow of goods or the flow of information. By increasing flow, the value of the customer of the chain may be improved as the chain become more efficient and more reliable.

5.1 Alternative Solutions to Increase Flow

Organize for focus on stream of goods

This solution is based on the focus on process rather than activities, which complies with the theory of BPR (Ballé, 1995; French & Bell Jr, 1999; Peppard & Rowland, 1995). Mainly, this solution involves the problem of plants that has licenses with separate carriers purchase goods from the same supplier. As stated in chapter *4.2 The Seven Wastes*, this problem result in the wastes of transporting and unnecessary motion. Because the licences of Bring and Grieg were transferred when xStatoil and xHydro merged, these two carriers are obliged to serve the respective plants they served before the fusion. This implies that the focus is on fulfilling the activities needed to supply the independent plants, rather than focusing on the different stream of goods, like the different categories StatoilHydro has already defined (see *Appendix 4: Category Wheel,* p. 90). To these categories there are connected suppliers which serve this particular category. If the suppliers in the different categories are divided between Bring and Grieg, the problem of double transport may be eliminated. Additionally, it may be easier to obtain the use of FCA where the supplier actually contacts Bring or Grieg, as it will only have one carrier to relate to. Moreover, the expediting is halved as one carrier transports form the specific supplier, hence only one need to be followed up instead of two. Today, both the transport from Bring and Grieg need to be expedited separately. To try to avoid especially double driving, the carriers keep in contact and use each other as subcontractors. When it

comes to focusing on categories rather than plants, there is one important obstacle that needs to be handled before this solution is relevant. This is the existing contracts between StatoilHydro and Bring and Grieg. These contracts bind the carriers to serve the specific plants. If the contracts are changed, this solution may be an alternative.

Joint storage between the plants

A joint storage implies that all inventories are centralized to one big warehouse. By doing this, each plant will only have a small storage facility for consumables like screws and nuts, but all the larger parts are located at the centralized warehouse. The positive side of this solution is that the suppliers and carriers will only have one delivery address to relate to. Additionally, the plants will get the goods they need from one facility, rather than many different suppliers. The problem of incomplete PO's delivered will also be able to eliminate as the warehouse may collect the partial consignments and transport the complete one to the warehouse. However, even though this problem will be eliminated at the specific plants, the problem will still be relevant for the central warehouse as long as the wish of delivery of complete PO's are not communicated to the supplier. On the other hand, a central storage requires an outgoing distribution net between the warehouse and the plants. This has to be defined. Either, StatoilHydro may start their own internal transport unit, or the agreement with Bring and Grieg may be expanded. Additionally, the warehouses at the plant cannot be completely eliminated as the need of consumables should be met immediately. If the customer needs to wait from one day till the next just to get a pair of gloves or a screw, the irritation would rise quickly. However, if no critical or expensive equipment is in storage at the plant, the warehouses located on the site could be a self-service storage where the customer may collect the consumables he need without contacting warehouse personnel. The problems with several pick lists will in this case also be eliminated. If this is done, the need of personnel at the onsite warehouses will be minimal. The deliveries from the central warehouse may be communicated to the requirer through SAP, where the requirer needs to schedule for delivery. When the truck arrives the requirer receives the goods on his own. By keeping a central warehouse, the parts on stock may also be minimized as some parts are the same at the different plants. Instead of having five spare-parts on storage at every time, one on each plant, it might be enough with one or two, as these parts will most likely not be needed at the same time. This implies that the waste of inventory may be reduced dramatically. Further, the problems of people not gathering the goods ordered for them may be eliminated as no goods are sent out before the requirer has agreed to a delivery date. However, many of the same

problems as with separate storages may still appear: misunderstanding between pick up and delivery date, deliveries not made on time, internal customers and suppliers ordering goods outside SAP and warehouse, purchase from same supplier from plants with different carrier licenses and several purchase orders to same supplier from same plant.

Even though a central warehouse may make the flow the last part towards the plant more streamlined, the same paperwork and handling of goods need to be done. This implies that the flow of goods will not be obtained, as a warehouse still serves as a bottleneck. Accordingly, a central warehouse will not increase customer value radically. Additionally, as pointed out in the interviews, closeness to the plant is crucial is a critical part needs to be changed. If a central warehouse result in many cases of unplanned downtime, as the transport of the spare-part is not efficient enough, it will be more costly than a decentralized warehouse located at the plant.

