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Direct Short Sea Shuttle Concept

– A Pre-study of the market potential for a DSSS-implementation in the North- and Baltic Sea-region

Robert Beach
Olle Engström
Haiyang Liu

Department of Technology Management and Economics
Division of Logistics and Transportation
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Division of Logistics and Transportation
CHALMERS UNIVERSITY OF TECHNOLOGY
SE-412 96 Göteborg
Sweden
Telephone + 46 (0)31-772 1000

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Abstract

Efficient short sea shipping is of crucial importance for trade and industry in Northern Europe and the growing importance of the same has been highlighted in various contexts, emphasizing the need to move larger volumes of goods from land-based transport to sea. Furthermore, limitations in the current railway infrastructure in Sweden and high capacity utilization on a majority of the lines undermine an efficient use of the transport network and have a negative effect on the possibility to increase the volume of containers transported by rail to and from the ports. In order to target the problem the direct short sea shuttle concept is developed.

This thesis aims to investigate the market potential of implementing a direct short sea shuttle concept, with emphasis on containerised cargo. The current study aims to identify which characteristics defines the DSSS-concept as well as to analyse under which conditions this concept could be feasible and competitive in the geographical area of scope, namely the North and Baltic Sea region.

The study is presented within the frame of the research project "Direkta Sjöfartsskyttlar". The research includes an investigation of possible volume increase in short sea transportation of containerized cargo in order to reach the European Union's goals for sustainable goods transportation, possibility to provide an alternative transportation system for industries in the region of scope.

The data collection method for this study is based on the theory of triangulation containing three methods in collaboration; literature review, workshop and interviews.

The DSSS-concept is defined as: *A reliable shipping service with fixed schedules with daily or weekly departures between a hub port and a number of strategically located ports. The shuttles providing a complementary service to existing rail shuttles for improved transport and trade opportunities.*

Though the market potential of the DSSS-concept has been difficult to estimate on aggregated level with regards to possible shifting of goods volume, the investigation has shown that there is a genuine interest from various stakeholders towards the implementation of the DSSS-concept. Furthermore, due to recent changes in the market conditions for short sea shipping as well as upcoming future regulations in the study region the timing of the concept investigation has been described as beneficial.

Keywords: Short Sea Shipping, Containerized goods, Direct Short Sea Shuttles – DSSS

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Robert Beach
Olle Engström
Haiyang Liu

Contents

1 Introduction

The chapter will introduce the topic and give necessary background to this report. Furthermore, the aim and objective of the study will be described and also the methods used for gathering data are presented.

1.1 Background

The need for transport derives from the demand from the manufacturing sector as well as the fact that the supply and demand situation for various products differ around the world. Transportation is a profound tool for global trade and its importance is discussed by Cippola (1974) as he suggests that the transport industry has throughout recent history been one of the prime contributors for shifting the world from essentially national towards the global economy system that exists today. Linking together geographical markets around the world has been made possible by shipping and seaborne trade. The shipping industry has played a vital part in the progression from a world of isolated communities towards and integrated global community (Stopford, 1997).

However, the idea of shipping as a catalyst for economic growth is now at all new. Adam Smith, Scottish philosopher and political economist, often considered as the father of modern economy saw shipping as a stepping stone for economic growth. Smith argued that by means of water carriage more extensive markets could be opened up for industries, Smith also saw the benefits of shipping as a cheap source of transportation as described by a comparison of land versus sea transportation of goods between London and Edinburgh (Smith, 1776/1974 Cannan, E).

Alderton (1973) defines the demand for shipping as a “derived demand” in the respect that nobody wants sea transports for itself, with exemption for cruising and yachting. Furthermore, Alderton (1973) states that the requirement of the shipping industry is safe transportation and arrival of goods or persons to their destination. However, during recent decades the maritime freight transport sector has experienced profound changes and strong growth. The commercial sector and its adoption of new production philosophies has led to the creation of more complex supply chains, thus, introducing more actors in the transport market and in extension more relations between them. To meet this need for efficient and extensive transports the world has evolved a transport system which provides fast and cheap access to almost every corner of the globe. Shipping provides one link in this transport chain which is usually considered to consist of road, rail, air and water transportation, both inland and deep sea (Stopford, 1997). The different types of transportation modes are applicable in various parts of the supply chain, however, seaborne trades dominates international trade. It is estimated that approximately 75 per cent of the world trade by weight is carried at sea, in terms of value the share of the shipping industry falls to approximately 65 per cent (Institute of Chartered Shipbrokers, 2009/2010).

