Master's degree thesis

LOG950 Logistics

The distribution of small consignments from a production facility remote to the markets. The case of OMYA Hustadmarmor AS

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Abstract

Designing new distribution solutions that has never been tried by a company before can be a challenging and demanding task. Finding the right solutions and the best way to do things may be a time-consuming process and often optimal solutions are not found at the first attempt. Hustadmarmor is currently in such a process, where they want to reach new markets by sending small volume consignments. This requires new distribution solutions and knowledge on topics that are new to them. The purpose of this thesis is to provide additional insight for Hustadmarmor by analyzing some important topics regarding packaging options, port choice, distribution flow balance and road versus sea transportation. A set of cases will be presented on different options they have for the distribution of their new project. The objective is to provide insight and suggest good solutions to their new project of distributing small consignments from Elnesvågen to a hub in Europe.

Preface

After working at OMYA Hustadmarmor (referred to as Hustadmarmor the rest of the thesis) several periods in the past and getting to know the people at the company it was natural for me to ask if I could write my Master thesis for the company. During my work at the logistical department in summer 2015, I was introduced to their new project of seeking new markets to utilize their capacity. This project was then in the early beginning and I was happy to hear that this could be a potential subject for my Master thesis. This is how I ended up with this particular theme. Later on in the project the company started to see where their biggest challenges were, and that's what's helped me forming my research questions. Hopefully Hustadmarmor will benefit from this research on their further way of realizing the project.

I would first of all like to thank Geir Teistklub and Vidar Hals at Hustadmarmor for incredibly good help writing this thesis. Giving me the opportunity to be a part of this interesting project and providing me with first-hand information from the department and from participation in meetings with the people and actors involved. Also a big thank you to my supervisor for providing me with ideas and guiding me on the right track. Special thanks also go to Arne Jacobsen (NCL), Jan Arve Hoseth (Tyrholm and Farstad), Geir Naas (Doosan), and Odd Petter Lyngstad (Purchaser at Hustadmarmor) for providing me with information on requested subjects.

Vidar Storvik

Elnesvågen, 21.05.2016

Figure overview

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Summary

This paper will use an explorative approach to give Hustadmarmor insight on packaging options, choice of hub port in Europe, distribution flow balance and Short Sea Shipping (SSS) versus road haulage. In addition a set of cases is made to analyze what could be the best solution for Hustadmarmors distribution of small volume consignments to new markets. Primary data is mainly gathered by unstructured and semi-structured interviews with Hustadmarmor, agents and shipping companies.

The theory review is linked together with the project specifications to try to find answers to the research questions. Analysis and discussion shows that lots of factors are affecting the total logistical cost for Hustadmarmor. Freight rates for the different solutions is the most vital to if the project will be feasible. Findings revealed that truck costs constitute for a large part of the total cost, so reducing the distance by truck will lower the freight rate and save the environment. This made Molde the best port for starting the distribution in the short term. In the long term Hustadmarmor could benefit from shipping directly from a terminal in Elnesvågen, either by containers or by the existing distribution network.

Having the opportunity to offer the customers a variety of packaging solutions would benefit Hustadmarmor to utilize the demand in the market and also make the supply chain more flexible. The research examined the opportunities for utilizing the distribution flow imbalance. Findings showed that Hustadmarmor and Doosan alone have a potential of importing 190 containers annually using the new distribution solution to even out the imbalance. Starting the project would give good repercussions to the local industry, especially if a terminal in Elnesvågen is opened and Sjøportalen will be a success.
To make this project a success Hustadmarmor is dependent on a flexible supply chain with partners that are willing to contribute to creating good solutions.

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PART 1 – CASE STUDY OF OMYA HUSTADMARMOR

1.0 Introduction to part 1

This part of the thesis will start by giving a general introduction to the company and the case study to give the reader background information on the company and the subject. Then the research questions are presented followed by a section on practical and scientific interest. In chapter 3 some theory on research methodology and data collection are elaborated before going into how this is used in this thesis. This to understand what type of research this is and the methods that have been used to gather information. Part 1 ends by describing the validity and reliability of the thesis.

2.0 OMYA Hustadmarmor and the white mineral industry

The history of OMYA Hustadmarmor AS started with founder Kjell Steinsvik in 1948. He founded Hustad Bruk AS with two subsidiary companies Hustadfjord AS and Hustad Kalk and Marmor AS. Hustad Kalk and Marmor was set to focus on obtaining and crushing limestone and this became the foundation of today's business (Hustadmarmor 2007).

The company continued to develop and expand over the two next decades and soon became the leading actor in Northern Europe in producing crushed marble granules to the construction industry. Based on the decision to invest heavily on calcium carbonate as an additive in the paper industry, Hustad Kalk and Marmor in the mid- 1970s decided to start a closer cooperation with the family-owned company OMYA AG. Hustad Kalk and Marmor was split into Hustadkalk, owned by the Steinsvik family, and Hustadmarmor, owned 50% by the Hustadkalk AS and 50% by OMYA AG (Hustadmarmor 2007).

In 2007 OMYA bought the rest of the Steinsvik family's shares, and is now a 100% owner of Hustadmarmor. Omya produces industrial minerals all over the world and their products are recovered from calcium carbonate, talc and dolomite. They are the largest producers of calcium carbonate (CaC03) in the world and the market leader on refining of marble based fillers and pigments to the paper industry. Omya has about 6000 employees across more

than 100 factories in over 50 countries, with Hustadmarmor as the largest plant (Hustadmarmor 2007).

Hustadmarmor is a Norwegian refining company located in Elnesvågen at the North-Western coast of Norway. The raw material is crushed marble arriving mainly with ships from a mine in Brønnøy or with trucks from local mines. The crushed marble is then refined and the end- product is calcium carbonate, also just called slurry. The main customers are the paper industry, where it is used as filler and coating pigments. The product contributes to a smoother surface and improves the quality of the paper. In a normal printing paper, there is around 55% slurry (Hustadmarmor 2007). It is also used in for example milk cartons and candy cartons. In addition to the paper and carton industry the slurry is used in a variety of different industries and still Hustadmarmor is constantly trying to be innovative and find new markets where the product is applicable. Plastics, agriculture purposes, food, cosmetics, pharmaceuticals, water treatment, building materials etc. are all examples of products and processes where the product is currently used (omya.com).

In 2015 Hustadmarmor had an annual net turnover equal to NOK 1.4 billion. There are currently 184 employees, and in addition some hired personnel. Hustadmarmor produced approximately 2.8 million tons of calcium carbonate slurry last year, and still has capacity for producing more. Almost everything produced is exported by ship to tank farms located around Europe, where it is further distributed to the customers by train, barge and truck. The tank farms are currently located in Moerdijk, Oulu, Förby, Emden, Gävle, and Aberdeen. The ships that are used for export are custom made chemical tankers with a maximum cargo load ranging from 8-18 000dtw. The ships are chartered from ship owner Utkilen AS, but some of the ships are partly owned by Hustadmarmor. To use ships to export the product is both practical, cost saving and environmental-friendly since there are so large volumes and since Hustadmarmor is located perfectly at the seafront with its own quay. About 20 shiploads are exported per month on average.

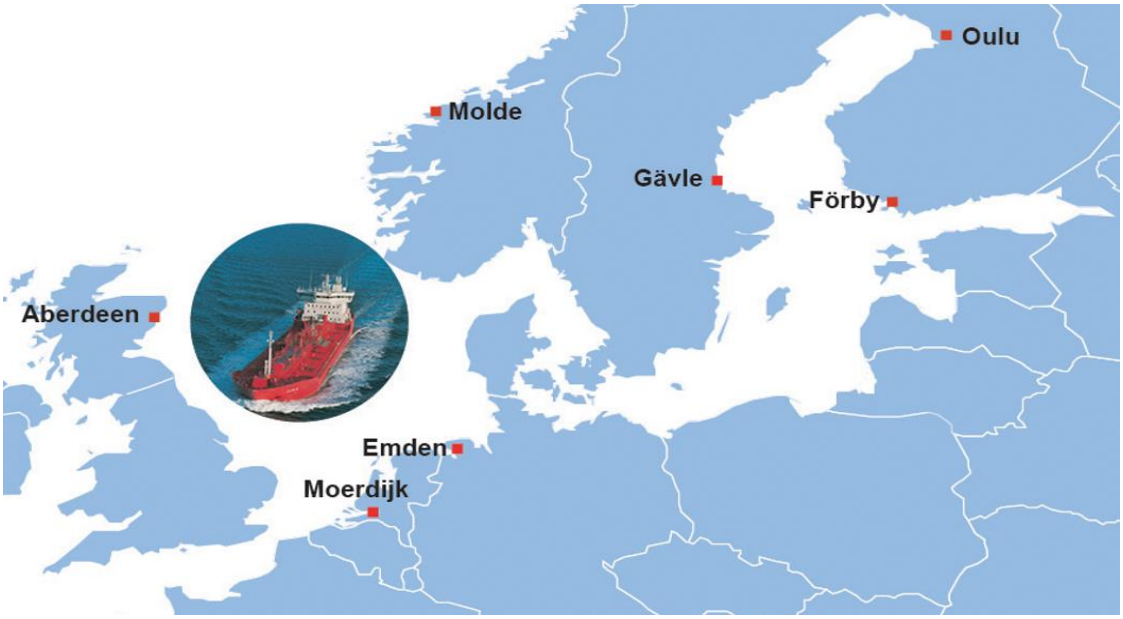


Figure 1: Export destinations *(Hustadmarmor)*

The small amount that is not exported by ships is loaded on tank-trucks and distributed mainly to farmers and waterworks around Norway. They have also sent tank-trucks to Europe, but this is not a large part of their business and only happens occasionally.

Figure 2: The plant in Elnesvågen *(Source: Hustadmarmor)*

2.1 Problem description: The Case

Hustadmarmor has rapidly expanded their business since the founding and to the downswing after 2008. After the financial crises and the downswing in the market they

have a large capacity in terms of production, but the demand has decreased. This has led to an overcapacity in production and the factory is not run at full capacity. Hustadmarmor has started the work of expanding to new markets with new products to increase demand, and utilize the production capacity at the plant in Elnesvågen. When expanding to new markets Hustadmarmor has a global approach and wants to develop specialized products to repeated customers. When creating new specialized products they will prefer customers that will need a certain amount of yearly volume. One time buyers are also welcome, but these customers will not be preferred in the product development process. All the segments mentioned in the company introduction are possible markets and geographically it can be anywhere. The limitation to deliver all over the world is the logistical cost and the competition from other companies producing the same product but who are located closer to the customer. This can be internal competition within the Omya group and external competitors. There are also some companies that produce substitute products to the slurry which can be used in the same market segments. So it is vital to create a competitive advantage in distribution and product development to be successful in their expanding.

Hustadmarmor is currently in an early stage of this project but has started to send test products to customers at different locations in Europe, Asia and America.

Since Hustadmarmor only has limited experience in global distribution with small volume consignments they wanted to know which alternatives they have for their distribution. Their main focus is how to get their product from the plant in Elnesvågen to a hub in Europe for further distribution. Logistical costs is the main issue if this is to be a successful project. Since this is a low value product large parts of the value will consist of logistical costs. The existing shiploads with the Utkilen bulk ships have a logistical cost on approximately 40-60% of the retail price, and with containers it's expected to be even more. If Hustadmarmor is going to achieve competitive advantage towards competitors they need to be the best at logistics, especially since Hustadmarmor is located at a remote location in Western Europe and their competitors are much closer to potential customers in Central/East Europe and Asia. They have to take advantage of their access to the sea. Important variables that will affect the choice of distribution network and the overall logistical costs are freight rate, choice of container types, port choice and transportation mode.

The new markets are estimated to demand approximately 40-80 000 tons the first year the project go live. This is about 1600-3200 containers annually, dependent on the density of the product. Test shipment to the market has been really positive so the numbers are expected to increase in the coming years. The customers are demanding both slurry in wet form and in dry form packed in bags. Slurry in dry form is either called dry slurry or crumbles. The product varies in weight and has a density on 1.4-1.9, dependent on what the product is used for. A dry product can contain up to 78% of limestone while a wet product can also contain 78% of limestone and still be in wet form, with equal amount of water percentage in both forms. This has to do with the production process and customer preferences. The products is mainly limestone with water added. In the production process a dispersant chemical is also added to prevent the product from separation. So all the different products are mainly different compositions of stone and water. If the water in the product freezes it will be damaged because of the sensitive separation characteristic. A temperature below freezing point is not recommended. The product has a temperature of 40 degrees coming from the production and since the product is shipped in quantities on average 15 000 tons this will not be a problem because these volumes will not freeze on the relatively short time it is transported. This is an issue that containers may face because of the low volume that is transported. Containers with wet slurry can't stay over long periods below freezing point unsheltered. For dry product this is not a problem. For short times in the freezing zone or i.e. sheltered between other containers and stored below deck it can be doable for wet product. If the time in a freezing zone is too long the transport must be cancelled or tank containers with heating systems can be used. There are also alternatives where the container is isolated outside. This will be an individual assessment depending on weather forecasts and destinations.

The wet product can be compared with paint in terms of how it looks and feels, and it can easily be washed away with water. The dry product is like powder or crumbs. There is no hazard to environment if there should be spills or emissions. The value of the product is relatively low compared to other chemical products. Signals in the market show that some customers want delivery already this Autumn/Christmas. Customers that have shown interest so far are located in USA, Mexico, Turkey, England, Sweden, Kazakhstan, China, France, New Zealand and Australia. Hustadmarmor is currently in a process where they are conducting meetings with potential carriers. Here distribution solutions are discussed and potential business relationships are made for future cooperation.

2.2 Research questions

In this thesis I will focus on answering the following research questions. The research questions are developed with help of interview guide 1 where the goal was to find what could be interesting for Hustadmarmor to know regarding their new project. In addition, conversations on the project with both Hustadmarmor and my advisor have led to the final formulation of the research questions.

RQ1 How critical are logistics costs for new market opportunities for Hustadmarmor?

RQ2 Which are the best supply chain designs for Hustadmarmor's distribution of low volume shipments to new global markets?

RQ2.1 Which variables are important for Hustadmarmor when choosing distribution method?

RQ2.2 Which packaging choices do Hustadmarmor have?

RQ2.3 What will be the best packaging option?

RQ2.4 How should Hustadmarmor choose the optimal European hub port?

RQ2.5 Which opportunities exist to utilize container flow imbalances?

RQ2.6 Is it possible to utilize existing cargo flows related to other local industry to enhance the viability of a new container shipping solution?

2.3 Practical and scientific interest

This case study is first of all interesting for the logistical department in Hustadmarmor who is trying to establish a profitable logistical network. In addition it will affect the marketing department which handle sales and promotions and the product development department who is going to tailor products to new customers. So, actually it is of interest for the whole company and could, if successful increase sales and profit for the company.