Elimination of warehouse

The most dramatic way of arrange for flow is to eliminate the warehouses on each plant. This solution implies that no goods are ordered for stock, only for consumption. By letting the customer pull the product through the chain, they should be delivered directly at the plant. In the previous chapter, the warehouse was defined as type one *muda*. If the products are pulled through the chain when needed, it may be a problem if it is a crucial spare-part. Before this critical step is taken, a through research among the suppliers has to be undertaken to identify which possibilities are present. The removal of the warehouse itself will not make the chain more reliable, it is a combination between the elimination and the focusing on pull, all the way from the supplier. An elimination of the warehouse will also demand a restructuring of the whole purchasing and logistics organization as it has to work faster and more precise to get the goods from the supplier as soon as possible. However, a very important thing to consider with this solution is that the cost of unplanned downtime is very high. If a chain organized for pull result in unexpected downtime which may last for days, millions of NOK will be lost. When the warehouses has a value of 30-50 million NOK on stock and a serious downtime costs two millions an hour, the spare-parts need to be transported to the plant very quickly. If the goods have long lead times, or the supplier is located far away from the plant, a warehouse is an easy security. Additionally, if talking about customer value, a warehouse containing daily consumables and critical parts located at the plant is the most reliable situation.

Gather volume to same destination

This solution implies that all goods to the same plant are gathered at an intermediate storage before it is driven to the plant. As mentioned in the situation analysis, this approach is already introduced at Kårstø and Kollsnes. If this is transferred to the other plants, wastes like unnecessary motion (unnecessarily many goods receipt), transport (carriers which does not find the way) and waiting (security clearance) may be removed. Additionally, the same advantages as a centralized warehouse apply and give the opportunity to gather incomplete and several PO's from the same supplier before they are sent to the plant. However, another rearrangement of the transportation is not needed, as it is the carrier that handles the intermediate storages. When it comes to increase flow, this solution is defined as a waste of unnecessary motion, as the goods are reloaded before they are delivered at the plant. When it comes to the contribution to customer value, the gathering of deliveries from the same supplier is not of great significance. It might contribute if the order can only be used complete. The waste of waiting will in this case not exist because the customer does not know that a part of the purchasing order has arrived and will use his time effectively on other matters. At the goods receipt, one delivery is also more efficient and contributes to flow at the warehouse. Nevertheless, the same PO needs to be handled twice in SAP, and in that case, the situation will not be altered.

Increased number of frame agreements

This solution may contribute to increased efficiency in the procurement process. When a purchase is done from a frame agreement, the purchase does not require a search in the market for possible suppliers. If a frame agreement is established, these parts of the procurement process may be reduced as the agreements tend to last for several years. A negative side of this solution is that the increase in frame agreements may result in less competition among the suppliers. However, there is a difference between a frame agreement and a frame contract. A frame agreement only binds StatiolHydro to buy from the supplier but says nothing about the amount. A frame contract implies that StatoilHydro have to purchase a certain amount from this supplier. Accordingly, it is the number of frame agreements that should be increased. As a tender competition includes among three to five companies, frame agreements should also be made with about three to five suppliers of the similar products to secure the competition and best price. When it comes to value adding activity, this solution may result in better reliability because the suppliers are aware of their commitment to StatoilHydro. The

purchasing process is also shorter, which implies that the order uses less time to get to the supplier and hence the time is shorter to delivery. Accordingly, it may make the chain more efficient.

Increased communication

This solution may be divided in two; internal communication, and communication with external suppliers. As several of the problems identified showed, many of the problems emerge as a consequence of lack of communication. When it comes to the quick wins, many may be obtained by increased information internally in StatoilHydro. This implies that the flow of information is inhibited. In order to avoid a defect purchasing process, the consequences of these divergences has to be communicated downwards in the organization. Additionally, the measuring of these discrepancies need to be carried out. As the situation analysis showed. Many different KPI's were used throughout the different plants. However, the KPI's defined for the procurement and logistic function as a whole were few. Additionally, these KPI's were not known by the respondents of the interviews. For the KPI's to have a meaning they need to be used. By measuring defects in the purchasing process, it makes it easier to know where the resources should be put in. Additionally, KPI's are an easy way to communicate the status of a situation and the progress towards a specific goal. Another issue worth mentioning is that the strategy of striving for lean procurement was not known by the respondents working at the warehouses. These are a large part of this strategy, but with no relation to it, they cannot live up to it. A solution to increase the focus on the flow of information is therefore to use the KPI's more actively, define the same KPI's at each plant and benchmark them against each other to measure the progress.

If StatoilHydro manage to better the internal communication, the problems of several PO's sent to same supplier, purchases outside SAP, orders not closed in SAP, goods not picked up from the warehouse straight away and several pick lists to the warehouse. Additionally, better communication, and also control may reduce the risk of someone violating the principle of segregation of ownership.

A better communication between StatoilHydro and the suppliers will hopefully lead to eliminate the problems of the incoterms DDU and EXW used. Accordingly, all arrangement of transportation outside Bring and Grieg may be reduced. The most important issue of this

solution is that the category responsible needs to be clearer about the terms of the agreements. Because some of the suppliers have their own transportation, they are not interested in arranging for transport by Bring or Grieg. The process of repeating the delivery terms to the suppliers is currently initiated, to reduce this problem (F. Hetland, interview, 16.03.2009).