The industrial organization of the shipping industry has rapidly evolved due to steady growth in freight volumes and the intensification of globalized trade, along with the geographical diffusion of production as the total of volume of trade has nearly doubled in the period between 1980 and 2005 (Institute of Chartered Shipbrokers, 2009/2010). This rapid expansion of global trade has led to fast growth of cargo volume throughput in many ports. As described above the majority of world trade is carried at sea, consequently, sea ports play a key role in the transportation of goods and they are of vital importance for the global infrastructure network. Bichou (2009) emphasises the critical importance of efficient port operations as it enables significantly lower trade costs and the fact that any delays in the port operations impose costs on logistics and supply chains through the cost of warehousing and inventory.

Changes in the global trade, demand for effective supply chain management development of cargo handling technology have indeed had impact on the port business management, rendering it more challenging and competitive (Bichou, 2009). In extension, the efficiency of moving cargo and the efficiency demand from port customers has reduced the number of players in the market. Volumes handled in major port gateways have in some cases reached their limit and have displayed strains in the surrounding infrastructure. These strains in a port's surrounding infrastructure can create problems in how to handle the flow between the port and the inland (origin/destination) also known as hinterland.

As a result of the increase in containerized transport some sea ports today face problems such as lack of space at the terminals and growing congestion on the infrastructure serving the port. For some seaports the weakest link in their transportation chain is their back door, where congested roads or inadequate rail connections cause delays and raise transportation costs. Road transports dominate the inland freight market in EEA member countries, road transports are also predicted to increase leading to a likely increase of congestion in infrastructure surrounding ports. In order to overcome possible congestion in the port infrastructure, ports can put emphasis on the development of their port hinterland connections and implementation of rail transports for inland access through dry ports.

The dry port concept is a development of the intermodal transport system, where the sea port is connected to a dry port in the hinterland both operative and administratively (Roso, 2009). A container can be picked up or handed in by the customer in the dry port in the same way as in the sea port with regards to customs clearance, administration work and maintenance.

An example on how ports can approach the on develop their hinterland connections is the port of Gothenburg who has developed a concept called RailPort Scandinavia, with the aim of connecting train shuttle operators closer to the port this concept is built up by railway shuttles connecting the Port of Gothenburg with important consuming and productive areas in Sweden. When the RailPort Scandinavia project started in 1998 it was a unique concept. There had never before been a rail shuttle within the scope of intermodal transport in Sweden (Nisslert & Aronsson, 2010). The implementation has been very successful and today there are 26 shuttles running daily to and from different inland destination all over the Sweden. This strategy resulted in more than 40 per cent of all TEUs being transported by rail to and from the hinterland.

Although the traffic on the Swedish rail-network has had a very positive development in the last few years and the capacity utilization has been very high on the majority of lines, the same is now challenged by the lack of the capacity and traffic disturbances. Furthermore, there are not only huge capacity problems in the rail network but also functionality problems influencing the freight transport negatively. All this has a negative effect on the possibility to increase the transport of the containers by rail to and from the seaport. It is a clear need for measures for improvement and one way to deal with this rail related issues is to relieve the rail network. Therefore, it is suggested that Direct Short Sea Shuttle (DSSS) services will be established on suitable routes as a complement to rail transports. Further, these services can also connect additional ports in the Baltic Sea and the North Sea that today do not have a link to Gothenburg.

The general idea of the DSSS-concept is illustrated in figure 1 where a DSSS-service is established between a hub port and a satellite port and further to the hinterland via rail and dry port.