This is a completely new area for the decision makers at Hustadmarmor. They have never used intermodal transport to send small volume consignments to customers and they could have use of the information that is found from the answers in this thesis to ease the process when designing distribution routes for their new markets. When Hustadmarmor is trying to expand to new markets the logistical costs are of great importance, and will directly influence the price for the customer, and also the bottom line for Hustadmarmor. So finding efficient distribution routes, and to be aware of pitfalls in intermodal transport is very important for achieving success in their expanding.

The ideas and solutions developed in this thesis may be of interest to other firms having the same sort of issues and that are dealing with small consignment distribution from remote locations. Since lots of companies in Norway are export companies and Norway is a pretty remote country compared to more central markets, the thesis may be of interest to others having some of the same issues concerning transport of small consignments.

3.0 Research methodology

When dealing with explorative issues and real life situations within organizations the single-case study approach is the best to use as a research methodology (Yin 2003). Yin (2003, 3) describes a case study as “a method that allows investigators to retain the holistic and meaningful characteristic of real life events, such as individual life cycles, organizational and managerial processes , neighborhood change, international relations, and the maturation of industries.” Yin (2003, 13) also defines a case study as “an empirical

inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

Three types of designs are used in traditional empirical research; explorative, descriptive and explanative designs (Yin 2003). An explorative design seeks to gather preliminary information that will help define problems and suggest hypotheses. The design is often used when the topic is new and when data is difficult to collect. The objective of a descriptive design is to describe the characteristics of various aspects, such as the market potential for a product or the demographics and attitudes of consumers who buy the product (Babbie 2007). An explanatory designs is used when testing hypotheses about cause-and-effect relationships and where the goal is to find whether there is a cause and effect relationship between variables.

3.1 Data collection

According to Yin (2003) there are two types of data, primary and secondary data. Primary data is the data you collect to a specific purpose with use of surveys, interviews or observations. This is first hand data that is collected directly from the source. Secondary data is collected by others to other purposes than this exact research. Secondary data can be journals, articles, studies, books, statistics etc. (Yin 2015).

3.1.1 Unit of analyse

The main unit of analysis in this thesis will be the container and the SSS market. Distributions network designs and packaging options will be investigated. In addition the thesis will look at port choices and the empty container problem.

3.1.2 Unstructured interviews

An unstructured interview is like a conversation, and there is no fixed way to conduct such an interview (Gary 2011). The respondents are not presented with a list of questions, but it is the interviewers job to guide the conversation in the right direction and to the right topics. It is important to go in with an open mind and just try to listen and facilitate(Gary 2011). Such interviews are of an open-ended nature, and you can ask the key respondents about facts or about their opinion on events (Yin 2015). The more the interviewer bring their own thoughts to the table the more they become an "informant" instead of just a respondent. The quality of key informants is critical to success in cases studies (Yin 2015).

3.1.3 Semi-structured interviews

In a semi-structured interview you provide a list of issues rather than specific questions, to be covered, and you have the freedom to follow up points as necessary. You are not obliged to go through this in order, but it has the advantage that you remember the topics that you want to cover during the interview (Gary 2011). If you ask direct questions you are likely to get an answer on that specific question. If you have a conversation on a topic, and have the opportunity to ask follow up questions you are more likely to get more information on the topic. "Probes can be used to encourage the interviewee to say more on a topic. "Probes" can be verbal, for example "go on" or non-verbal such as a nod, smile or tilt of the head" (Gary 2011)

One of the major purposes of such an interview might be to corroborate certain facts that you already think you have established. In this situation the questions have to be carefully worded so you appear naive about the topic and allow the respondent to provide a fresh commentary about it. In contrast if you ask leading questions the corroboratory purpose of the interview will not be served (Yin 2015).

3.2 The case: Data collection

This thesis will use an explorative design since the problem is unclear and new to the researchers and the company. The main approach in this thesis is to "draw a picture" (Gary 2011) and illustrate the different opportunities Hustadmarmor have for their container distribution.

The research tasks that will be carried out to answer the problem statements will be a combination of qualitative and quantitative research where theory found on the subject will be linked with the data gathered from the industry and from the firm, to find good answers to the problem statement based on this. Unstructured interviews and conversations with the top management in the logistic department will be the main primary source of information. Semi structured interviews have also been conducted, to get as much information as possible about relevant topics without being locked into pre made questions, but still have an agenda on topics (Appendix). To get information on the container market, prices, routes available, port availabilities, container imbalances etc. unstructured interviews through phone, mail and meetings with Nordlines, Tyrholm og Farstad, NCL and Moldegaard Maritime have been conducted. The purchasing department of Hustadmarmor and Doosan have also provided information on import volumes. This to map the potential of how two large companies in the community can utilize imbalanced container flow to create good synergy with the local industry by changing mode from road to sea.

The thesis will present a set of cases that are of interest to the company and the goal is to find the best possible option for the company in the short and long term. Different important variables will be analyzed in the cases to help draw a good picture for the company.

'Primary data that is used for the thesis is; relevant internal information from the company through the ones responsible for the project. This is mainly data on customer location, demand data, customer product specifications preferences (density etc.). The information gathered from the unstructured interviews are also primary data sources. In addition I will through my work at Hustadmarmor and participation in the project be able to gather primary information about the project through meetings and conversations with people involved. This will be managers at Hustadmarmor, shipping companies and agents.

Secondary data elements that are collected are; information about the main elements in the problem statement. Especially spot prices on containers transported by truck and vessel, and handling cost at different terminals. This is the quantitative data that is gathered. In addition qualitative information on methodology, container distribution, shipping, truck-routes, distribution planning, packaging options, port capabilities, container flow imbalances, road haulage, and SSS. This is obtained from various articles, journals, books and Master thesis.

The findings from the literature survey will be linked to the Hustadmarmor case and the goal is to find the best possible solution to the problem statements based on this.

3.3 Validity and Reliability

For all research studies it's important to control the validity of the study and its findings. A valid study is one that has collected and interpret its data in a way that the conclusion accurately reflects and represent the real world problem. Yin (2015) therefor suggest to use design features that will strengthen the validity of the claims and findings. Ellram (1996) states that a good research design in a study should contain four disciplines with respect to validity: External validity, reliability, construct validity, and internal validity. External validity represent to which extend the findings could be true for other places, people, companies etc. and if the results can be generalized. Reliability addresses the repeatability of the results, and if the results will be the same if the experiment is repeated. Construct validity refers to the extent to which operationalization of a construct do actually measure what the theory says they do. Internal validity is an inductive estimate of the degree to which conclusions about causal relationships can be made. Internal validity is not relevant in my thesis because it is only used in explanatory cases dealing with relationships of variables (Ellram 1996). The other three disciplines are important concepts to my thesis to make my findings valid and reliable.

Yin (2009) suggest three different methods to achieve increased construct validity. The two first methods are to use multiple source of evidence and to establish a chain of evidence. This has been done by interviewing several people from different companies involved in the project, and talking to people that are experienced in shipping. In addition using multiple sources of literature together with empirical findings a chain of evidence has been established between them. The third method is to have key informants to review the case the draft of the case. The draft have been reviewed with respect to correct information from Hustadmarmor, and the informants have confirmed that my interpretation of the answers given to questions by mail and interview guides are correct. Due to time pressure for writing the thesis and busy key informants the whole draft of the finished thesis has not been reviewed.

Testing for external validity deals with the issue of knowing if the findings of the study are generalizable for others (Yin 2009). Using theory from various articles, text books and journals is a method of achieving external validity in my thesis. The thesis is a very practical case which is made explicitly for Hustadmarmor. But still, parts of the thesis can be generalizable to other companies with similar problems.

According to Yin (2009) testing of reliability is to find errors and biases in the study. Best way of reducing these errors is to conduct the research so that someone else could repeat the procedures and arrive at the same conclusion. In my thesis references for information sources are made to easily see where the information is found from. Primary data collection are also well explained in chapter 3.2 and copies of interview guides is attached as appendix. There is some information that could be hard to reproduce accurately and that is the information collected from meetings, conversations and information found through my work at Hustadmarmor.

PART 2 – CHOICE OF DISTRIBUTION SOLUTIONS FOR SMALL CONSIGNMENTS – ELEMENTS OF THEORY AND LITERATURE REVIEW

4.0 Introduction

This part of the thesis will consist of theory that is important to elaborate for understanding the topic and to answer the research questions. To understand the topic and the research questions it is important to explain why container freight has developed so fast and become so big. Background information on the container market and especially the container market for the chemical industry is provided to more easily see the "big picture". The research questions addresses issues on packaging options, port choice, container flow imbalances and the issue of truck vs SSS. So to include theory on these topics will be vital to answer the research questions in a scientific manner. The first part of the chapter will consist of some general introduction of supply chain management and introduction to the container market, different types of containers and the container management. Further the chapter goes deeper into the important criteria of port choice, container flow imbalances and truck vs SSS. The second part of the chapter will take the reader through the different cases. Description of the case and an analysis over advantages and disadvantages will be reviewed. This will be followed by a discussion where the analysis will be the foundation for the recommendations. At last the thesis will provide a conclusion and a section on further research and limitations.

4.1 Supply Chain Management

Supply chain management includes topics from manufacturing, purchasing, transportation and physical distribution into a unified program. Successful supply chain management coordinates and integrates these activities into a seamless process. It links all the partners in the chain or network to enhance collaboration. In addition to the departments within the organization, theses partners include vendors, carriers, third-party companies, and information system providers (Zygiaris 2000). Numerous definitions of supply chain management has been made. Cox et al. (1995) define supply chain management as:

1 - The processes from the initial raw materials to the ultimate consumption of the finished product linking across supplier-user companies; and

2 - The functions within and outside a company that enable the value chain to make products and provide services to the customer

In today's demanding business environment it is important to be efficient to be competitive, and to satisfy the customer needs. The trade is getting more global than ever and supply chain management plays an important role to move goods or information more quickly to the destination (Zigiaris 2000). Especially container supply chain may be difficult to coordinate because of all the actors that are involved from the container is sent from the supplier and until it arrives at the customer, and the challenges related to obtaining balanced flows minimizing the need for relocation of empty containers that will occur due to imbalance in trade.

4.2 The container market

In April 1956, a refitted oil tanker carried fifty-eight shipping containers from Newark to Houston. This was the start of an era of huge development in shipping and globalization and the start of a huge industry that made the boom in global trade possible. Until the 60s handling cargo was a labor intensive activity, and transportation time and cost was a huge obstacle to trade. This made transcontinental and global trade economically unfeasible. It was the effort of Malcom McLean that made container shipping to what it is today. McLean had a brilliant simple idea, instead of packing everything into a ship, unpacking it, sorting it, putting the cargo on a truck or a train and unpacking them again, put everything in a container. His vision was to create a universal transportation system where goods could be placed in a box and shipped around the world without ever being handled. It took years and huge sums of money to convince labor organizations, shipping companies, ports and investor of this new technology. There was a need for standardization to get this idea possible, and containers got standardized to fit ships, trucks and ports. Ports handling equipment also got standardized to handle these boxes. Some traditional ports around the world was put out of business because there no longer was a need for the manufacturer and commodities to stay close to a port. It was McLean's success in supplying U.S. forces in Vietnam that ultimately persuaded the world of the container's potential. Because of the new standards, the reduced handling costs, and the new transportation system, containerization was able to reduce transportation cost so much that global trade became economical profitable. The containerization has changed the way we do business and the

fact that industry could locate factories far away from their customers has paved the way for new trade patterns, especially the import of low cost products from Asia. (Levinson, 2010)

Today's world container market plays a very important role in the global trade, and accounting for more than 60% of the world's seaborne trade (Clarcsons.com). In the last decades there have been an enormous growth in container trade due to the changed patterns in production and consumption, and because of the focus on containerization of cargo. In 2015, world container traffic comprised over 200 million TEUs, according to UNESCAP (2016). But in 2015 the growth of container traffic was lower than historic average and representing only 1.1%. This low growth was a consequence of an overall slowdown in the world economy (globalports.com). Today's container trade is built up with routes from producing countries to consumption countries. The container trade may be divided into 3 different trades:

> (1) East-West trades, which circle the globe in the Northern Hemisphere linking the major industrial centres of North America, Western Europe and Asia; (2) North-South trades articulating around major production and consumption centres of Europe, Asia and North America, and linking these centres with developing countries in the Southern Hemisphere; and (3) intraregional trades operating in shorter hauls and with smaller ships (Regional shipping and port development 2015).

Figure 3 shows the trade lane growth in million TEUs from 2005-2015. There has been a healthy growth on all trade routes these years and we see that the European trade with Asia is getting increasingly important.

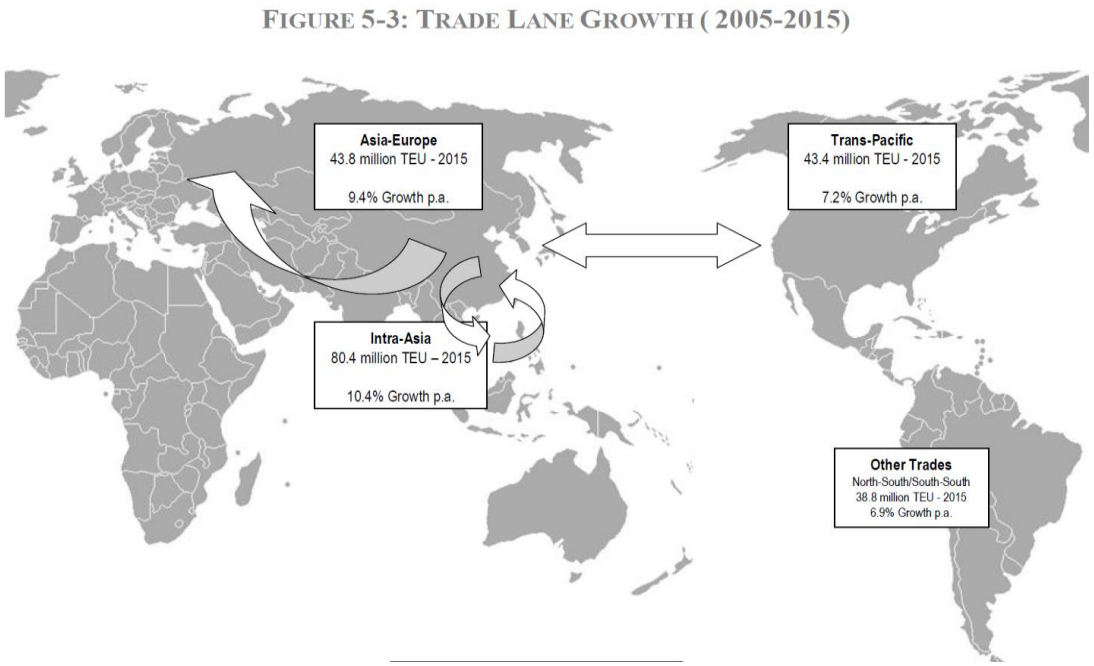


Figure 3: Trade lane growth 2005-2015 *(source: www.unescap.org)*

These trade routes use global hub ports (transshipment hubs) for import and export. Los Angeles and New York/New Jersey for USA. Shanghai, Singapore and Hong Kong for Asia and Rotterdam and Bremerhaven for Europe, are examples of large hub ports. The development of these transshipment terminals in the recent years led to a new transportation model called hub and spoke (illustrated in figure 4). In this type of transportation network we have a mega container ship which handles the trunk routes (mother vessel). The blue connections represent the short sea services provided by feeder container ship. These ships act as further distributors of the cargo arriving with the mega ship. Feeder ships distribute the cargo further to feeder ports, direct call ports or niche ports. These ports can also function as small hubs for further distribution. So the feeder link may be connected to a new feeder link. Examples of this can be:

Hong Kong→Rotterdam→Gothenburg→Molde

Singapore→Bremerhaven→Oslo→ Molde

The number of feeder ships will be different from each specific region. The main factors that define the network are: the cargo flow, and the number of liner operators working in the port (Nedyalkov and Nedyalkova 2011).