One process, one responsible

An example of this is the category responsible. By letting one person being responsible for one category, tenders and contracting, the quality of this process is secured. When it comes to procurement, there is no superior responsible for the whole process. As the segregation of ownership was introduced to minimize the risk of fraud, this also resulted in several people involved in the same process. Down the chain the information need to go through several steps before it is transmitted to the person that needs it. If the purchaser forgets to transmit the request to the supplier or the supplier fails to transmit the order to the production facility, not only the information flow is abrupt, but the chain becomes less reliable. Additionally, a third part is included to handle the expediting of the consignments. This implies that the information needs to be communicated to yet another part. Today, Bring and Grieg are located at the plants once or twice a week with access to SAP to ease the flow of information. The expediting function was outsourced as a part of the transportation, but it also has a close relation to the purchasing process. If these functions were merged, a waste of motion would be eliminated as the information would only need to go through one step. Additionally, the supplier has to relate to two parties; the purchaser at StatoilHydro and the carrier to arrange for transport. This may be a reason for why the problem of arrangement for transport outside Bring and Grieg occur. Even though the supplier is already in touch with the purchaser he needs to contact the carrier separately. If one person is in control of the whole process from ordering to the arrangement for transport, it would be easier to keep the information flowing.

Joint venture of carriers

This solution implies to create a joint venture between Bring and Grieg, to make the transportation more coordinated. Today, Bring and Grieg cooperate as close as the competition laws allow. If they cooperate too close, the question of price fixing and other law breaking issues may arise. A joint venture will ease the cooperation between Bring and Grieg, and give StatoilHydro a possibility to influence the transportation process directly. If this is done, the chain will be more streamlined in addition to be more transparent. As Bring and Grieg try to communicate and cooperate as close as possible, but it is not enough to make the

chain transparent because no one has complete overview of everything that is going on. Another issue that will be less problematic if this solution is chosen is that the coordination of the transportation will be easier as one superior unit supervise the whole chain. However, a joint venture demands capital, time and effort. If StatoilHydro wishes to have an even tighter control of their logistics, an involvement in a joint venture would be a possibility. Still, StatoilHydro wishes focus on their core competence, which is one of the reasons why the transport is outsourced initially. An involvement by StatoilHydro is therefore seen as less likely. Nevertheless, the gains of a joint venture may be discussed. As the coordination between the carriers will improve, the contribution to customer value will be minimal. Additionally, if the carriers go into a joint venture, the competition between them is eliminated. Because of the extent of their business, they may reach a monopolistic situation. This is stated on the foundation that even though double driving may be avoided and the expediting will be less comprehensive, the reliability of the chain will not increase significantly. If the venture on the other hand manages to minimize the number of reloads before the carrier reaches the plant, real customer value is created. By minimizing and maybe removing these reloads, several wastes are avoided.

In this chapter alternative solutions to increase the flow of information and goods were presented and evaluated. In the next chapter, the recommended solution will be presented.

6 Recommended Solution and Justification

When a solution is to be recommended, the first thing to decide is what terms the recommendations should be based upon. Throughout the analysis of the inbound logistics, the basis has been the theory of lean thinking. So far, all the five principles of lean; value, the value stream, flow, pull and perfection have been mentioned. Of these five, the four first have been the focus of the analysis. According to Womack & Jones (1996), when the four first steps have been followed through, the last step, perfection will emerge on its own. As the analysis has identified several problems which cause different wastes, or *muda*, it is also clear that the inbound logistics at StatoilHydro need some changes to reach the three last steps of becoming a lean enterprise. Based on this reasoning, a recommendation can be made.

The Recommended Solution

If any real difference in the sense of lean thinking should be made, the warehouses should be eliminated, to let the customer pull the product through the chain without hindrance. As the warehouse is an enormous bottleneck, the only good it serves is the security of prevention. When the aims of the inventory kept at the onshore plants is compared to theories on the subject of inventory, the theories state that the value of the stock should be as low as possible, with the highest turnover possible. At StatoilHydro on the other hand, there is no aim of minimizing inventory, the only rule followed is that when something is needed, it has to be in stock. Additionally, the warehouse represents a large gathering of different wastes, even though many of the wastes at the warehouse are actually a result of other wastes caused by a supplier or a customer.