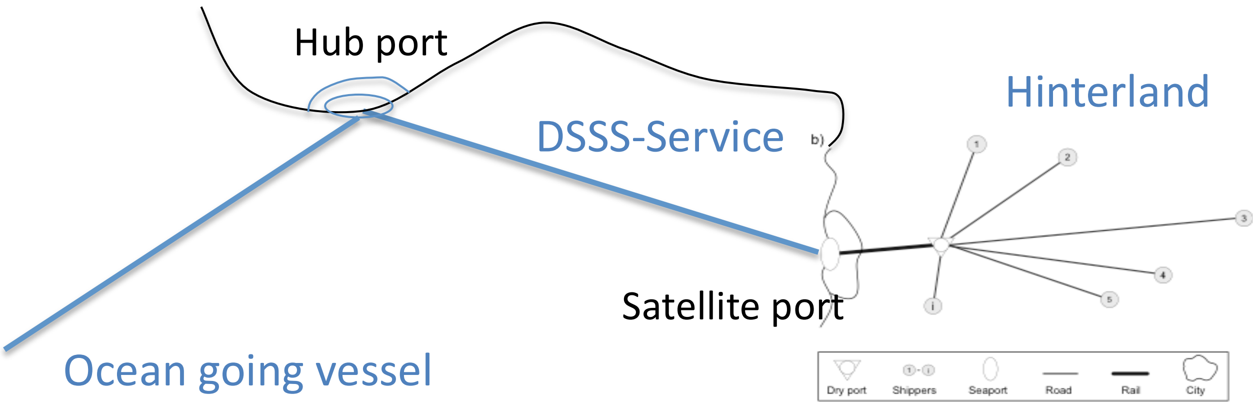

Figure 1.1. Illustration of the DSSS-concept and its integration in the transportation system

Paxiao and Marlow (2002) concludes that the short sea shipping is a complex maritime transport service for unitized and non-unitized cargo performed by five different vessel types and delivered by various channel intermediaries within a specific geographical scope. The different types of vessels included in the definition are; Traditional single deck bulk carriers, sea-river ships, ferries, dry-bulk carriers and tankers and container feeder vessels. The focus of this study lay on containerised cargo, hence, container feeder vessels will be the vessel type most frequently described and referred to.

1.2 Objective

The purpose of this research is to define the concept of Direct Short Sea Shuttles (DSSS) and to investigate under which conditions this concept could be feasible and competitive in the study area.

The study includes an investigation of possible volume increase in short sea transportation of containerized cargo to and from the port of Gothenburg in order to reach the European Union's goals for sustainable goods transportation. Furthermore, analyze possible efficiency improvements in the transport chain with a short sea shuttle set-up as a demand from regional business to lower the cost for transportation and increase availability of global goods in the region.

1.3 Problem Analysis and Research Question

Limitations in the current railway infrastructure in Sweden and high capacity utilization on a majority of the lines undermine an efficient use of the transport network and have a negative effect on the possibility to increase the volume of containers transported by rail to and from the port of Gothenburg.

Decisions have been made both from governmental and regional direction for investments in the railway infrastructure surrounding the port of Gothenburg, however, capacity increase will take time to achieve and a long-term time-frame to reach set goals for capacity have been mentioned. In the meantime, use of existing port infrastructure and sea transportation is a possibility to facilitate the

Port of Gothenburg's connection to its hinterland. In order for this solution to be effective it is suggested that high frequency departure and efficient cargo handling in the regional ports need to be in place.

The following research questions have been formulated for this master thesis;

1. What are the characteristics of a DSSS-concept?

2. Under what conditions can the DSSS-concept be feasible and competitive?

1.4 Delimitations

The scope of this research will be limited to the geographical areas of the North and Baltic Sea region with emphasis on gods flows to and from Sweden. Notwithstanding, goods flows from other countries which can be connected to the Port of Gothenburg will be investigated. Furthermore, the type of goods studied will be limited to containerized cargo only, thus, transport of liquid or dry bulk, passengers, unitized cargo such as semi-trailer or general cargo will not be investigated.

2 Methodology

In order to meet the purpose of the study and answer the research questions the authors have decided to use different methods for data collection which are described below.

2.1 Triangulation

Denscombe (2003) define triangulation as the practice of viewing things from more than one perspective. Thus, this means researchers collect data from various resources and investigate from different aspects. The underlying principle this is that triangulations allows the researcher can get a broader data and therefore a better understandings of problem through comparison during different findings.

The triangulation method creates a foundation for the study and for the authors to find conclusions. In order to create a result which is considered to be good with regards to validity and reliability, the three methods used within the scope of the triangulation is worked out separately and then compared to each other. Due to the fact that a workshop was conducted with participants of the project i.e. stakeholders to a potential DSSS-service, the authors held a critical approach towards the information provided. Furthermore, the authors also held a critical approach when performing the interviews due to the fact that the interviewees are in different ways connected to a potential DSSS-concept. The interviewees' positions may suggest that they answer questions from their perspective and give answers that would benefit their own position.