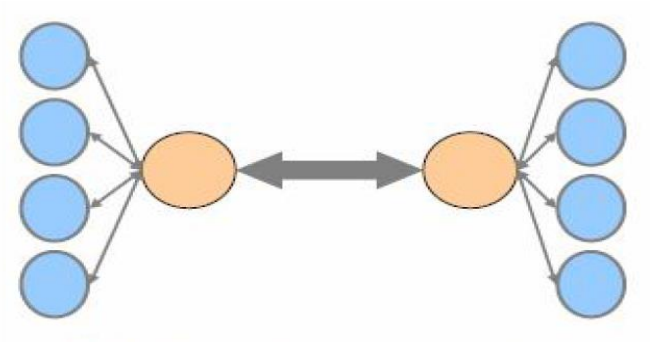


Figure 4: Hub and spoke transportation model *(source:www.mech-ing.com)*

The mega container ships have become larger and larger to utilize the economy of scale and some of them can handle up to 19 500 TEUs, and are way too big for some feeder ports, and other regional ports. The large amount of containers also makes it impossible for many ports to handle. That's why it is vital to have hub ports that can handle the size of mother vessels and feeder ships for further distribution to the end destination port.
The development of this network is a consequence of trying to be more efficient and maximize the utilization of economies of scale to lower unit cost per ton or container (Coulter 2002). The reason that this beneficial cost can be achieved is that goods from lots of regions are gathered and put into large vessels. Gathering of this cargo from the regions is vital to fill the large motherships and to have frequent ship calls.
Increased global trade and the advantage of having large ports to share high quality facilities is also important factors. Reducing transportation costs makes it possible for customers to consume commodities manufactured on the other side of the world at competitive prices. This has led to an enormous growth in global trade the last two decades.

4.3 Short Sea Shipping in Europe

SSS is often referred to as the motorway of the sea. During the last two decades the European Union has led the promotion of SSS corridors as an alternative to road haulage. The main motivation for this is to better coordinate transport modes and reduce congestion and other environmental damages from road transport (Suárez-Alemán 2015). Maritime transport in Europe accounts for 38% (intra-EU 27) of the ton per km, and is almost as important as the dominant trade; road haulage. SSS dominates the maritime transport in

Europe and have had a large growth in recent years (Bulletin of the Observatory of Transport policies and strategies in Europe 2013). SSS is divided into different flows using different transportation types. Most common are: bulk cargo and general cargo. General cargo is divided into two categories, Ro-Ro (roll on – roll off) and Lo-Lo (lift on – lift off). Lo-Lo is primarily containers being loaded and unloaded with cranes, while Ro-Ro is rolling cargo such as road trailers or complete lorry-trailer combinations loaded and unloaded via ramps.

The SSS market competes with other modes of transport such as road or rail, but it also cooperates with the same markets to form intermodal logistical chains (ECSA 2016). Compared to deep sea shipping, SSS typically involves very frequent port calls. This results in that price and quality of all port related services and hinterland connections have a relatively bigger impact than on deep sea operations. For example, vessels with a deadweight of 10 000 tons or less, which is typical for SSS accounts for more than 50% of port calls in Rotterdam (ECSA 2016). The market is also characterized as a diverse sector. It varies from large companies owning hundreds of ships to captains owning and sailing their own vessel. The diversity also counts for ship types and sizes. The European SSS fleet is a mixed between ferries, car carriers, multipurpose vessels, container carriers, bulk carriers, offshore service vessels etc. The price on these vessels can vary from hundreds of millions to small vessel with a newbuilding price of 15 million (ECSA 2016).

4.4 Container market for the chemical industry

The scale of the global chemical industry is enormous and in 2003 the total value of the global production exceeded US $1.7 trillion. Transport of chemicals represent a significant portion of the world wide transport of goods. The transport of liquid chemicals is conducted in of the following modes: pipeline, bulk tankers, parcel tankers, tank containers or drums (Erera, Morales, and Savelsbergh 2005). Pipeline and bulk tankers are primarily used for transfer of petrochemical products with large quantities of a single product. Parcel tankers are smaller vessels with up to 42 tank compartments which can transport multiple liquid cargoes at the same journey. Drums are often used for higher value goods of smaller quantities (Erera, Morales, and Savelsbergh 2005). In addition to drums and parcels 3 other relevant packaging methods relevant for this case will be explained; dry bags, tank containers and flexitanks.

4.4.1 Dry packaging

To pack and ship small quantities of dry products the most common method is to transport in big bags. Big bags comes in different sizes and handling methods. Handling methods may include lifting by cranes with straps or by the forks of a truck lift. The largest benefit from transporting in big bags is that you can transport in smaller quantities compared to larger quantities which are shipped in dry bulk vessels. Most common sizes is 200-1200 kilos. Big bags can be shipped into containers, pallets or loaded directly in an open hatch dry bulk carrier. The bags can also be placed at rolltrailers (a type of CCU) and shipped as RORO cargo. MAFIs are the tractors used to load/unload the rolltrailers. After use, the bag is thrown and there is no need for cleaning cost or backhaul loads.

Figure 5: Illustration of bags for dry product *(source: www.poraver.com)*

4.4.2 Tank containers

Tank containers can be referred to as ISO-tanks, intermodal tanks or IMO portable tanks. These tanks are standardized and designed to fit intermodal transport by road, rail or ship. Tank containers have many advantages for the international transport of liquid chemicals:
"• Compared to big bags and flexitanks they are environment-friendly, since they are less prone to spillage during filling and unloading, as well as leakage during transportation.
• They permit a higher payload when compared to drums stowed in dry containers (43% more volume).
• They can be handled mechanically, which results in cost savings, but also ensures safety when handling hazardous commodities.
• They provide secure door-to-door multi-modal transportation (by road, rail, sea or inland waterways), and do not require specialized port-side infrastructure.
They are safe and durable, with a design life of 20-30 years.

• They can be cleaned and placed into alternate commodity service with minimum downtime.
• They can be used as temporary storage for customers with limited space or high-cost permanent storage" (Erera, Morales, and Savelsbergh 2005, 2-3).

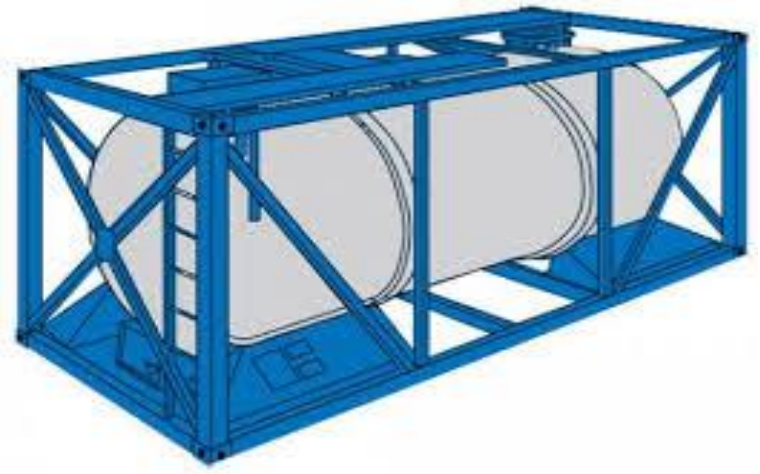


Figure 6: Illustration of a tank container (*source: www.jms-logistics.com)*

4.4.3 Flexitanks

In recent years it has become more and more popular to use flexitanks instead of normal tank containers for some product groups. A flexitank includes a bladder and mechanisms to protect, secure and load/unload the bladder (Thomas and Schilling 2014). The bladder can be used inside an intermodal container so in practice it converts a 20' container into a 24 ton bulk liquid hauler. The flexitank has some advantages compared to the tank containers:
• The bladder can be thrown after use and you save cleaning cost
• Intermodal containers are cheaper to buy/lease/rent than tank containers
• It is easier to get return load with 20' containers compared to tank containers
• Easy loading and unloading
• The bladder comes in different sizes dependent on the purpose, and several bladders can be fitted into a container to transport multiple products. (eptpac.com)

Figure 7: Illustration of a Flexitank *(source: EPTpack.com)*

These flexitanks also are made for dry product. These bags are called inliner big bags and is used the same way. The difference is that it is cheaper than a flexitank for wet product and doesn't need to be as robust as a flexitank. You are also dependent on a pump to blow the product in and out of the bag, or a truck that can be tilted.

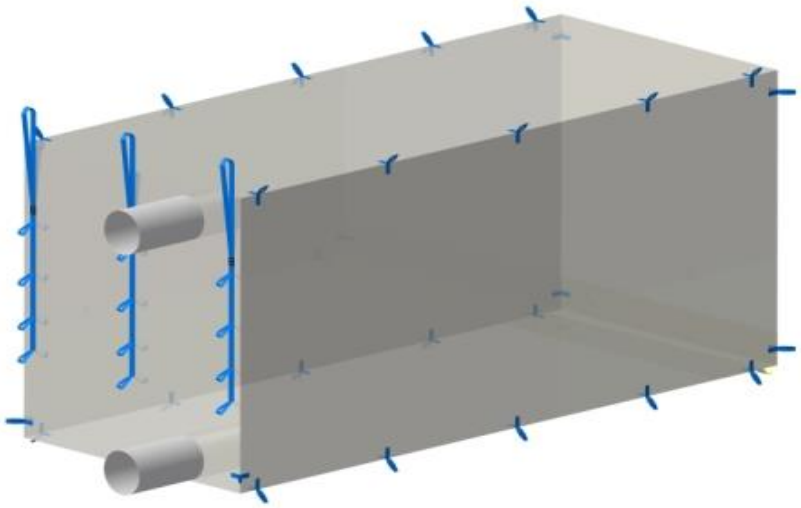


Figure 8: Illustration of an inliner big bag *(source: www.big-bag.net)*

There are different solutions when it comes to packaging of goods. Small volume shipments usually uses one of the mentioned methods, while higher volume is shipped in bulk vessels. Which packaging to choose depends on several factors including value of the goods, quantity, type of product, available transportation modes and, type of ships available etc. Tank containers are expensive to use compared to flexitanks and the cost is higher both to rent and buy (Høgseth terminalen 2016). Tank containers are usually used

for chemicals and has reputation to be a very safe method to transport hazardous liquids and high value products. When using tank containers for transportation you also have to have in mind that there will incur cleaning cost, and that it is harder to get return goods than with regular 20" containers. A flexitank serves the same purpose as a tank container, but you have more opportunities. I.e. you can transport several products in the same consignment and you are more likely to get return loads in a regular 20" container after the bladder is thrown, than a tank container. You also save cleaning cost. But there are some constrains on which material you are allowed to transport in these bladders. For dry product packaging we have big bags and inliner bag in a container. These are alternatives to dry bulk vessels if you need to transport smaller volume or if the customer demands the product in prefabricated sizes and bags.

4.5 Container management

When a company wants to transport a container from A to B they normally get in contact with an agent, shipping company or container leaser. These 3 actors are here called operators and they manage a fleet of containers to transport cargo for a variety of customer between any two points in the world. At the end of 2015 container leasing companies owned 48% of the container fleet and the rest is owned by shipping companies and shippers (clarksons.net). In addition to owning containers themselves, shipping companies and agents lease containers from these leasing companies. When the container operator receives an order, they will provide with the actual number of containers to the customer location, and arrange transport for the container across multiple modes and to the end destination (Erera, Morales, and Savelsbergh 2005). The journey often include truck transportation from the origin plant and to a nearby port (or rail) and then sea transport to a port near the origin destination and truck to the origin destination if necessary. Railway and barges are also modes that could be used, dependent on the geography.
Container operators usually do not own or manage the transportation services that are being used during the transport, instead they go into contracts with a number of service providers. These can be trucking companies, railroads, ports, container ships and other service companies necessary to handle the container on its journey. It is the combination of available routes and services that the operator use to provides an origin-to-destination service for their customer. Often several options for an itinerary is presented to the

customer, with different transit time and price. The price is calculated by adding an inland transportation cost (if necessary), a profit component, and possibly an overhead cost allocation to the ocean service cost. The transit time is determined by adding the inland transportation time to the transit time for ocean transport (Erera, Morales, and Savelsbergh 2005).

5.0 Port choice

The main actors in port decision making is according to Aronietis, Van de Voorde, and Vanelslander (2010) shippers, forwarders, shipping companies and terminal operators. The choice of port is first of all greatly influenced by the business strategy that the company have chosen. The choice of port for these actors will have influence on their cost, performance and capabilities. A lot of studies have been performed on the topic and what's interesting in this thesis is to have the perspective from a shipper and the supply chain management perspective.

5.1 Port choice criteria from a supply chain management perspective

In the literature review of port choice from a supply chain perspective conducted by Panayides and Song (2012) they found the most common criteria for port decision making for the main actors. These were port technical efficiency, cost, supply chain performance, service adequacy, value added services and information systems.

5.1.1 Technical efficiency

Ship owners and shipping lines consider the time that a ship spends in port to be expensive and unproductive, so it is of great importance that the ship minimizes its port time. Speed and efficiency of cargo handling is important to turn the ship around at the shortest amount of time possible. This puts pressure on ports to be more efficient and to be more productive. Panayides and Song (2012) define a ports technical efficiency as the maximum output that a port can provide in utilizing a given level of output (or resources).
The higher the efficiency level of a port the more likely it is to be preferred by users.

High level of technical efficiency is associated with scale, greater private-sector participation and with transshipments as opposed to gateway ports(Cullinane et al. 2006). The recognition that ports technical efficiency is a key criterion in users port choice has led to extensive studies of ports around the world. The approach that has been widely used is to consider the port as a productive unit that processes a given number of inputs to produce outputs and the ports efficiency is defined as the efficiency with which inputs are converted into outputs(Panayides and Song 2012). Examples of inputs include the number of gantry cranes, the size of the labor force, capital investment, labor expenditures, the number of berths, the number of tugs, the size of the terminal area, the book value of the assets, operational costs and total length of quay, whereas outputs include TEU throughput, level of service, port service satisfaction, frequency of calls made by ocean carriers, revenue from port facilities, ship working rate, number of ship arrivals and departures, and value of sales (Panayides and Song 2012).