The principle of keeping stock for security violates all the principles of lean that leads to perfection. With this in mind, a reengineering of the whole purchasing function should be implemented, so that unnecessary inventory could be eliminated. However, based on the function of the warehouse and the enormous economic consequences that may occur if the warehouse was removed, this solution seems less likely to be carried out. Additionally, gigantic organizational changes would have been needed to cope with these changes, thus Ballé states that business process reengineering may be done at department level, small steps at the time (Ballé, 1995). If the resources are to be committed to this kind of change, several

analyses should be undertaken; economical, risk and a thorough assessment of the suppliers and their capacities. This implies that even though this paper has identified the issue the warehouse represent as a waste by the principle of lean thinking, it is not enough to make such a comprehensive decision. The solution chosen for recommendation is therefore a solution that demand some adjustments, but that may result in increased flow if implemented.

As one of the main focuses in lean thinking and business process reengineering is to focus on process rather than activity, the solution chosen is *one process, one responsible.* This solution was chosen because of its possibility to increase flow and customer value. Because the existing focus in the purchasing process is on the different activities that has to go together in order to get the good to the requirer, to organize for one responsible for the whole purchasing process will increase the flow of information. As the flow of information goes faster, the supply chain will become more efficient and reliable. Several of the problems identified, is a result in lack of communication. With today's situation, misunderstandings occur and suppliers do not comply with the terms of the contract. By making one person responsible for the whole purchasing process, these problems may be eliminated and several of the quick wins identified in the previous chapter may be gained. Examples of these quick wins are; purchaser forget to close case in SAP (even closer follow-up then today), misunderstanding between pick up and delivery date, several PO's to the same supplier by the same plant (as one purchaser is responsible for the whole process of the purchase), the use of incoterm DDU and EXW (as the purchaser is responsible to contact the supplier and arrange for transport) and plants with different licences buying from same supplier (the purchaser is responsible for the whole process).

The question of how to handle the implementation of this solution in practical terms needs to be evaluated and discussed. One possibility is to include another of the evaluated solutions and create a joint venture with Bring and Grieg, and outsource the whole purchasing function to an own unit. The positive effects of this solution is that the purchasing function gets to specialize on what they do best hopefully reach the state of perfection promised by the theory of lean if the other steps are implemented. However, the discussion about how to implement the recommended solution is outside the scope of this paper, hence, the paper may serve as a starting point for further action.

Justification

As the choice of solution is made, it is important to acknowledge that a recommended solution without a cost analysis may be of little value in the business world. According to Taylo (1999), it is not an excuse to avoid taking a stand because not all the factors are available. He states that all decisions in business are made on the base of imperfect and incomplete knowledge. As the angle chosen to accomplish the purpose of this paper was lean thinking, the recommended solution is also based on these principles. If another theory base had been used, another answer may have been obtained. Different or several respondents could have given another picture of the as-is situation which again could have influenced the identification of problems and issues. The method chosen has also put its mark on the resulting solution as the researcher has had the liberty to let the research develop as it went along. It is therefore a possibility that another method could have produced different results.

Even though these possibilities exist, action research sais something about the validity of a research. In chapter *2.5.1 Validity and Legitimacy* (for reference see p. 28), the internal validity of a research is gained when the supply chain is illustrated and the problems and issues are identified. This is obtained in this report. The legitimacy of the paper is yet to be investigated.

Therefore, with the groundings of the theory-base, the recommended solution is the one that is the most realistic and the one that may give the largest contribution to quick wins and increased flow.

7 Conclusion

The mapping of the supply chain revealed several problems and issues StatoilHydro may pursue in the goal of lean procurement. Although not all the problems are equally easy to eliminate, they represent some sort of gain if they are removed. To be able to suggest the quick wins and recommend a solution the theory of lean thinking served as a guideline. The identification of customer value was based on what criteria the customers of the process valued. This showed to be a reliable and efficient chain. To accomplish this, the most important step of the five principles of lean showed to be flow. As the waste of unnecessary inventory makes it hard to arrange for pull, the focus on quick wins should be to better the flow, both of goods and information. To accomplish this, a solution was recommended. This solution implied to arrange for focus on the procurement as a process rather than different activities that has to go together to get the needed good to the requirer.

The research in this paper has shown that a thorough analysis of a supply chain may reveal all sorts of waste. When the value is defined and the value stream located, all the remaining activity which does not add to customer value may be eliminated. However, the problems revealed are sometimes a cause of a necessary activity to create the product valued by the customer. In this case, the starting point needs to be the elimination of the wastes that may actually be eliminated without jeopardizing customer value. As these processes become more and more lean, and several parts of the organization are reengineered, the *muda*'s that could not be removed before finally be abolished. By repeating this process, the organization will move towards the last step of lean; perfection.