Methodological triangulation (between methods) is the most commonly method used in social research in which findings from one method are expected to be contrasted with finding from another. There is generally considered to be two advantages by using this method:

- Findings can be corroborated or questioned by comparing the data produced by different methods
- Findings can be complemented by adding something new and different from one method to what is known about the topic using another method (Denscombe, 2003)

Denscombe (2003) also pointed out the disadvantages of the triangulation method. Firstly, there are sacrifices e.g. time resources needed during research. As more than one method is involved in the research more resources will be consumed during the study. In this respect the researchers can be restricted in regards to available founding and time for the study. Consequently, by using more than one method the researcher/s will probably need to do sacrifices elsewhere. Secondly, the data analysis will most likely be more complex when using triangulation research due to the fact that the collected data needs to be compared and integrated with each other. Thirdly, the triangulation method involves risk when findings from one method are not corroborated by findings from another. This normally leads to further investigation and research to find out the reasons and explain why the findings are not confirmed in the different methods. In short-run research, which involves time deadlines, this situation would likely limit researcher/s and possibly lead to uncompleted research.

In the framework of this Master Thesis three data collection methods will be used; collection of secondary data through literature studies and collection of primary data through interviews and a workshop, which is creating a triangulation method. The focus in the initial part of the process will lay on collecting secondary data from previous research within the field of logistics and short sea shipping. This secondary information shall form the basis for gathering of primary data, through interviews and initially through a workshop. The interaction between these two types of data gathering allows the authors to use two dimensions in the study, pure facts as well as subjective assessments. Furthermore, a case study involving the Port of Gothenburg as a hub port for the shuttles will be performed by the authors in order put relevant theory into practice and to explore possible benefits of the suggested transport system.

- *Literature review* - Which focus on searching for previous studies regarding the conception of short sea shipping, logistics and similar implementations in global level.
- *Workshop (open discussion)* - Involved people from different parties of the maritime business such as port representatives, shipping company, governmental authorities, maritime and logistics researchers and consultants etc. An open discussion about the DSSS-concept was held, the main topics focused on DSSS characteristics, expected functions, potential volume and SWOT analysis.
- *Interviews* - Included different stakeholders related to the DSSS-concept and also benchmarking and service model investigation regarding Grand China Shipping (GCS), who is currently running similar short sea container shuttle services in China.

Furthermore, a case study is performed in order to corroborate theory and findings by practical case.

2.1.1 Literature review

Hart (1998) defined literature review as the selection of available documents (both published and unpublished) on the topic which contain information, ideas, data and evidence written from a particular standpoint to fulfill certain aims or express certain views on the nature of the topic and how it is to be investigated and the effective evaluation of these documents in relation to the research being proposed.

Literature review is an essential process research, not only because some questions can be answered by undertaking a literature topic being reviewed, but also literature review is an integration of successful previous academic studies. There are two areas to be searched:

- The literature relevant to the topic.
- The literature on research methodology and data collection techniques (Hart, 2001).

Hart (1998) points out that the major benefit of the literature review is that it ensures the researchability of the topic before 'proper' research commences. Moreover, a review on available literatures can help the researcher in developing academically research skills. It allows the researcher to consider the topic and future feasible research, thus being helpful for future stages in the research.

Chris (2001) describes different steps in the literature review as follows; Firstly, the researcher must fully understand the topic which is studied. At this stage is it important to search and study available. Secondly, analyzing literature which is a critical stage allows the researcher to understand how other researchers previously have approached the topic and how they framed their research and also what findings have been made previously. Chris (2001) elaborate that a thorough critical evaluation of existing research often leads to new insights by synthesizing previously unconnected ideas which can provide methods for the collection of data and suggest solutions.

Five advantages of literature review are listed below:

- It will help the researcher to identify work already done or in progress which is of relevance to the topic.
- It is a preventive method of possible duplication on what has already been researched on the topic.
- It gives the researcher a possibility to avoid some of the pitfalls and errors of previous research.
- It assists the researcher in designing the methodology for the study by identifying the key issues and data collection techniques best suited for the research.
- It will enable the researcher to find gaps in existing research, thereby providing a unique topic.

In order to create a basic knowledge structure for the research project, the authors have searched for scientific literature related to different fields relevant to the topic. The authors approach during the search for literature sources focused on achieving a knowledge based on different conceptions of the area on study. Previous research on the topic and on similar transportation and modal systems has been taken into consideration as well as general perceptions regarding short sea shipping.