5.1.2 Cost

Cost is here referred to as all costs accumulating while visiting a port. This is an important criterion in port choice because it constitutes to a significant part of the total transportation cost. However these fixed costs have different impact on the actors.
For some actors these costs are relatively low compared to costs that incur with port inefficiency, delays, low reliability etc. So they are willing to pay higher port costs in substitution for superior performance (Panayides and Song 2012). For other actors having i.e. smaller volume and lower profit margin on their goods, the port cost have larger impact on the total supply chain cost.

5.1.3 Supply chain performance

Supply chain performance is a very important criteria to especially shippers. It is the process of door-to-door transportation of cargo and may include warehousing and other services. Traditionally ports played a role as facilitator focusing on substructure and infrastructure for ship operations. Loading/unloading, storage and intra-port operations were the main focus. Ports nowadays play a different and important role as links in the door-to-door supply chain. They function as a bi-directional logistical system; they receive

goods from ships who's going to be distributed to land, and opposite they receive goods from land which is distributed further by sea. This requires a high degree of coordination and inter-connectivity capabilities within the port system. In this role, the port is one of a cluster of different logistics and transport operators involved in bringing value to the final customer. (Panayides and Song 2012). To many shippers it is very important to have good bi-directional capabilities of a port to have smooth flow in their supply chain and lots of opportunities to transport to the final customer. (Robinson 2002) suggests that ports are part of a value-driven chain system competing with other value-driven chain systems. Cargo flow will seek to find the routes with lowest cost and ports that have good availability of hinterland connections and good intermodal transport connections. Location of the port is important on the performance of the overall supply chain process in the way that it can reduce costs and benefit from being at an attractive location close to major shipping lanes and important hinterlands.

5.1.4 Service adequacy

Service is referred to as all aspects related to the service offering and value proposition of the port to its user and markets. Service include service variety and range, provision of value added services, quality, including reliability and responsiveness to user's needs and how capable they are to be flexible to changing user needs (Panayides and Song 2012). According to Notteboom and Winkelmans (Panayides and Song 2012) is the ports reliability of port operations the ability to be accurate and dependably an important criterion when choosing port. Their ability to offer its services without delays which may arise from ineffective practices, strikes, equipment breakdown, weather conditions etc., will affect the port choice of the users. Competitive advantages will be gained by having a port associated with service quality.

5.1.5 Value added services

Value added services are important to contribute to port service differentiation and adding value to and differentiate the service, which is appreciated by some users.

Tongzon and Heng (Panayides and Song 2012) found that a ports adaptability to customers' demands through understanding their needs and making offers to meet and exceed their expectations is an important factor in the users port choice.

Paixão and Marlow (2003) discuss how the ports can add value in the context of different operations, services and capabilities that takes place in a port, and includes;

> the capacity to provide hinterland and foreland for road/rail access, launch new tailored services and handle different types of cargo; the speed with which the port can take decisions on altering schedules, amend orders and change design processes to meet customers' demands; the variety of services in intermodal operations; the capacity to convey cargo, through the most diversified routes or modes and in the least possible time, to end - users ' premises; and the capacity to deliver tailored services to different market segments and to act as a collaborative intermodal hub network(Panayides and Song 2012).

5.1.6 Information systems

A seamless flow of information to ensure efficient servicing of operations is important to make the users achieve their goals. It's important to all users and the port itself to facilitate best possible performance of the daily operation. Seamless communication also integrates the supply chain and has impact on costs and service level. A well-functioning information system can reduce lead times and speed up processes and help sharing information in general (Panayides and Song 2012).

5.2 Port choice criteria's from a shippers perspective

From a shippers perspective there have been lots of studies and Aronietis, Van de Voorde, and Vanelslander (2010) sum up the most important ones for shippers in a table (Appendix 2). Nir et al. (Aronietis, Van de Voorde, and Vanelslander 2010) found through results of their survey to shippers that the most important criteria was the highway travel time. Which is the time it takes from the origin and to port. 3 other important criteria were travel cost, number of available routes from the actual port and frequency of the sailings. Tiwari et al.(Aronietis, Van de Voorde, and Vanelslander 2010) found similar results from their study but had in addition total TEUs handled at port, TEUs per berth at port, TEUs of cargo per crane and handling volume per length of quay. This study was for container

shippers and had a little more focus on handling and capacity of the port and the shippers seemed to be focused on minimizing time in port. De Langen(Aronietis, Van de Voorde, and Vanelslander 2010) listed in addition to the mentioned ones location of port, quality of terminal operating companies, service level on agents and information, and reputation on damage goods/delays. As of the studies there is a trend and most of the criteria are the same in one form or another. There are also numerous other criteria that may come into consideration when choosing port. I.e. has policy development and environmental responsibility played a larger role in the shipping environment recent years. But the listed criteria are the most focused ones. Which criteria that are important for each company depends on multiple factors like business strategy, opportunities, volume, value and type of goods, lead time conditions etc.

6.0 Distribution flow balance in Norway

The conclusion of the trade patterns in the chapter about the container market is that there is an imbalance in trade. This also affects the container trade and the container distribution flow balance because the consumption and production is at different locations (ECON 2015). When the export is larger than the import more containers are loaded than discharged in Norway. Resulting in a demand for containers in Norway and an overcapacity of empty containers where the goods is shipped. This imbalance in trade is the primary source of accumulation of empty containers, and the need for repositioning of containers to where the demand is higher for export. This is also known as the "backhaul problem" (Demirel, Ommeren and Rietveld 2007).

In the largest ports in Norway we have what we call a hybrid distribution flow. Where there are either excess of import or export. In figure 9 we can see an illustration of a hybrid imbalanced container flow. You have an import flow and an export flow and the imbalance between these flows are solved by repositioning of empty container to where it is demand (Rodrigue 2013).

Containers arriving in the market as import must eventually leave, either empty or full. The longer the delay the higher accumulation of costs. The repositioning process starts immediately after unloading and is important since it is costs that must be assumed by the shipper and are thus reflected by the cost paid by producers and consumers (Rodrigue 2013). An increasing number of containers are repositioned empty because cargo cannot be found for a return leg. This has resulted in a growth in repositioning costs because

shippers is trying to utilize their container assets more efficient. Around the world about 2.8 million TEUs are stored empty, waiting to be used. These empty containers accounts for 10% of the existing container assets and 20.5% of the total global port handling. Because of this, empty container management is one of the most complex problems concerning global freight distribution (Rodrigue 2013). Saeidi et al. (2013) listed in addition to imbalanced trade patterns dynamic movement, unclear transportation demand, diversity of tools, blind regions in transportation chain(remote locations) and daily strategic affairs of transportation officials(planning) to be important factors that influenced the repositioning of empty containers. The empty container problem is according to Rodrigue (2013) caused by trade imbalances, repositioning costs, revenue generation, manufacturing and leasing costs, usage preferences and slow steaming.
Repositioning costs can be low if imbalances are acute as carriers will offer discounts for flows in reverse direction of dominant flows. However, if costs are high shortages of containers may appear on export markets. Ship owners want to maximize their revenue by allocating their containers to export ports with higher rates. This is often not the best for economic opportunities for their customers. Accumulation of containers can also happen when the cost of manufacturing a new container or the leasing cost is lower than the cost of repositioning them. This can happen over larger distances but is a temporary phenomenon because leasing cost is correlated with the imbalances. Due to the highly competitive situation in the market and the reluctance of shipping lines and container leasing companies to share market information and container positions the actors have not yet succeed in making container pools by cooperating. Another cause is slow steaming, where ships reduce their speed due to high bunker prices or excess capacity. This ties up a lot of containers in inventory in transit and reduce the availability of containers inland. (Rodrigue 2013)

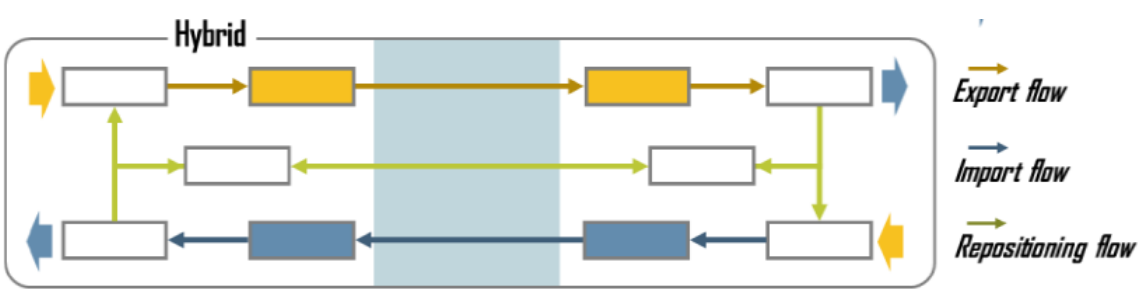


Figure 9: Hybrid imbalanced container flow *(source:www. people.hofstra.edu)*

Norway has 27 ports worth to mention along the coast. These are divided in 4 regions: East-Coast/Oslo, West-Coast, Middle-Norway and North-Norway. In addition there are a lots of private owned ports where companies with large import/export demand is located (Hydro, Elkem, Norcem, Norske Skog, Hustadmarmor, supply bases etc.) (Netter and Oterhals 2009). When elaborating the distribution flow balance in Norway the thesis will focus on the container flow because this is what's relevant to the section on utilizing unbalanced container flow. The container flow in Norway is characterized as imbalanced due to the imbalanced trade pattern. The container flow between Norwegian and foreign ports are dominated by 20" and 40" container and very minor volume on other types and sizes. From table 1 we can see the relationship between import and export by regions in Norway. The Oslo region is the only area in Norway where the container import is larger than the export. This is a result of the import trade, mostly with Asia and Europe. Rest of the regions are characterized with an export larger than import. The West-Coast is an example where commodities like petroleum products, chemicals, aluminum and fish are big industry and the export is larger than import. This imbalance results in regional differences and an uneven demand for empty containers. Empty containers will pile up in the Oslo region while there is a demand for empty containers in other large ports especially on the West-Cost, Middle-Norway and North-Norway. The empty containers are repositioned from Oslo and to the closest domestic ports where there is demand (Netter and Oterhals 2009). The demand for empty containers at other ports will be solved by repositioning empty containers by ship from ports in Europe (Jan Arve Hoseth 2016).

	Import	Export	Total	Export share
Østfold	9 981	41 354	51 335	0,81
Oslo/ Akershus	63 267	23 893	87 160	0,27
Hedmark/ Oppland	278	2 326	2 604	0,89
Buskerud	675	10 364	11 039	0,94
Vestfold	4 987	2 617	7 604	0,34
Telemark	976	12 183	13 159	0,93
Agder	4 077	25 824	29 901	0,86
Rogaland	5 107	9 124	14 231	0,64
Hordaland	4 663	6 360	11 023	0,58
Sogn og Fjordane	853	10 770	11 623	0,93
Møre og Romsdal	4 515	16 056	20 571	0,78
Trøndelag	1 964	2 981	4 945	0,60
Nord- Norge	269	4 154	4 423	0,94
Total	101 612	168 006	269 618	0,62

Table 1: Container import and export by region in TEUs (1997) *(Source: ntp.dep.no)*

6.1 The container flow balance in the West-Coast region

On the West-Coast Ålesund and Haugesund have large regional ports in terms of Norwegian benchmark. Tyrholm and Farstad (Jan Arve Hoseth) located in Ålesund reported (2015) that 26 000 TEU was loaded at the port for export. While the import was 9000 TEUs of loaded containers and 19 000 TEUs were empty containers repositioned by ship from Europe. So there is a significant imbalance in container flow at his port. This has to do with the large fishing export from the fishing industry in the region. Of these 26 000 TEUs 90% were 40ft reefer containers and just a small amount were 20ft and tank containers.

North Sea Container Lines (NCL) is located in Haugesund and operates ships along the West-Coast of Norway connected to transshipment routes and SSS. NCL had in 2015 a yearly turnover of approximately 125 000 containers. This were primarily 20", 40" and 45" palletwide. Approximately 10 000 empty TEUs are yearly positioned to industry on the West-Coast for export. This is mainly 40" reefer containers which are hard to get backhaul loads on and are used for export of frozen fish and 45" palletwide containers coming from SSS import from Europe. According to Arne Jacobsen in NCL they are now working with getting more import cargo to the coast of Norway so the import containers can be used for export by the Norwegian industry.

He states that there is a trend that more of the production will happen in Europe than earlier. This results in more import from Europe compared to Asia and America than earlier, and there is an excess of empty containers because of the import. NCL is now considering to a larger extend to repositioning these containers to the Norwegian industry to get backhaul loads and utilize the capacity. Conclusion will be that there is an imbalance both in the transshipment routes and in the SSS market. Arne Jacobsen further reports that the industry ship way to many empty containers which has a huge potential to be utilized to create value for all players and save the environment. He suggests new digital techniques and systems can help realize this potential. Digital systems which handle sharing of containers among all the container owners is a solution Arne Jacobsen suggest introducing to utilize the container capacity.

Both Arne Jacobsen and Jan Arve Hoseth agree that there is an imbalance in container flow on the West-Coast of Norway. In average the export is larger than the import, but the more south the ports are located along the coast the higher is the import volume. Imbalances are larger the more specialized the cargo carrying unit (CCU) are because of

the difficulty to find backhaul loads for specialized CCUs. 40" reefer containers and tank containers are examples of CCUs that requires special type of cargo.

6.2 The container flow balance in the Romsdal region

Johannessen, Oterhals and Svindland (2013) conducted a survey in 2013 where they interviewed 35 companies in the Romsdal region. Based on this survey the container flow balance in the region was imbalanced and there was far more export than import. In 2013 these 35 companies imported 1533 containers by sea and exported 26 288. At the same time the container import by road was 14 825 and export 4100. Even though the region is characterized by more export than import it tells us that the companies in the region are more likely to export by sea than import by sea. According to these numbers there is a huge potential in getting the container flow more balanced to utilize the capacity. Moldegaard Maritime also confirms that there is an imbalance in container flow where the export is larger than the import by sea, and the opposite for containers by truck. In general there isn't a huge container activity by sea in the region, and large parts of it is distributed through private ports.