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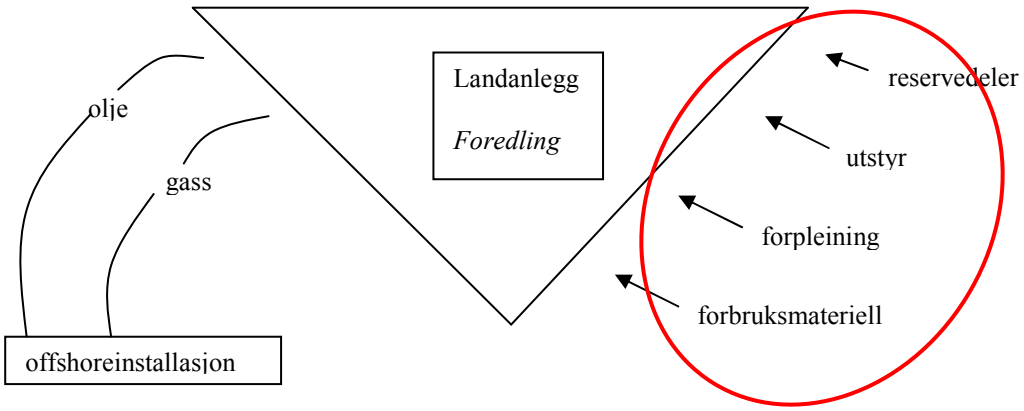
Appendixes

Appendix 1: Presentation e-mail

Hei!

Jeg heter Ane Sofie Julien og har fått muligheten til å skrive masteroppgaven min for StatoilHydro, som en del av PROFF P&L- prosjektet. Arbeidstittelen på oppgaven er:

Mapping the logistic functions towards the plants (refineries & terminals) at StatoilHydro, identify main problems and issues; suggest quick wins and possible solutions.



I den forbindelse lurer jeg på om jeg kan få lov til å intervjue med deg, hvor vi snakker litt rundt logistikkprosessen og hvordan den fungerer. Det jeg er interessert i å vite noe om er den delen av logistikken som kommer inn til anlegget for at anlegget skal kunne drive videreforedling av det som kommer inn fra offshoreinstallasjonen. Dette vises i illustrasjonen under, hvor jeg vil vite noe om den delen som det er satt rød ring rundt.

Selve intervjuet vil være et telefonintervju, som vil ta opp til to timer, alt etter hvor mye du har å fortelle meg. Spørsmålene jeg ønsker å stille er lagt ved slik at du kan se gjennom dem før vi prates og notere eventuelle spørsmål og ting du gjerne vil ta opp.

Dersom det er mulig vil jeg gjerne foreta intervjuet i uke 11 – 13. Hvis jeg får lov vil jeg kontakte deg i løpet av uken slik at vi kan avtale tid.

Håper på positivt svar. Mvh Ane Sofie Julien

Appendix 2: Interview Guide

Land anlegg:
Navn:

1. Hva er din nåværende stilling hos StatoilHydro?
2. Har du arbeidet for xStatoil, xHydro or StatoilHydro og hvor lenge har du arbeidet her?
3. Hva er din arbeidsbakgrunn?
4. Hva er dine daglige gjøremål?

Logistikk kjedens struktur

5. Hvilke kategorier er definert i den inngående logistikken?
6. Kan du forklare logistikkprosessen fra førstelinjeleverandør til varene er levert hos rekvirenten?
   6.1. Er den forskjellig for de ulike kategoriene?
7. Hvordan flyter informasjonen langs kjeden?
   7.1. Bli bestillingsstatus kommunisert til rekvirenten, hvor varen er i kjøpsprosessen, hvor den er i transportkjeden osv.?
8. Kan du forklare innkjøpsprosessen og hvem som er involvert i den?
   8.1. Er den ulik for de ulike kategoriene?
   8.2. Er innkjøpsprosessen ulik når det kommer til innkjøp fra rammeavtale og innkjøp utenfor?

Transport

9. Hvem har ansvaret for levering av varer til anlegget?
   9.1. Hvilke Incoterms brukes?
10. Blir varer fra samme leverandør levert innkjøsordre for innkjøpsordre, eller leveres de samlet?
11. Blir leveringstider alltid overholdt? Hvis ikke, blir rekvirenten gjort oppmerksom på forsinkelsen?
12. Ser du på transporten som effektiv? Hvis ikke, hvordan ville du forbedret den?

Lager

13. Hva bestemmer størrelsen på lageret?
14. Hvordan er ordrerutinene?
15. Brukes prognoser når det bestilles varer for lager? Hvis ikke, hvordan bestemmes ordrevolum?

Supply Chain Performance

16. Bruker din avdeling kvalitetsmål (KPI's)? Hvis ja, kan du gi noen eksempler?
17. Vet du om noen kvalitetsmål for hele Procurement & Logistics?

Kontekst

18. Kjenner du strategien til Purchasing & Logistics avdelingen hos StatoilHydro?
19. Hvordan oppfatter du den generelle holdningen til logistikk hos StatoilHydro?

Appendix 3: Respondents

Arne Morken, Head of Operational Procurement Onshore. He is responsible for purchasing onshore, manufacturing & marketing (M&M) and has been in Statoil in 17 years.
Background: offshore and purchasing. Daily tasks: leader of purchasing.