The authors focused the search of literature material to the research field of shipping and logistics and also information directly from different stakeholders. Furthermore, the search for literature also focused on information regarding the current market situation on specific routes. In order to create a good foundation for the study the current transportation systems in the geographical area on study was also taken into consideration.

2.1.2 Workshop

As a part of the research for this study, a workshop was held with the participants of the reference group for the project.

The workshop took place at Chalmers University of Technology in Gothenburg, the 26th of February 2013. During the workshop many interesting question related to the concept and its potential were discussed. The framework of the workshop was set to only treat DSSS and relevant surrounding issues, the workshop was held as an open discussion. The workshop discussion was finished by constructing a SWOT analysis of the DSSS-concept, which formed a foundation and starting point for the interviews and the SWOT analysis conducted in the scope of this thesis. All of the participants of the workshop where in some way connected to this project either as academics, practitioners, and actors of the transport system or potential customers. The complete list of work shop participants are presented below.

2.1.2.1 List of workshop participants

Linda Styhre, IVL Swedish Environmental Institute
Erik Fridell, IVL Swedish Environmental Institute
Violeta Roso, Chalmers
Kent Lumsden, Chalmers
Kaj Ringsberg, Chalmers/ILAB
Rickard Bergqvist, GU
Olle Engström, Chalmers (Chalmers master student)
Robert Beach, Chalmers (Chalmers master student)

Haiyang Liu, Chalmers (Chalmers master student)
Tomas Arvidsson, Trafikverket
Rolf Thor, VGR
Elias Wästberg, Port of Göteborgs
Hans Gutsch, APM Terminals
Jonas Ringsberg, Chalmers
Lars Rexius, Unifeeder
Per Gisle Rekdal, Port of Oslo

2.1.3 Interviews

Although there are seemingly many similarities between a conversation and an interview, the reality, however, is not quite as simple. Denscombe (2003) describes the interview as more than just a conversation. He suggests that an interview involves a set of assumptions and understandings about the situation which are not normally associated with the conversation. If interviews have been chosen by the researcher it is considered that the decision is based on the conception that the particular research project would be better served by gathering material which provides a more in-depth insight to the topic, based on information provided by fewer informants. According to Denscombe (2003), when contemplating this decision the researcher need to consider the following questions and be persuaded that, overall, interviews are a reasonable option to pursue in terms of the desirability of the particular type of data they produce.

- Does the research really require the kind of detailed information that interviews supply?
- Is it reasonable to rely on information gathered from a small number of informants?

Research interview questions usually seek to elicit information about attitudes, opinions, perspectives or meanings and are widely used because they are a powerful means of obtaining both information and insights. A range of questioning styles are available from closed-ended, structured and tightly controlled questioning that seeks to establish the efficiency and accuracy of questionnaire types of hypothesis testing questioning before these are tried out on larger populations, to highly unstructured conversations between researcher and respondent, where the latter much more influence over the course and content of the interview. Denscombe (2003) describes three different types of interview; *structured interviews, semi-structured interviews and unstructured interviews.* Due to the nature of the study, described below, the researchers have chosen to design the interviews somewhere between the two extremes i.e. as semi-structures.

When performing a semi-structured interview the interviewer have a clear list of issues to be addressed and questions to be answered. However, the interviewer should be prepared to be flexible in terms of the order in which the topics are considered, and, perhaps more significantly, to enable for the interviewee to develop ideas and speak more widely on the issues raised by the researcher. The answers are open-ended, and emphasis should lie on the interviewee elaborating points of interest (Denscombe, 2003).

The authors' idea is that the best technique for gathering primary data for the research in the present project is semi-structured interviews. We have general ideas about the topics of the interview and there are already a number of identified points revealed from the conducted workshop in the initial stage of the research that may arise in discussion. These points may come up in the natural course of the discussion as the interviewee talks.

When designing the interview the authors had in mind the overall research questions concerned to the study and, thus, exactly what was aimed to found out. This is a reflection of the purpose of the interview and the way it has been drawn forth from underlying hypotheses regarding the important factors or opinions in regards to the DSSS-concept. Furthermore, when conducting the interviews and designing the questions the authors have considered the interviewees as people who act in their professional context in different professional settings. The authors aim was to ensure that a sample was gathered across the groups of interest to the research according to appropriate criteria, such as position and experience. However, the authors have not engaged in developing a fully representative sample in the present project due to the framing of the project and the initially exploratory nature of the conducted research.