6.3 How can container flow imbalances be managed?

Imbalanced container flow is the cause of empty containers. Moving, storing and handling empty containers are expensive to the companies involved, society and environment. To cope with the imbalance in container flow and the empty container problem different strategies have been tried. The best way to cope with this imbalance is to reposition the containers to where it is demand or to get backhaul trips. Repositioning is as previously stated to move the empty containers to a new location where it is demand. While a backhaul load is when you manage to fill the container with cargo for the return trip. There have also been some experimenting with foldable containers to save costs on repositioning and to balancing out trade with recycle flows (Brito and Konings 2007). Foldable containers are a new technology that has come up where after folding, 5 containers can occupy the same space as 1 unfolded (PIERS 2011). To use recycle flow for the return trip can be explained as shipping end-of-life products on a return trip to be recycled at another destination. For example China has a huge demand for paper. Used paper can then be

shipped as backhaul loads and recycled in China (Brito and Konings 2007). Same as for electronics where China is the largest producer, they could benefit from recycling close to the manufacturer.
Among these options it is the ability of getting backhaul loads on return trips that creates most value for the actors involved. But repositioning is also a good option if the repositioning cost is within an acceptable level. Having read these articles and statistics about SSS and talking to different companies, it may seem as a good idea to take advantage of the imbalance by cooperating within local industry clusters about how they should organize their import and export transportation mode choice, as a strategy to manage empty containers.

7.0 Shorts sea shipping versus road haulage

The European Union define SSS as:

> the movement of (2) cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering (3) Europe. Shortsea shipping includes (4) domestic and international maritime transport, including (5) feeder services along the coast, to and from the islands (6) rivers and lakes. The concept of shortsea shipping also extends to maritime transport between the Member States of the Union and Norway and Iceland and other States on the Baltic Sea, the Black Sea and the Mediterranean (shortsea.info).

Road haulage is simply the cargo transported by road and don't need further definition.

When choosing whether to transport by road or sea there are some important factors to take into consideration. According to Swahn (2006) study there were found 7 basic factors when decision makers are going to choose between transportation choices; security, delivery precision, price, information, time, environment and flexibility. The factors are weighted in chronologic order, with the highest weight first (security). Road and sea transportation have different characteristic in performance for these factors. To take a closer look at the individual performance for these modes we have to go deeper into strengths and weaknesses.

Casaca and Marlow (2007) discussed strengths and weaknesses of SSS in their study and found 13 strengths and 19 weaknesses while Paixão and Marlow (2002) identified 7 strengths and 6 weaknesses. To concentrate on the common and most important ones SSS has a huge geographical area available with a total coastline of 67000km. This builds a good competitive situation. Additionally 60-70% of the EU industry is located within 150-200 km of the coastline (TransBaltic Extension project). One of the most important advantages SSS have over road haulage is the capability to transport large volumes by utilizing economies of scale which creates lower freight rates/ton for the customer. Further sea transport has virtually an unlimited capacity and infrastructure investment and maintenance costs are much lower than with road transport. According to Paixão and Marlow (2002) the cost of port maintenance and port investments is low compared to other land based transportation modes, especially by considering external costs like congestion and pollution. The only external investment necessary is providing for an adequate port infrastructure that can handle entry and exit of goods without congestions. There are a lot of players in a port so involvement and cooperation is important to prevent bottlenecks. Paixão and Marlow (2002) states that this situation implies that SSS does not need innovation in form of new investments in infrastructure, but the performance can easily be increased by cooperation of SSS and business related players. The implementation of such cooperation among players would increase flexibility, creativity, integrity, leadership and openness to learning. This will help handle market uncertainty and new logistical challenges like Just In Time (TransBaltic Extension project). Another strength is that the market has high entry barriers, due to a capital intensive industry and high skill and knowledge of the players.

Over the last decade minimizing the environment footprint has been increasingly important for the industry and especially with respect to CO_2. Shipping may be the most environmentally friendly of all modes regarding CO_2, possibly with the exemption of electric railways where these are available. A comparison (TransBaltic Extension project) between modes shows that an average feeder ship can handle 1500 TEU, a train 75 TEU and a truck 1.6 TEU in average. This means that one feeder vessel can carry the same amount as 20 trains and 937 trucks. Being able to transport large volumes over long distances is an advantage when comparing CO_2 emissions per ton/km between transportation modes. Hjelle and Fridell (2012) found in their study about SSS and the environment that SSS may very well deserve their "green label" with respect to CO_2

emissions. This conclusion was valid for cases where the vessel had realistic operating environment in terms of speed and load factor, and when the shipping leg is not much longer than the distance of the land based modes. Slow steaming, maximum load factor both ways and longer distances would increase the benefit of SSS. Additional advantages of SSS are the higher safety levels of dangerous goods. It safer to have these goods at sea, where there are long distance to humans. Also heavy goods can more easily be transported at sea where there might be weight restriction on road. Finally SSS is an underused capacity mode and has almost endless potential in terms of capacity.

Paixão and Marlow (2002) identified 6 weaknesses of SSS. These were costly/time consuming port operations, conservative corporate culture and structure, lack of innovation, information technology, lack of marketing, no customer orientation. Recent years we have observed that some of these weaknesses have been improved, but SSS yet has an unreleased potential.

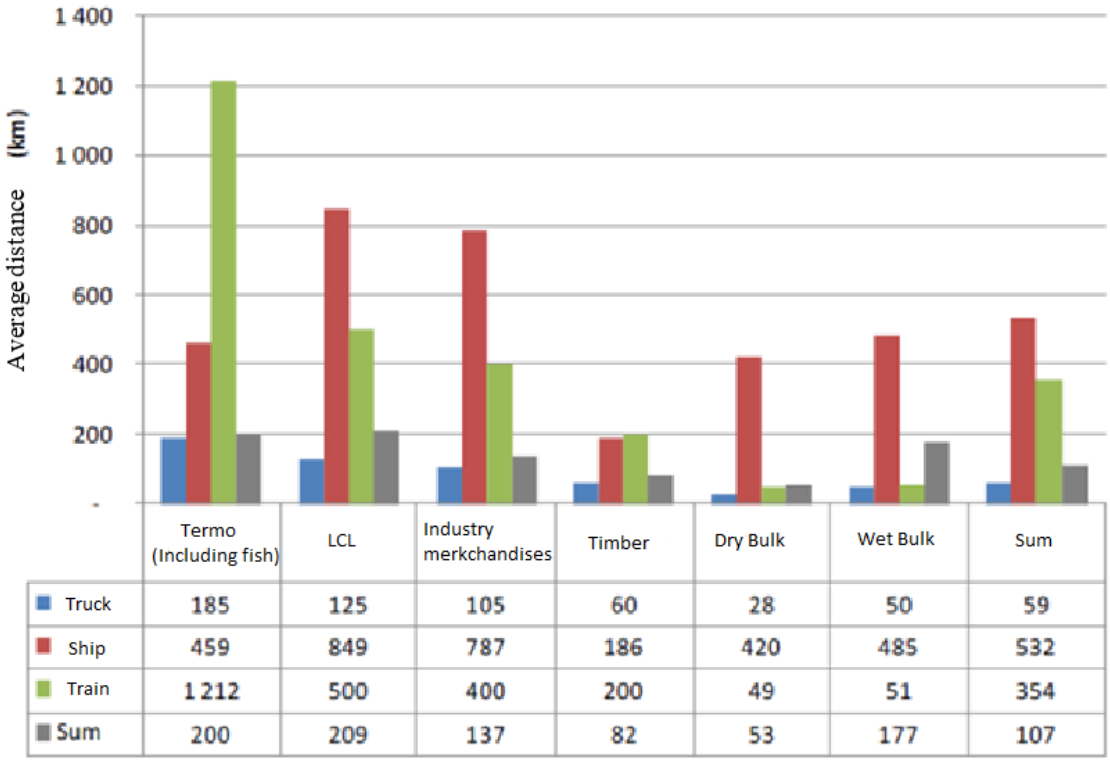
One major weakness of SSS is the incapability of offering door-to-door services. SSS is depending on the collaboration with other land sided modes to provide this service, and lack of cooperation with respect to interconnectivity, interoperability and availability of information systems who support the supply chain in terms of flexibility makes this a broken transport chain. Road transport is with its frequent departures and delivery possibilities a very flexible choice and SSS is way behind in these capabilities. Medda and Trujillo (2010) observed that port infrastructure is often not prepared for SSS and is not favoring this business. This can cause queues and deep sea carriers are often favored. There can also be lack of adequate cargo equipment or downtime of this equipment which results in lower handling rates and cost increase, which is further emphasizing the lack of transparency of port charges (TransBaltic Extension project). Another weakness of SSS is the administration burden. The cargo handling requires a lot of paper work compared to road transport. Flexibility and reliability are also much higher in road transport with respect to arrival and departure times. Weather and sea conditions can influence this and create delays. The time a ship stays in port is also a weakness because of high inventory costs for the shipper in SSS which will be reinforced if exposed to delays. Paixão and Marlow (2002) also listed some obstacles to success for SSS. These were: time restrictions of labor within the terminals, insufficient traffic coordination, managerial problems, delays

caused by locks and bridges, lack of adequate storage facilities, and weak coordination links between shipper and customer.

In some ways the strengths of SSS is the weakness of road haulage and vice versa. But to see the whole picture the next section will take a look into some of the strengths and weaknesses for road haulage. The biggest advantage of road transport is the flexibility and the fact that the cargo is driven from the shipper and all the way to the door of the customer. This reduces cartage, loading and unloading expenses (DHL 2016). As previously stated this is one of SSS biggest improvement areas. Lead time is also a strength for road transport if the distance is short or medium like national transport or mainland Europe. Another advantage is that it is very easy to monitor the location of the goods and also to communicate directly with the driver. If transporting in rural areas i.e. exchange of goods between towns with no connection with rail, sea or air, road transport is the only option. There is also lesser risk of damage to goods because intermediate loading and handling are avoided. The cost associated with loading, unloading and handling of cargo is also smaller than with SSS in addition to a less bureaucratic way to handle documents (Agarwal 2016). Major weaknesses of road transport is that you cannot deliver everything you want because certain restrictions are imposed with regard to size and weight of delivered items (Jaruzel 2016). Road transport is also subject to traffic delays and breakdowns. Bad weather and driving regulations can also create delays. This mode of transport is also unsuitable for long distances and costly for transporting bulk cargo over long distances (Agarwal 2016). The environmental aspect is also a weakness where road transport can't compete with SSS on pollution in ton/km. Accidents are also more likely to happen on road than sea transport.

Choosing between SSS and road haulage is a strategic choice. In addition to Swahns (2006) factors when choosing transport mode the TransBaltic extension project (2014) found that competition increases when distance is getting smaller due to increasing number of companies and transport modes serving one and the same route. So the longer the distance become and the higher the volume is the more offsetting become the scale effects of container vessels in terms of fuel consumption. A wide range of aspects has to be considered when thinking about changing mode on a specific relation. Among these are volume as mentioned, and the regularity of shipments. The goods category is important

too; are the goods high and heavy, or can it be containerized? Number of transshipments (subdivided transports) and flexibility also plays as important factors in the decision making. Figure 10 Explains average distance for different goods with respect to transport modes domestic in Norway. This gives a picture of the relationship between choice of mode with respect to distance and type of goods.



	Termo (Including fish)	LCL	Industry merkchandises	Timber	Dry Bulk	Wet Bulk	Sum
Truck	185	125	105	60	28	50	59
Ship	459	849	787	186	420	485	532
Train	1 212	500	400	200	49	51	354
Sum	200	209	137	82	53	177	107

Figure 10: Average distance for different goods with respect to transport modes in domestic trade *(source: adapted from: www.nholt.no)*

To sum up, both SSS and road hauling have their advantages, but in today's demanding environment with concern of policies and directives and the focus on getting goods from road to sea, the SSS is preferable when choosing mode if possible. When transporting substantial volumes, road haulage can't compete with SSS on price and C02 emissions (Vanherle and Delhaye 2010).

8.0 Lessons from the literature as background for the analysis

The literature review in this thesis is supposed to give the reader an understanding of the different central subjects that is relevant for answering the research questions. In addition the review is important for the author to solve the problems in a scientific matter.

The first sections in the review give an overview over the container market and the hub and spoke system. The hub and spoke system gathers cargo from different regions and literature confirms that this system is developed to utilize the economy of scale to reduce unit costs.

The theory reveals lots of packaging options for shippers. Big bags and small bags for dry cargo. Tank containers and flexitanks for larger consignments, both wet and dry.
Bags can be put on pallets, into containers or on rolltrailers. Flexitanks are shipped in containers. A tank container is an intermodal tank that is shipped as a container.

The review found that the important criteria from a supply chain perspective doesn't necessary have to be the same as for a shipper's perspective. In a shipper's perspective the most important criteria was the highway travel time, travel cost, number of available routes and frequency of sailings.

Looking at the container flow balance in both Norway and west coast of Norway it's characterized as imbalanced with more export than import. The empty container issue may be solved by repositioning or backhaul trips. Foldable containers can be used to reduce repositioning cost and recycle flows can be means to get backhaul loads where there are no other opportunities for backhaul loads.

SSS and road haulage both have advantages and disadvantages. SSS is promoted as a more environmental alternative with respect to $C0_2$. It is also a cheaper alternative than road haulage when transporting bulk cargo over long distances. Moving more of the cargo from road to sea will also generate positive effects for the container flow imbalance.
SSS in Europe has still some challenges in being flexible and provide door to door solutions, that is one of the advantages for road haulage

9.0 Analysis

The analysis will start by looking at the choice in Europe, analyzing some important factors taking this decision. Then the choice of packaging is analyzed with respect to the project, discussing how the different solutions can be handled for dry and wet product and the advantages and disadvantages. Further the opportunities for utilizing the container flow imbalance is discussed followed by how this can be managed. The last section of this chapter will be used to analyze the different cases discussing advantages and disadvantages of the different solutions.

9.1 Choice of port in Europe

According to the literature port choice has influence on a shipper's costs, performance and capabilities. Aronietis, Van de Voorde and Vanelslander (2010) found through their survey that the most important criteria was the highway travel time. This is in Hustadmarmors case not so important because the goal is to find a hub port for further distribution. Still the port location has to be central to be able to distribute further to end customers. If we are talking about the departure port in Norway this has far more relevance because of the high truck rates on short distances within Norway (discussed in case 2 and 3).
Good connections to hinterland is important, if the customer is located in Europe and needs further transportation by truck, train or barge. The most important criteria for Hustadmarmor in their port choice is according to the logistical department and from meetings with shipping companies: Availability of transshipments, transportation costs and routes available. Panayides and Song (2012) also state that it is important having bi-directional capabilities of a port to have smooth flow in the supply chain and lots of opportunities for distribution to customers. This will be important to Hustadmarmor since their customer locations require distribution to all over the world. The most obvious choice for Hustadmarmor is a major port situated in central Europe. Rotterdam, Bremerhaven, Hamburg, Eemshaven and Antwerpen are all ports that have been considered. All these ports are major ports offering a wide range of services. Lots of shipping companies are visiting the port and have regular schedules both trans-ocean and SSS. The capacity of the ports makes lots of companies to offer their services which is resulting high frequency of sailings. All these opportunities give Hustadmarmor the opportunity to seek routes with the

lowest costs for further distribution (Robinson 2002). Overseas journeys from these ports are often conducted by huge containership utilizing economies of scale to reduce freight rates. Good connection to hinterland and intermodal connections are also characteristics of the ports. This is important if the customer is located in Europe. Some of the shipping companies emphasize that it can be costly if you have to change terminal inside the port i.e. to an overseas terminal. Costs of transporting, handling and fees will have impact on the total transport cost. So the importance of arriving at a terminal with overseas connection is something Hustadmarmor have to take into consideration. Here the shipping companies suggested that arriving at Eemshaven was a bad choice if distributing further overseas. This because of the need to change terminal inside the port, and lack of multiple good overseas connections compared to the others. Rotterdam, Bremerhaven, Hamburg and Antwerpen are the four largest container ports in Europe. In 2015 Rotterdam was the largest with a container throughput of 12.2 million containers, Antwerpen 9.6 million containers, Hamburg 8.8 million containers and Bremerhaven 5.5 million containers (porteconomics.eu). All located in the central Europe with good hinterland connections and large container handling capacity will give Hustadmarmor good solutions to further distribution to end customers. In many ways it is the shipping company that chooses their destination ports, and Hustadmarmor is the one choosing the shipping company. But in this case with large volumes, deals and relationships have to be formed to make good freight rates. So Hustadmarmor has some power to choose their destination port through making deals with the shipping companies.