Tjeldbergodden: Atle Karlstrøm, leader of logistics, invetory and workshop. He has been in StatoilHydro for 3 years. Background: food production. Daily tasks: delegate and distributes assignments to employees. Responsible for 14 people.

Mongstad: Helge Rambjør, special consultant operational purchasing. He has been in Statoil for 23 years. Background: logistics, but have also worked with work procedures. Daily tasks: purchasing of materials and services.

Åge Skjelvik, unit-leader for mechanical workshop and inventory. He has been in Statoil for 22 years. Background: logistics. Responsible for 18 people, whereas 8 handle inventory and 10 are mechanics handling mechanical equipment and repairs. Daily tasks: monitoring and supervision.

Bjørge S. Christiansen, company representative, transportation contracts.
He has been in Statoil for 18 years. Background: purchasing. Close contact with Bring and Grieg. Daily tasks: logistics, analysis and development.

Sture: Magnus A. Heggø, leader purchasing and logistics. He has been in Hydro in 19 years. Background: purchasing and logistics. Daily tasks: purchasing, contracts, inventory management and warehouse management.

Kollsnes: Per Ståle Eide, team-leader logistics. He has been in Statoil for 19 years. Background: purchasing and logistics. Daily tasks: organizing and daily management.

Kårstø: Olav Inge Endresen, leader purchasing and contracting at Sture, Kollsnes and Kårstø. Daily tasks: supervisor.

Kaj Rune C. Rossebø, head of warehouse department Kårstø and Kollsnes. He has been in StatoilHydro since 2008. Background: Maintenance of equipment and warehouse management in addition to 3, 5 year of quality assurance in the Norwegian defence. Daily tasks: approves and manages all requests and purchase to storage, both for spare parts and special delivery.

Jan Arne Stueland, local company representative, logistic contracts.

Finn Hetland, purchaser. He has been in Statoil for 12 years. Daily tasks: purchase goods for storage, decides the goods criticality and if storage is necessary.

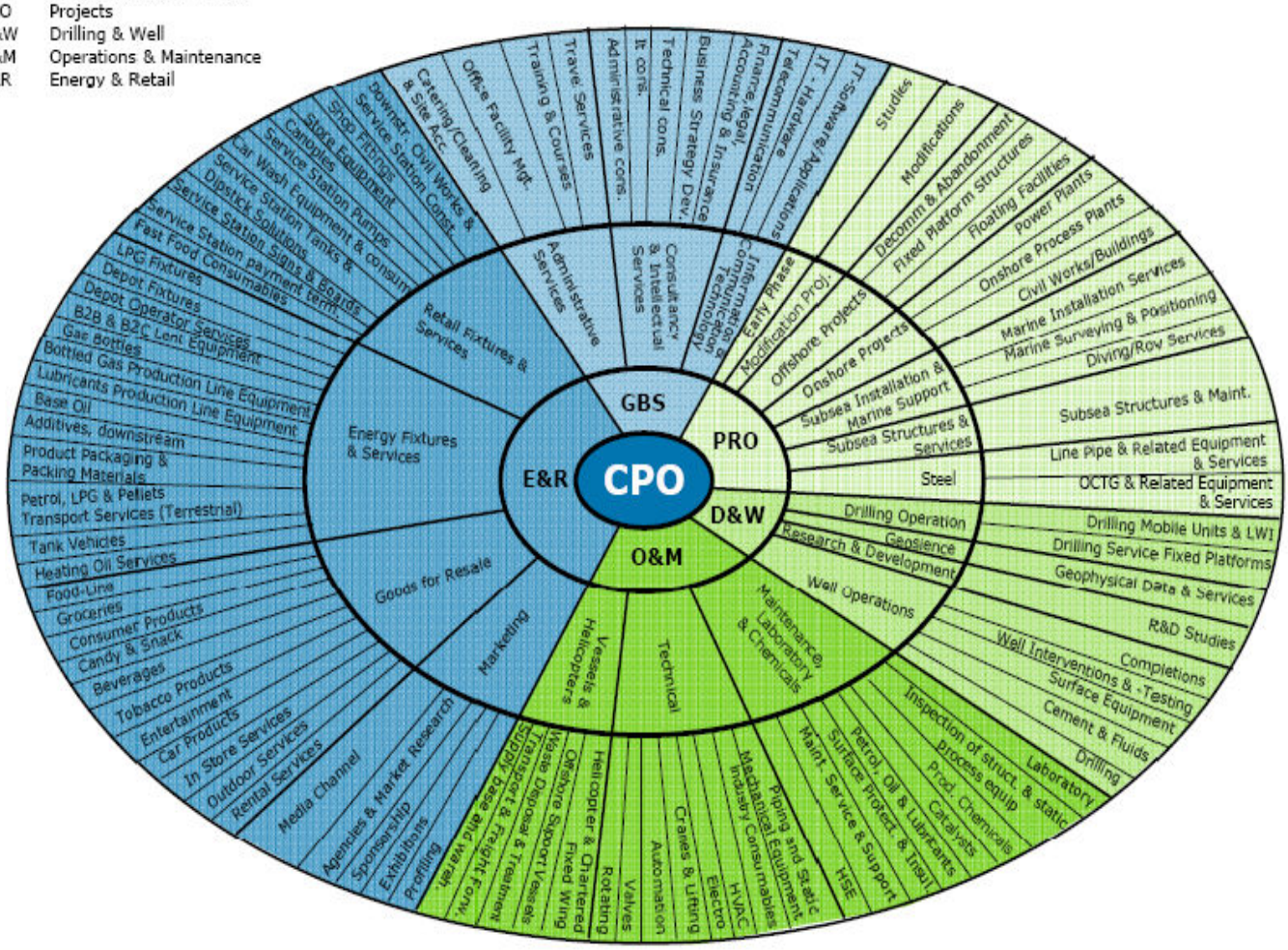
Grieg Logistics: Frode Blålid, responsible for the contract with StatoilHydro, xHydro. Daily tasks: supervision and daily follow-up of contracts.