I.e. if a shipping company is scheduled to Hamburg with a vessel with 50 of Hustadmarmors containers, they can negotiate to make them take an additional stop in Bremerhaven if this is a better port for further distribution. This can incur additional costs, but total transportation costs to the end customer can be reduced by choosing the best suited port.

9.2 Choice of packaging

There are lots of opportunities when choosing how a product is packed. The options listed in Part 1 is the most relevant once to Hustadmarmor. According to Cox et al. (1995) it is important to create value and provide services for the customer. This can be related to this choice. Hustadmarmor could choose to only offer their customer liquid bulk by flexitanks. With this option they will lose all customers asking for smaller volumes than 20 tons and

all customers asking for dry product. According to the sales department a significant percentage of the total expected new customers has a demand for these services. So this choice is absolutely a strategic one.

Transportation of these ways of packing the product is different. For dry products you have the option between different sizes of big bags, usually 200-1200 tons or inliner big bags. Normal big bags can either be loaded directly into a dry bulk carrier or be containerized. The disadvantage of loading it directly into a dry bulk carrier is that it may need to be containerized at a later stage on the route to be able to reach the end customer. I.e. if dry bulk ship is not available from the port in Europe to the end customer, or if it becomes too expensive to transport it further with a dry bulk carrier. Also if the big bags need to be containerized at a later stage on the route it will incur costs for handling, loading and renting container. The advantage of transporting in dry bulk is that larger volumes can be transported and you will have a better load factor than with containers. Another opportunity that Hustadmarmor may consider is to use the Utkilen chemical tankers to transport dry bulk in tanks made for wet bulk. According to the technical department at Utkilen it is possible to rebuild some of the tanks to take dry bulk. This requires a pump that blows the product into the tank and a vacuum pump to suck the product out of the tanks and into tank storage in Moerdijk (owned by Hustadmarmor). Investments must be made if choosing this solution and they have to take a close look at regulations and policies if it is even allowed. With this solution Hustadmarmor will get a very cheap freight rate to a hub in Europe, since the ship is carrying wet bulk to the same destination anyway.

Big bags can also be put on pallets and loaded directly on the vessel by a sideloading system or the pallets can be loaded into a container. It is also possible to use MAFI-rolltrailers as Ro-Ro cargo. Loading directly into the vessel has the same disadvantages as for loading directly into a dry bulk carrier, it may need containerization at a later stage. In addition to big bags the product can be loaded in small bags, usually 25-50 kilos stacked on pallets. These pallets can be transported the same way as big bags on pallets. Inliner bags function as a dry bulk containers and can be transported as any other container.

Having all these options Hustadmarmor has to look at what’s important to their customers and if it is profitable to offer all services. Delivery of bags, both small and big will require

some sort of a packing operation at the plant. This is not a large investment seen in comparison with the size of the company, but will require extra labor and new internal routines. Another alternative is to ship in bulk ships to Moerdijk and conduct the packaging operation on the tank storage in Moerdijk. This will be a bit like the situation in case 5 where Hustadmarmor puts away some of the production and logistics to other companies. It also will result in less control over the supply chain. In terms of transport, all these packaging options can be stacked into a container. This gives them a guarantee that the product can reach the end customer anyhow you pack it. So the concept is established with use of a container stacked with either big bags or small bags with or without a pallet or with an inliner bag. This will be different to each customer requirements and further distribution from Europe. If the modes allow it and the price is right they also can transport with use of sideloaders and dry bulk hatches.

For the wet product, small consignments of liquid slurry is either loaded into a tank container or a flexitank. This method is easy because it's containerized and standardized to be handled by all modes and doesn't need to be opened before it reaches the customer. The largest part of the new markets will demand small consignments of wet slurry. Market research showed that a tank container is a lot more expensive to rent than a container used as a flexitank. It also showed that tank containers are used for much higher value products than slurry, and that it is difficult to justify the high price compared to the relatively low value product that slurry is. The tank container needs cleaning, which may be costly and it is difficult to find backhaul cargo for these tanks. While the flexitank has the advantage that the bladder inside can be thrown away, and then the container becomes a normal 20" container with a much greater chance to find backhaul cargo for. This has led Hustadmarmor to start testing the system and they have already sent one test container from Elnesvågen to USA using this flexitank-system. On figure 11 we can see the preparation and loading of the first flexitank sent from Hustadmarmor. This was a success and showed Hustadmarmor that this may be a future solution for transporting wet slurry in containers.

Figure 11: Preparation and loading of flexitank at Hustadmarmor *(source: Vidar Hals)*

9.3 Opportunities for utilizing distribution flow imbalance

Chapter 6 reviews the container flow balance and found that in the region Hustadmarmor is located there is a significant imbalance in trade, where the export is larger than import and the demand for empty containers to export companies is present. So the obvious way of using import containers for export is to a small extent possible because of the minor import in the region. The most common way to satisfy this demand is the repositioning of empty containers (Rodrigue 2013). The repositioning cost is often included in the freight rate from the shipping companies. There are still ways to solve this issue, but awareness and cooperation are necessary to cope with it. And by arranging backhaul loads you can reduce the freight rate and cut the repositioning cost. The author will suggest following three main solutions to help coping with imbalance container flow: put an effort in going from road transport to sea transport, collaborate with local industries to share containers for their import of i.e. raw materials or merchandises used in the industry, and close cooperation with the shipping companies to make deals on return loads.

Every export company have some import. This can be machinery to the manufacturing, spare parts, raw materials and so on. To increase the import in the region it may be a

solution to containerize goods that previously have been transported by road, to benefit from the cheap freight rates from backhaul loads at sea. As discussed in chapter 7 SSS is highly price competitive over long distances and since sea transport is referred to as the "green mode of transport" this may be a good idea to look at for companies. According to general manager in Samskip Are Gråthen (2016) there is also possibilities of getting subsidies if you can prove that you have moved cargo from road to sea. Hustadmarmor has forecasted a weekly export of 40-80 containers. This means a potential of getting 40-80 containers with backhaul goods. It may be extremely ambitious to get backhaul goods on all these containers, but if the local companies focus on transporting more of their import by sea, it is possible to utilize some of these containers for backhaul loads and achieve reduced freight rates. This counts for Hustadmarmor in their export freight rate and for the local industries import freight rate. A report from Møreforskning (Oterhals and Kvadsheim 2015) where 17 companies in the region were interviewed showed that 502 containers were imported by sea annually and that the potential for increased use of transport by sea was 103 containers. This is a pretty small amount compared to Hustadmarmors forecasted annually amount of 1600-3200 containers, but there is still potential for increased utilization. In addition Hustadmarmor is now looking at what can be containerized of their import, and what can be moved from road to sea. According to purchasing manager at Hustadmarmor Odd Petter Lyngstad the potential for using container flow imbalances for import is about 3489 tons annually. This will be approximately 160 containers with a weight of 22 tons. Mainly this is grinding balls in different sizes, used for grinding down the limestone in smaller pieces. In addition there are some chemicals that are used to purify the raw material and to balance the PH-levels. Moving this import from road to sea will result in a lower freight rate for import, but also for the export because cargo are transported both ways. Purchaser Geir Naas at Doosan reports that Doosan already is getting approximately 30 (22 tons) containers annually shipped to the Høgseth terminal. These containers has the potential to be moved to the Hustadmarmor distribution network to utilize the imbalance. This way they will reduce the transport distance by road from 40km to 2km. In addition the freight rates may be lower because of the reduced truck time and because it utilizes the empty containers that are shipped to Hustadmarmor for export. He also states that containerizing more of the import cargo is difficult because it is small volumes from different locations in the world and most of the suppliers are located inland.

To increase the import and to be able to get small shipments containerized and shipped by sea it is important to cooperate with other companies to share containers. One of the reasons many companies choose to transport by road is that the shipment is too small to be sent in a container. This can be solved by sharing containers with other companies. Sjøportalen is a great example of an initiative of how to do this. Sjøportalen is an online system for companies in the Romsdal region where they can add what, when and where they would like to ship cargo. It's then up to the responsible to coordinate the shipment and fill the containers to create beneficial transportation costs. This system functions both as an import solution and an export solution. The system is in a pretty early stage and has not yet released its potential. If this becomes a success on the import side, it may create good conditions for reducing empty containers at sea. But it requires willingness to cooperate and also to take more control over the import logistics from their suppliers.

Cooperation with the shipping companies to get return loads is the last suggestion. With 1600-3200 containers annually Hustadmarmor will be a large provider of volume to the shipping companies. Shipping companies very often has good overview of the market in the regions they operate with respect to the import/export situation. So to large customers they can make deals on getting backhaul loads. Arne Jacobsen reports that NCL currently is working with new oversea routes to the west coast of Norway. This will create an excess in empty containers that they will consider to offer to their customers for export. Having contract on arrangement like this will benefit Hustadmarmor and affect the freight rate in a positive way. So it may be an idea to focus on this when negotiating and choosing supply chain partners.

9.4 The distributions solutions

The cases described in the following section are possible distribution concepts for Hustadmarmor. They are found through conversations with the logistical management on what options Hustadmarmor have for their distribution to reach a distribution hub in Europe. Each case is analyzed by looking at the advantages and disadvantages at each option. Some cases also lead to an analysis over opportunities that can occur if the case is realized. The analysis follows by a discussion over which case is best fitted as a new

distribution solution and at the end a recommendation for what the author thinks is the best solution for Hustadmarmor in the short and long run.

Since large parts of the price of the product consists of logistical costs, this is an important factor to if this projects will be realized and successful. Slurry is characterized as a low value product and large turnovers are important to make profit. This has huge impact on the costs since large volumes means high transportation costs. So the cost variable is absolutely vital to if this project is going to be realized in the first place. To be competitive Hustadmarmor need to get their product to Europe at a cost of approximately 250NOK/ton. When they have found distribution concepts that can fulfill this requirement they can start look at other important variables. To get this price to Europe it is important to make the logistic as efficient as possible, both internally and externally. Internally by the way they produce, plan, handle and prepare the consignments. Externally with what modes, routes, packaging, carriers, port and agent they choose.

The base for this analysis is that 40-80000 tons is going to be produced for shipment in small volume consignments either in dry or wet form. This is the forecasted volume for the first year, and according to sales department the volume is expected to increase the next couple of years. There are no exact volumes given to different end-destinations, but the most relevant destinations currently are USA, Mexico, Turkey, England, Sweden, Kazakhstan, China, France, New Zealand.

The shipments are going to be distributed the best way possible to a hub in Europe for further transportation. The vision is that if Hustadmarmor can distribute their product cost efficient to a hub in Europe, they can reach global markets from that hub and be competitive.

Figure 12 shows a graphic illustration and the geography over the different distribution solutions that is going to be analyzed. To distinguish between the two cases Elnesvågen-Europe, the red line represent case 5, distribution through existing network.

Figure 12: Illustration of distribution solutions *(source: adapted from maps.google.com)*

9.4.1 Case 1: Elnesvågen – Europe by ship

Description of case 1:

The consignment is loaded from the production and stowed directly on vessels arriving on a frequent basis. MAFIs are used for transporting the consignment from the production facilities and to the quay where the vessels are berthing. In this case volume have to be large enough to encourage shipping companies or liner services to make it profitable to provide their services to the port in Elnesvågen.

To transport directly by ship from Elnesvågen to Europe may be the most logistically efficient way to distribute their products. The important variable here is the volume shipped. The total volume demanded by the new markets is vital to if this case is feasible. Low volume demanded means less containers at each shipment which results in higher freight rates. Hustadmarmor has forecasted an annual volume on 40-80 000 tons the first years with containerized cargo. This is approximately 1600-3200 containers yearly and 30-

60 containers weekly. These numbers are also expected to increase in the following years according to the sales department. With this large amount several shipping companies has shown their interest to make their trip to Elnesvågen. Stable high volume is important to maintain acceptable freight rates. If the volume is unstable and the volume becomes much lower than forecasted this will increase the freight rates and there will be no value neither to the shipper nor to the carrier and customers. Hustadmarmor is dependent on a carrier partner that is able to serve a hub port in Europe and preferable a carrier that also has a route to England. Finding the correct partner is important for success. Freight rates and route opportunities are the most important factors when choosing this partner. But also finding a partner that is willing to adapt to find good solutions and create a good relationship.

To handle the forecasted amount of containers in Elnesvågen a new terminal has to be built. Hustadmarmor currently has two quays, one for import of raw materials to the production, and one for export of finish product by bulk ships. None of these are able to handle containers due to weight restrictions on quay and the space needed to handle containers. The area for this possible new terminal are available and has lots of space. It requires some investing in groundwork, cold storage facilities and equipment for handling the containers. The area has a depth that can handle large vessels and is located very close to where the containers are loaded. The containers need to be moved after loading and transported to the container quay by MAFI rolltrailers which is about 6-800 meters.

Figure 13: Opportunities for building a container port *(source: Hustadmarmor)*

At figure 13 we can see the export quay (black ring) where the red vessel is moored and the import quay where the next vessel is moored (green ring). The grey area to the left (red ring) is currently unused space and could be used as a possible new terminal for handling containers to new markets. By making a new quay, Hustadmarmor do not need to transport anything by road haulage to get to Europe. This saves costs and environment (Vanherle and Delhaye 2010). They are also able to handle all the operations and logistics themselves without outsourcing anything. Loading, packing, handling etc. is done on site and if containerized, the box don't need to be opened before it reaches the customer. This creates value and control over logistics to the company and value to the local community. An additional opportunity with building a container handling terminal is to make it open for the industry. This way they can create value to the local industry for import and export. This also can exploit the opportunities of getting more goods from road to sea and to take advantage of the imbalanced container flow in the region. If the port is open for the public and this is a success, Hustadmarmor will have more opportunities for different types of packaging and more frequent ship calls because more shipping companies will take the trip to Elnesvågen to offer their services. The downside about this case is that if the project isn't a success and volumes seems to be lower than anticipated, investments on a new container terminal will be partly lost and the quay could only be used as berth for vessels waiting to be loaded in bulk. Another disadvantage to this case is that it is a time consuming project, and building a new quay and to make contract with a carrier may at worst case take years. First consignments is planned to be shipped in Autumn/Christmas to Turkey, so this will be a dilemma. Another thing to bear in mind is that opening the port for the public could result in resistance from the local community. Large amounts of containers would potential be moved to and from the port, so there will be an increase in traffic and strain on the road network on a small place with only 3000 inhabitants.

On the other hand, if successful, this port has a potential to be a new regional port because of its geographical location. Both potential carriers and agents have implied that this could be a good solution. This would be a dream situation for Hustadmarmor giving them flexibility because of frequent port calls with multiple carriers, and at the same time reliability. If the local industry is gathered at one port that also rises a larger opportunity to get cargo both ways, which results in beneficial freight rates. Indication prices from several shipping companies reveals that distributing it directly from Elnesvågen versus

Molde will reduce the price with 40NOK/ton. With the forecasted volumes this will constitute a saving of 1.6-3.2 millions annually.

9.4.2 Case 2: Ålesund – Europe by ship

Description of case 2:

The container is loaded into a container in Elnesvågen and driven by truck to the port in Ålesund. From the port in Ålesund the container is distributed further to a port in Europe. Ålesund port is the largest port in the county with most ship calls and opportunities for end destinations.

The strengths of the port in Ålesund are the size of the port and the volumes it handles compared to closer located ports. The large fishing industry in the region gives the port large volumes to handle and container vessels frequently visit the port. This gives Hustadmarmor more choices for their distribution because multiple carriers are offering their services to Ålesund. Compared to Molde they have more liners and other carriers providing regular services. Ålesund also has transshipment connections to chosen destination all over the world, and in addition many of the sailings visit ports that have transshipment capabilities. These destinations vary by demand and seasonality. The port has the capacity to handle a substantial amount of containers and is relatively flexible due to the frequent ship calls and amount of carriers offering their services.
The disadvantage is the location relative to Elnesvågen. This requires a truck transportation for the containers to a price of approximately 25-3500 NOK per TEU.
In comparison Hustadmarmor had a case where they quoted the freight rate for transporting one flexitank to Australia. Cheapest offer was on 23 000NOK per TEU. So transporting the container 100 kilometer by truck constitutes for approximately 13% of the total price it takes to transport a container whole the way to Australia. Taking the indicated price of 310NOK/ton from Ålesund to Europe into consideration, the truck cost will constitute for 44% of the total transportation cost. This means that the truck costs consists for large part of the transportation costs and in the end it will affect the price the customer has to pay. Profit margin also will decrease because too high prices results in decrease in demand. With this arrangement Hustadmarmor has to base their freight calculations on sending one and one container. This is much more expensive than sending multiple

containers at once. When shipping 30-60 containers a week, it will be inefficient to not utilize the economies of scale to achieve reduced freight rates. Hustadmarmor most likely can't be competitive by sending one and one container, especially with the high truck rate added. They of course have the option to send all containers at once at a regular basis and get volume discounts, but this has some preconditions. It requires truck capacity to get all the containers to Ålesund before the ship departures. Since the trucks only can handle one container at once, the containers will arrive at different times through the week. This opens the need for storing the container in port until the ship can be loaded. There may also be capacity constraints on the Molde-Vestnes ferry with all these trucks going back and forth. If the temperature is below freezing point the product can be damaged, so in winter there is also need for a warm storage. To store containers in warm storage for up to a week is expensive and will affect the total transportation cost significantly. Assuming there will be 30-60 containers weekly to be transported Elnesvågen-Ålesund by truck, this also will affect the environment and pollution in the district. Strain on the road network and slow traffic also are factors that have to be considered when taking the decision about which solution to go for.

9.4.3 Case 3: Molde – Europe by ship

Description of case 3:

This is the case where the consignment is loaded in Elnesvågen and transported by truck to the port in Molde. The port in Molde is the closest port that handles containers and that has equipment and connections to provide SSS services to Europe.

This solution is pretty much the same arrangement as for shipping from Ålesund, but there are some important variables that are different. The truck cost and distance to Molde are smaller compared to Ålesund. The cost of transporting a container from Elnesvågen to Molde is about 1800NOK. This is almost half the cost compared to transporting it to Ålesund. This will result in lower cost/ton than for the Ålesund solution. Calculations done by Hustadmarmor shows that savings from shipping from Molde compared to Ålesund are on approximately 50NOK/ton. This is a substantial reduction when their goal is to be in a hub in Europe for 250NOK/ton.

According to terminal operator in Molde, Geir Solemdal they have the capacity to store and ship this amount of containers on a weekly basis. Molde has less frequent ship calls than Ålesund and handles less volume, which result in less variety in available routes. Norlines is the main actor at the terminal in Molde and offer multipurpose ships for a wide range of cargo. Relevant destination ports at current time from Molde is Cuxhaven in Germany, but this can be negotiated (Geir Solemdal 2016). Choosing this solution Hustadmarmor is still dependent on making deals with shipping companies to get reduced freight rate with help of large volumes. This opens the opportunity to get other shipping companies to take their trip to Molde (if volumes becomes large enough) and to affect the choice of destination port. The higher the volume becomes the more bargaining power Hustadmarmor will get and the higher the competition will be between the shipping companies to get the contract. This will all result in lower transportation costs and reduced dependency on available routes in their choice of distribution solution. With large enough volumes new routes can be made. Since the truck price from Elnesvågen to the port has so huge impact on the total transportation cost, location of the port is vital. Molde is the closest port to Elnesvågen that has the capabilities to handle these volumes, so this choice may be considered a good solution if they can get acceptable prices from the shipping companies. On the other hand if the volumes are lower than forecasted this may be an expensive solution because of relatively little traffic and the fact that they may be forced to ship to ports that are not suitable for Hustadmarmors further distribution.

9.4.4 Case 4: Elnesvågen – Europe by truck

Description of case 4:

This is an alternative to SSS. A truck is loaded with a container in Elnesvågen and transported by truck to a port in Europe. A truck can carry approximately 20-26 tons of slurry dependent on the truck and road restrictions. The truck arrives the port in Europe and the consignment is being distributed further to where the customer is located.

Choosing this option Hustadmarmor will get a good flexibility in pick-up and delivery dates. The container is driven directly to the port with little bureaucracy on the way (Agarwal 2016). This is an advantage if customers have tight deadlines, but also in the planning process for Hustadmarmor, where they have more options of departure dates.

Operating with the forecasted volumes annually of 40-80000 tons over such a long distance with a low value product is not profitable. Transport costs will kill the project and Hustadmarmor will not be competitive. A truck with one container of 25 tons is estimated to cost approximately 1600NOK/ton to Rotterdam. This is 1340NOK/ton more costly than distributing it from for example Molde, according to indication prices (Moldegaard Maritime). At this rate they will lose money and the project can't be realized. In addition they will need 30-60 trips Elnesvågen-Europe weekly to fulfill the demand. This is neither environmental-friendly nor cost friendly. This is backed up by Agarwal (2016) when he states that road haulage is unsuitable and costly for transporting bulk cargo over long distances.

9.4.5 Case 5: Elnesvågen – Europe by existing fleet

Description of case 5:

Hustadmarmor is currently sending slurry to tank farms in Moerdijk (Netherlands), Gävle (Sweden), Förby (Finland), Oulu (Finland) and Emden (Germany). This is shipped by chemical tankers in bulk using a pool of vessels ranging from 8-18000 dwt. The vessels are in average loaded with close to max capacity at each journey. Arriving the destination the slurry is discharged into tank farms owned by Omya. From there the slurry is further distributed to hinterland customers by barges and trucks. This case will look at possibilities to use this existing distribution network to reach new customers globally. The idea is to fill these ships and tanks with extra slurry to utilize the cheap bulk price on transport to Europe and use it as a hubs for further distribution to new markets globally.

It is almost impossible to get a cheaper price from Elnesvågen to Europe than this arrangement. But there are both advantages and disadvantages to this case. Advantages of using existing fleet is the transportation costs. Cost of Euro/ton to Europe is the cheapest Hustadmarmor can possibly achieve. If we take Moerdijk and Emden, which has the most central locations and closest located to major ports as an example: For the largest vessels on 18300 deadweight tons the freight rate is 6.59 Euro to Emden and 7.19 Euro to Moerdijk. For the second largest vessels on 15200 deadweight tons the freight rate is 7.46 Euro for Emden and 7.93 Euro for Moerdijk. This gives Hustadmarmor a price of

approximately 70NOK/ton which is a cost reduction of 130NOK/ton compared to shipping it in containers from Elnesvågen (case 1). Using these prices will make Hustadmarmor very competitive compared to some of their competitors that are located without sea borders and needs to transport smaller volume by rail to a transshipment port. Economies of scale are here utilized to achieve these prices (Coulter 2002).

As discussed in the chapter about choice of packaging choosing this solution will give them the opportunity to transport in dry bulk at the Utkilen vessels if some vessels are modified (and this is approved and allowed) and the volumes are large enough to make it feasible. This will save them the container costs and packaging costs and at the same time be able to utilize more of the vessel capacity.

Another strength of this arrangement is that you don't need to use road haulage to a local port. This saves the truck transportation cost which consists of a decent part of the total transportation cost. It also saves the environment through reduced CO_2 emissions and the reduced intermediate handling (TransBaltic Project).

For Hustadmarmor it is important to develop their business in Elnesvågen. One of the disadvantages with this case for Hustadmarmor are that the packing and handling of the containers will be done by other companies at other locations. This will also incur additional costs compared to doing it at the plant in Elnesvågen and control over parts of the supply chain will be given away. The tank farms are located close to ports and terminals where there may be lack of space for handling containers, and increase in volumes can be a challenge. The tank capacity can also be a problem because the established tanks are fitted to less volumes, so there may be need for investments on increasing tank capacity. Tanks for storage of dry product must also be invested in if this will be an option. The ports where these potential "hubs" are located are ports with limited connection to transshipment opportunities. So if the customer is located in a place with a need for transshipment, the containers must be moved to the closest port that has services for transshipments. This is costly and inefficient. Because of unsecure and fluctuations in demand from the new markets there will also be challenges related to planning production, shipments and volume. This will also affect the reliability to the other established markets. The vessels from Hustadmarmor is planned the way that almost every journey has volume equal to max cargo intake (adjusted for draft). Dependent on the volume required from the

new customers there may be need for changing to larger vessels to not getting lack of product on the tanks in Europe. Hustadmarmor have the opportunity to plan for larger vessels to arrive, but if these larger vessels aren't filled up there will be costs related to dead freight claims. If tank capacity is expanded and ships are filled without having planned customer orders, the time the product spends in a tank will increase. This can cause problems for the durability of the product. If the Utkilen vessels are not capable of transporting dry product another issue occurs with this case. Since containers or pallets can't be transported by the Utkilen vessels, this solution is not capable of delivering small volumes of dry products to the customers. The solution would be to invest in a drying plant on-site, but then we have the same problem as with the packaging plant; loss of control and loss of investment and value creation at the plant in Elnesvågen.

10.0 Discussion

This chapter will discuss and compare the different cases with respect to the variables that are most important to Hustadmarmor. The discussion and conclusion also seeks to give an answer to the two main problem statements:

> *RQ1 How critical are logistics costs for new market opportunities for Hustadmarmor?*
>
> *RQ2 Which are the best supply chain designs for Hustadmarmor's distribution of low volume shipments to new global markets?*

The five cases analyzed previously is potential distribution solutions for Hustadmarmor. Each case has different strengths and weaknesses in the way they perform.
First let's take a look at which variables that are of importance to Hustadmarmor. According to Geir Teistklub and Vidar Hals (Interviewguide 2) the most important variables in this project are freight rate, routes available, flexibility and choice of packaging.

The freight rate on the different distribution solutions has the largest influence on the overall logistical cost. Hustadmarmor is dependent on getting a freight rate that is low enough to get the project realized. If not, the project will be rejected by the Omya group

before it has started. So getting an acceptable freight rate is vital to if this project is going to exist.

As the first research questions concerns the logistical costs are of great importance. The main part of the logistical cost for sending small consignments is the freight rate. The freight rate between the cases varies, and the lowest is the solution using the existing fleet and make Moerdijk to their hub in Europe. The solution with the highest freight rate of the shipping solutions is Ålesund-Europe, where the truck rate from Elnesvågen to Ålesund consists for large part of the total transportation cost. Elnesvågen-Europe by truck has the absolutely highest freight rate. According to numbers from Hustadmarmor and indications from the shipping companies the estimated freight rate for the different cases is:
Case 1: 200NOK/ton, Case 2: 310NOK/ton, Case 3: 260NOK/ton, Case 4: 1600NOK/ton, Case 5: 70NOK/ton. This is approximations and varies with volume, density and shipping company, but gives a picture of the price relationship between the solutions.
Given the goal of being in a hub in Europe at the price of 250NOK/ton four of the cases are pretty close to that goal, only the truck option is far from the goal. This makes the truck option excluded just based on the freight rate.

The largest port among the cases are Ålesund and they are also the best option on routes available. A large fishing industry contributes to making this a port handling large volumes which gives them more routes and more shipping companies will visit the port. This also gives them better frequency of sailings compared to Molde. With the forecasted volume of 1600-3200 containers the first year, there are opportunities to affect the shipping companies at which location to pick up the containers and to which destination hub they are being distributed. So this reduces the dependency on the routes that are available on the two ports. This variable of routes available becomes more essential when sending one and one container and where there are no deals with the shipping companies involved. In Case 1 new routes still has to be established, and Elnesvågen will become a destination in a shipping company's sailing schedule. Having the right shipping partner that is flexible can help Hustadmarmor to participate in the route-design process and that way they may be more flexible themselves regarding finding the best hub for further distribution. For the case using the existing distribution routes, Emden and Moerdijk are the best routes for reaching a central hub. Molde and Ålesund both have routes to hubs in Europe, like Rotterdam, Bremerhaven and Cuxhaven. The key will be to find good shipping partners

that can facilitate and be flexible to make the project a success and create value for both partners.

The choice of packaging option is an important and strategic one for Hustadmarmor. The analysis shows that there are lots of different ways to pack the consignment. Case 1, 2, 3 and 4 have all the packaging options available with investments in a packaging and drying plant in Elnesvågen. This will give Hustadmarmor a variety of options they can choose from to meet the demand and specifications of each specific customer. Both dry and wet product, in big bags, small bags, inliners or flexitank. Having all these options available also makes the supply chain more resilient for unexpected events. It makes the supply chain more robust and avoids some of the risk with having only one alternative. Case 5 also has these options, but then the investments in packaging and drying plants must be done at the tank storage in Moerdijk, because the existing distribution network uses wet bulk vessels. If the Utkilen ships can start to take dry product in their tanks it may be a possibility to dry the product in Elnesvågen.