Bring Logistics: Gjerdt Meyer, sales director. Daily tasks: supervision and daily follow-up of contracts.

Harald Selås, representative for Bring Logistics. He works at Kårstø twice a week. Daily assignments: follow-up of transportation and delivery.

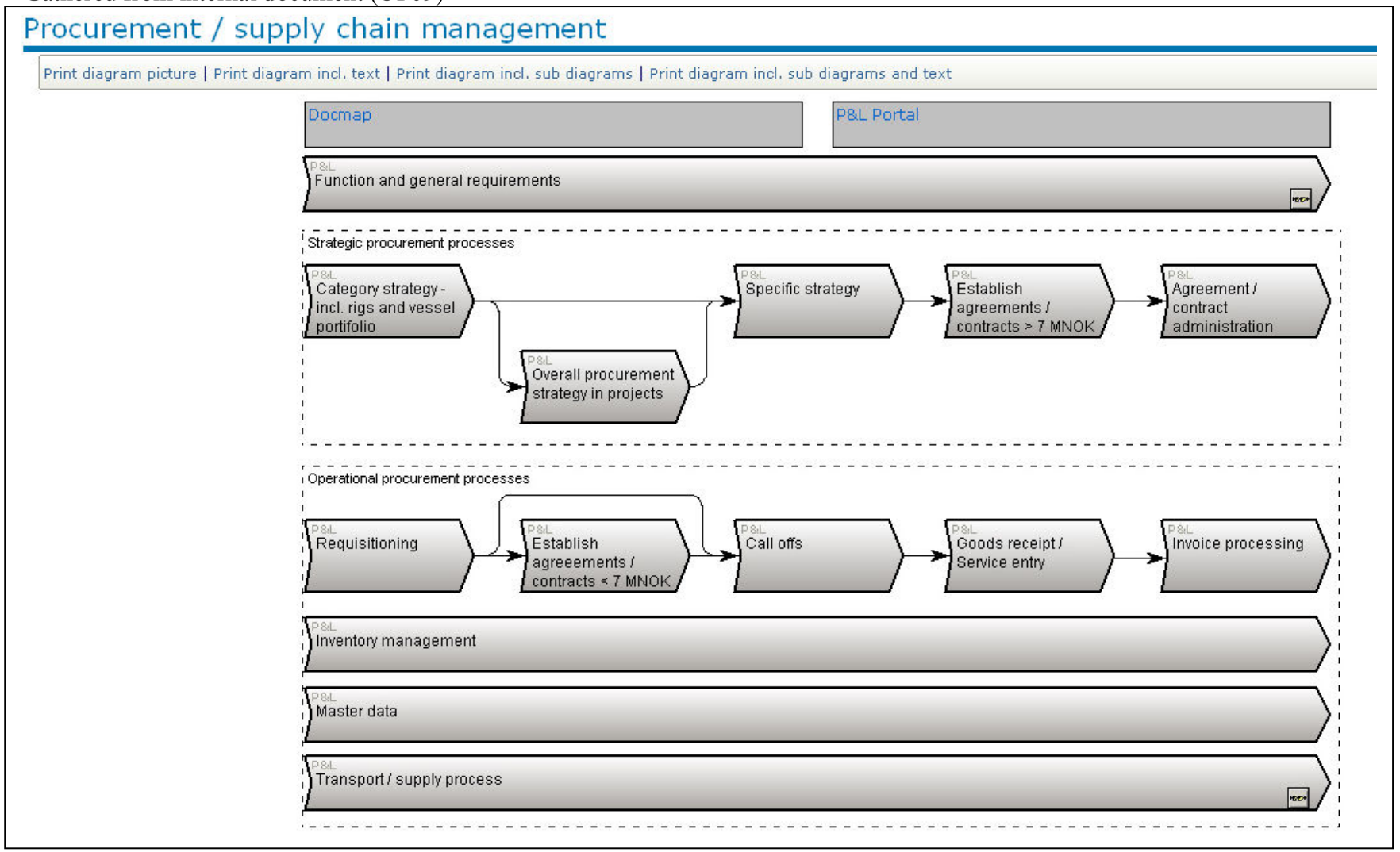
Appendix 4: Category Wheel Details