Flexibility is another important variable to Hustadmarmor. This because the customers are spread all over the world and are demanding different products and packaging. This places high requirements to the distribution solution they are choosing. The most flexible distribution solution will be Elnesvågen-Europe. This because it's more efficient and cheaper to have the packaging and drying plant at the factory (Hustadmarmor 2016). So all packaging options can be conducted in Elnesvågen. In addition this solution gives more flexible hub choices than using the existing distribution network, which are not connected to hubs with good transshipment capabilities. For further distribution in Europe hinterland, using the existing distribution network may be a good solution, especially if the vessels can be modified to take dry product. This case have frequent sailings and the opportunity to coordinate with Utkilen which ship size to be used at different ship calls and the frequency of the ship calls.

11.0 Conclusion

This research has explored how Hustadmarmor can utilize their full production capacity by starting to distribute small volume consignments to new markets. This is a project that is difficult to give exact conclusions and recommendations on because of the uncertainty in many factors concerning the project.

The findings on container flow imbalances showed that there are ways of utilizing and manage these imbalances. Three solutions based on information from shipping companies were suggested; put an effort in going from road transport to sea transport, collaborate with local industries to share containers for their import of i.e. raw materials or merchandises used in the industry, and close cooperation with the shipping companies to make deals on return loads. This is something Hustadmarmor can benefit from and should have in mind under the planning of this project and when negotiating with the shipping companies. Moving goods from road to sea saves money and environment if the distance is long and volumes are high. Getting more cargo to sea also will help cope with the container flow imbalance because it seems to be a trend in the region that large parts of the import is done by road and the export is done by sea. The research found that Hustadmarmor and Doosan alone have a potential of importing 190 containers with 22 tons in each. A report from Møreforskning (2015) showed that additionally 103 containers have a potential to be moved from road to sea in the Romsdal region.

The analysis over port choice in Europe identified some important factors choosing port, and the most important one for Hustadmarmor will be the port cost and the capabilities of reaching multiple destination for further distribution, including overseas connections.

Regarding packaging, multiple options on how to pack it may be important to be able to supply most of the demand possible in the market and to make the supply chain more flexible. So to be able to handle and offer all of the packaging alternatives mentioned, without the tank container could be a good idea. The tank container is expensive relative to a flexitank, so in the case for small consignments of wet product, a flexitank will be a better solution because it is cheaper, but takes the same effort to transport and gives the customer the same value.

When deciding on a supply chain design for the distribution of low volume consignments the case with the truck will become too expensive. The same counts for the Ålesund case where Molde is a better option because of the truck distance to Ålesund. Due to the fact that it takes some time to build a quay and to find out if they should do the investments in Elnesvågen or Moerdijk regarding packaging and drying plant, the best option probably is to choose the Molde-Europe solution in short term. The Molde option has lower freight rates and the same capabilities as Ålesund, if we assume deals with shipping companies on regular pick-ups. The first shipments are expected to start at the end of 2016 so this will be too soon for the Elnesvågen solutions. In the long term the solutions of starting a container terminal in Elnesvågen may be the best choice, especially for overseas customers, where the competitors located inland will have a hard time competing on freight rates. This will also create good repercussions for the local industry, if the terminal is opened to the public. The local industry can take advantage of this solution to move more of their cargo from road to sea. It also will be easier to share containers with other local companies if a solution like Sjøportalen is a success and can use this terminal for sharing of shiploads. This will result in lower logistical costs for the companies.

For distribution further in Europe it may be the best to place the investments in Moerdijk and use the existing distribution network to utilize very low freight rates compared to containers. Using these solutions they get the advantage of utilizing economy of scale. The reason for distinguishing between European and overseas customer is that the competitors are located in Europe so they have the advantage that they are closer to the customer. This means Hustadmarmor will need an extremely low freight rate to compete, and this can most likely only be done by bulk transportation on existing network.

The key for Hustadmarmor in this project probably will be to have several possibilities open. Having deals with several shipping companies to have more opportunities for destinations and to have different possibilities for packing and CCUs. This way they can utilize all the demand in the market and be flexible in their supply chain. Since lots of factors are so uncertain it may also be an idea to start “small” and feel the market, and then build better concepts around the solutions they have success on.

12.0 Limitations and further research

The purpose of this research was to analyze some important factors concerning Hustadmarmors new distribution project and find the best suited supply chain designs. This is a project with lots of uncertain factors, especially regarding demand, density and customer locations. In addition the project is at a very early stage. This has led to a pretty general approach to the project for this thesis.

Several interesting findings have been made, but because of the uncertainty of the project and the time scope of the thesis it was hard to really dig deep into the economy of the project. Suggestion for further research could be to go deeper into the economy of the different distribution solutions.

Since the case with the use of truck to Europe became so costly it could be interesting to investigate to what destinations truck transport could be favorable over sea transport. I.e. to inland destination far from ports, but close enough to Elnesvågen to make it feasible. Graphs and intersections of the costs could be made to make this applicable to other companies as well.

This thesis only investigates how to get from Elnesvågen and to a hub in Europe. Because Hustadmarmor doesn't yet really know exactly where their customers are located and how much slurry they will consume it will be of little help to suggest some random destinations. Further research that could be interesting is to investigate the further distribution from Europe and to the end customer.

In the chapter about port choice some interesting factors are found when taking this decision. After knowing the exact customer locations a more thoroughly analysis over which port that is fitted best to which customers can be done to give more precise answers.

The last suggestion for further research is to find out how a new port in Elnesvågen will affect the local industry and the other local ports. Here it could be interesting to look into the benefit of having this terminal open for the public, who may be interested and if it creates value for the actors involved.

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Appendices

Interview guide 1: Semi-structured interview

Attendance
Geir Teistklub, Vidar Hals, Vidar Storvik
Theme
Hustadmarmors new project concerning shipment of low volume consignments.
Form
The author of the thesis meet with the logistical department at Hustadmarmor. Notes will be taken and in addition the conversation will be taped. The interviewer makes a summary and revert it for approval. Tapes then being deleted.
Purpose
Purpose of the interview will be to find good propositions of research questions based on the conversation. The interviewee will be guided into themes and asked follow up questions among the key questions.
Key themes

- Project description
- Distribution
- Packaging
- Customer locations
- The product
- Demand estimations

Key Questions
Can you describe the project?
What is important in this project to succeed?
What are the major pitfalls in this project?
What distribution solutions are you considering?
Where are the customers located?
What is the volume demanded from the new markets?
What packaging options do you have for this product?
Which port do you consider using for container distribution?
Do you have suggestions for potential research questions?

Summary
Sum up the answers provided and clarify misunderstandings.

Interview guide 2: Semi structured interview

Attendance
Geir Teistklub, Vidar Hals, Vidar Storvik

Form
The author of the thesis meet with the logistical department at Hustadmarmor. Notes will be taken and in addition the conversation will be taped. Follow up questions will be essential. The interviewer makes a summary and reverts it for approval. Tapes are then deleted.

Purpose
Gather information that is necessary to help answer my research questions.

Theme

- Existing distribution at Hustadmarmor
- Freight prices
- Container
- Hubs in Europe
- Road haulage
- Import/export situation
- Rout choices

Key Questions

What options do you have for distribution so far?
What are the most important variables when choosing distribution solution?
What contact have you had with agents and shippers concerning the project?
What is the products specifications?
What information do you have on freight rates so far?
Have you been calculating profit margins?
What destinations are most important to reach?
What packaging options do you consider?
How is the space and capacity on the tank storage at the existing distribution network?
Which criteria do you have for choosing a hub port?
What's your focus on environment connected to this project?
Is door-to-door road haulage an option?

Summary
Sum up the answers provided and clarify misunderstandings.

Interviewguide 3: Semi structured interview

Attendance
Separate meeting with Geir Naas (Doosan) and Odd Petter Lyngstad

Purpose
Map the import/export situation on two local companies to see if there is potential to get more cargo from road to sea, and if there is possibilities to utilize this to get more backhaul cargo.
Theme
Import/export with container and potential for moving cargo from road to sea.
Form
Semi structured conversations where the interviewer takes notes on answers given. Interviewer also asks follow up questions where it is suitable.

Key questions
How much can potentially go from road to sea? (RORO, container, pallet, MAFI)
How much is your import volume?
Do you have a logistical department?
What companies do you use for sea?
What deals do you have with carriers?
Are one single supplier able to will a whole container at one shipment?
Where is your suppliers located?
At which hub arrives the goods you already are transporting by sea?
Where do you export?
How much do you export?

Documentation of meetings:

Theme:

Initial talks on how to find distribution concepts from production of product is finished, and to arrival in a hub in Europe.

Key issues:

- Capabilities of both companies
- Designing concept on distribution solutions
- Packaging alternatives
- Destinations
- Routes available

Meeting 1: 06.04.2016:

Attendance:

Moldegaard Maritime: Geir solemdal and Gard Solemdal

Hustadmarmor: Geir Teistklub, Vidar Hals and Vidar Storvik

Norlines: Tor Arne Borge

Meeting 2: 19.04.2016

Attendance:

Moldegaard Maritime: Geir Solemdal

Hustadmarmor: Geir Teistklub, Vidar Hals and Vidar Storvik

NCL: Arne Jacobsen

Meeting 3: 02.05.2016

Attendance:

Moldegaard Maritime: Geir Solemdal

Hustadmarmor: Geir Teistklub, Vidar Hals and Vidar Storvik

Samskip: Are Gråthen and Cathrine Lippestad

Meeting 4: 04.05.2016

Agenda: Sum up the initial meetings with the shipping companies. Thoughts on how to proceed further. Start collecting price information from the shipping companies on given cases.

Attendance:

Moldegaard Maritime: Geir solemdal and Gard Solemdal

Hustadmarmor: Geir Teistklub and Vidar Storvik

Litterature review: Ports choice criteria

Murphy and Daley (1994)	□ Purchasing manager (shipper)	• Shipment information • Loss & damage performance • Freight charges • Equipment availability • Convenient pickup and delivery • Claims handling ability • Special handling ability • Large volume shipments • Large & odd-sized freight	□ Survey

Source	Actor	Criteria	Methodology
Kumar and Vijay (2002)	□ Shipper	• On time performance • Value • Information technology • Customer service • Equipment and operations	□ Analytic hierarchy process
Mangan *et al.* (2002)	□ Decision makers (on ferry choice) in transport companies	• Service availability • Sailing frequency • Risk of cancellation • Fastest overall route • Proximity of ports to origin/destination • Cost • Speed of getting through ports • Suitability for special cargo • Delays • Intermodal/connecting links • Information availability	• Modelling • Survey
Nir *et al.* (2003)	□ Shipper	• Highway travel time (origin: company, destination: port) • Travel cost • Number of available routes • Frequency	• Survey • Revealed preference multinomial logical model
Lirn *et al.* (2004)	□ Shipping lines	• Physical infrastructure (including depth) • Geographical location (proximity to markets, main routes) • Port administration and service to vessels (turn around time) • Carriers cost per call	□ Analytic hierarchy process

Tongzon (1995);(2009), Tongzon and Sawant (2007)	□ Forwarders	• Frequency of ship visits • Port efficiency • Adequate infrastructure • Location • Port charges • Quick response to port users' needs • Port's reputation for cargo damage	□ Survey
Ha (2003)	□ Shipping companies	• Information availability on port activities • Port location • Port turnaround time • Facilities available • Port management • Port costs • Customer convenience	□ Survey

Source	Actor	Criteria	Methodology
Tiwari *et al.* (2003)	□ Shippers	• Ship calls (frequency) • Total TEUs handled at the port • TEUs per berth at the port • TEUs of cargo per crane • Handling volume (thousand tons) per length of quay • Number of routes offered • Port and loading charges	• Literature review • Discrete Choice Analysis
Malchow and Kanafani (2001)*;* (2004)	□ Shippers (commodity types)	• Distance • Frequency of sailings • Average size of vessel • Loading/unloading time □	□ Discrete choice model
Song and Yeo (2004)	• Ship owners • Shipping companies • Shippers • Terminal operators • Academics	• Cargo volume • Port facility • Port location • Service level • Port expenses	• Analytic hierarchy process • Experts surveys
Cullinane *et al.* (2005)	• Shippers (demand trends) • Port authorities (supply)	• Price • Generalized cost • Quality of service • Policy developments	□ Relative competitiveness analysis
Guy and Urli (2006)	□ Shipping companies	• Port infrastructures • Cost of port transit for a carrier • Port administration • Geographical location	□ Multi-criteria analysis
Ugboma *et al.* (2006)	□ Shippers	• Efficiency • Frequency of ship visits • Adequate infrastructure	□ Analytic hierarchy process

Acosta *et al.* (2007)	Terminal operators	• Infrastructure • Superstructure • Technology and communications systems • Internal competition • Cooperation of the institutions and companies involved in the port activity	Survey
De Langen (2007)	• Shippers • Forwarders	• Location of port • Efficiency of cargo handling • Quality of terminal operating companies • Quality of equipment • Quality of shipping services • Information services in port • Good reputation to damage/delays • Customer focus • Connection to hinterland modes • Personal contacts in port	Survey
Shintani *et al.* (2007)	Shipping companies	• Costs • Empty container distribution	Algorithm-based heuristic analysis
Source	**Actor**	**Criteria**	**Methodology**
De Martino and Morvillo (2008)	• Port authorities • Shippers • Forwarders • Shipping companies	• Quality of the entire port: infrastructure, links to transport systems, terms of services • Value is generated by joint effort of port actors in the satisfaction of clients' needs	Literature review
Grosso and Monteiro (2008)	Forwarding companies	• Connectivity of the port • Cost and Port Productivity • Electronic information • Logistics of the container	• Literature review • Survey
Leachman (2008)	Importers	• Transportation costs • Alternative routes • Door-to-door transit times • Shipments pooling • Lead times of container movement	Economic optimization model
Meersman *et al.* (2008)	• Shipping companies • Terminal operating companies • Port authorities	Port hinterland connection capacity	Analysis of expected trends

Wiegmans *et al.* (2008)	□ Container terminal operators	• Port physical and technical infrastructure • Geographical location • Port efficiency • Interconnectivity of the port (sailing frequency of deep-sea and feeder shipping services) • Reliability, capacity, frequency and costs of inland transport services by truck, rail and barge (if any). • Quality and costs of auxiliary services such as pilotage, towage, customs, etc. • Efficiency and costs of port management and administration (e.g. port dues). • Availability, quality and costs of logistic value-added activities (e.g. warehousing). • Availability, quality and costs of port community systems. • Port security/safety and environmental profile of the port. • Port reputation (satisfactory ranking in benchmarking studies).	• Interviews • Literature review
Karlaftis *et al.* (2009)	□ Shipping company	• Distances between ports • Demand • Supply • Service time	□ Modelling

(Aronietis, Van de Voorde, and Vanelslander 2010, 5-7)