GBS Global Business Services
PRO Projects
D&W Drilling & Well
O&M Operations & Maintenance
E&R Energy & Retail

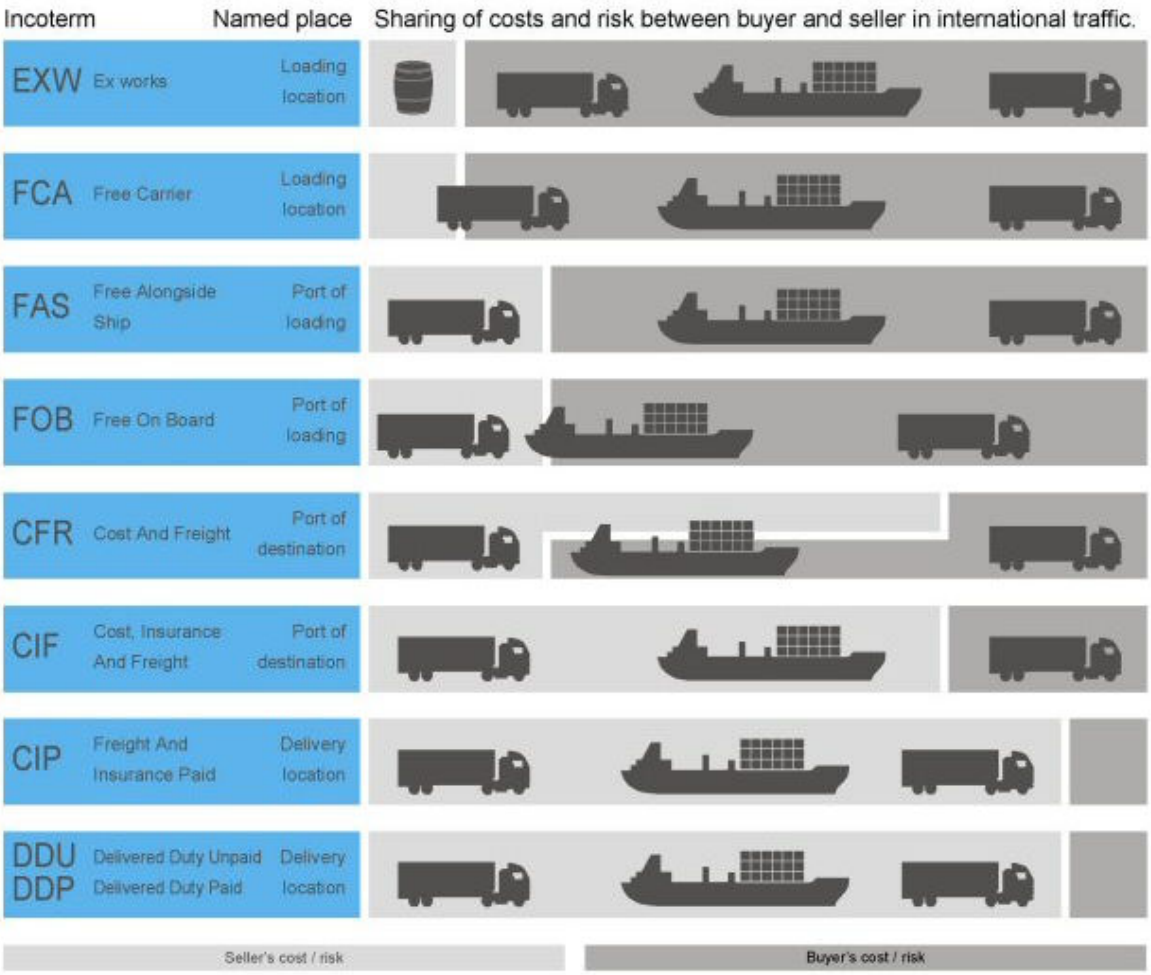


Appendix 5: Procurement/Supply Chain Management process at StatoilHydro

Gathered from internal document (OF09)



Appendix 6: Schema Incoterms



("EUport Incoterms," n.d)