In this study the authors are looking to explore a working hypothesis and to develop further questions for the research process by conversing relatively openly with our subjects. In doing so the authors are making do with an opportunity sample in the specific areas where access has been offered and aiming to possibly develop this sample further through personal contact and recommendation as the research proceeds. Therefore, it is important to exercise caution in assuring that inappropriate generalizing claims for the findings will not be made.

The authors concerns about controlling the interview and avoiding the interviewee leading us into areas outside of our concern and perhaps also talking too abstractly or even vaguely about the topics of interest has meant that the authors have adopted a semi-structured approach with some pre-set questions but also some scope for open-ended answers. In order to try to guarantee the relevance and suitability of the questions devised the authors have tried to produce a justification for every question used. In cases where it has not been able to come up with a good rationale the question have the question have been decided to be dropped. Furthermore, the authors have been careful not to ask questions in a way that may lead respondents into providing confirmation of the authors own views rather than eliciting theirs.

If the authors had set-out conduct a more focused study wishing only to gather data on certain issues a structured interview might have been more appropriate, with predetermined questions and less scope for the interviewee to generate the agenda.

Based on careful consideration regarding above discussion the authors have agreed that interviews, as means of gathering primary information is indeed justifiable and applicable to the intended research. Furthermore, the authors are aware of specific problems surrounding interviews such as; reliability, interviewer effect and inhibitions etc. Conducted interviews are of semi-structured character, however, questionnaires shall be prepared in advance. The interviews will not likely be limited to these questions.

2.1.3.1 Interview list

- *Christopher Pålsson* - Managing Director Maritime Insight, interview March 14th 2013
- *Lars Rexius* - Managing Director Unifeeder Sweden, interview March 21st 2013
- *Lars Green* - Managing Director Green Consulting Group AB, interview 15th March 2013
- *Viktor Allgurén* - Market Intelligence Analyst at Göteborgs Hamn, interview 8th March 2013
- *Alexander Olsen* - Logistics Manager GAC Sweden, interview 26th April 2013
- *Stefan Nyström*, Sales Manager Joship, agent for CSAV, interview 25th April
- *Kristian Kisch* - Manager European Shipping Services Stora Enso, interview 8th May

- *Margus Sitsi* - Business Manager Port of Tallinn – Telephone interview 2nd May 2013
- *Yngve Johansson* – Director NYK Group Europe Ltd – Scandinavia – Questionnaire 6th May 2013

2.2 Case study

Robert K. Yin defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context in which multiple sources of evidence are used (Yin, 1984). However, case study research is not uncontroversial. Whilst it excels at bringing us to a quite detailed understanding of a complex issue or object through a contextual analysis of a limited number of events or conditions and their relationships in contemporary real-life situations, critics of the case study method believe that the study of a small number of cases in this way can offer no grounds for establishing reliability or generality of findings and that the intense exposure of the researcher to a single study of the case biases the findings. On these grounds there is a strong belief that case study research is most useful as an exploratory tool as a carefully planned and crafted study of real-life situations, issues, and problems. This is the manner in which the authors have used the case study research with respect to the present investigation. The advantages of the case study method are its applicability to real-life, contemporary, human situations and its easy reader accessibility.

This understanding of case study research fits also the definition of Lekvall and Wahlbin (2001), who denote the term case study for research where the interest is aimed at detailed and often deep-going descriptions and explorative studies where a detailed comprehension of processes of different natures are researched and where it is not pre-determined what is important to research and what is unimportant (Lekvall and Wahlbin, 2001).

In order to put DSSS-concept into a practical condition, the authors have established a DSSS-scenario in which a DSSS-service is implemented on the between the Ports of Gothenburg and Sundsvall. Detailed information is illustrated in the scenario such as distance, speed, time, particulars of vessels, frequency, and potential cargo. Additionally, some costs from two ports are also concerned. In the DSSS-scenario the authors have aimed to implement the findings from the interviews into a practical situation, in doing so and illustration of a possible DSSS-concept would be established.

Furthermore, the scenario is conducted with an aim to illustrate a possible implementation of the DSSS-concept and also as guidance for further research and investigation. This study is to be considered as an initiate approach to DSSS-concept, in order to facilitate further studies as sustainable and feasible, this research is supposed to provide more feedbacks from stakeholders and market.

2.3 SWOT Analysis

The SWOT Analysis or the SWOT Matrix was created by Albert Humphrey, who led a convention at the Stanford Research Institute (SRI International) in the 1960s and 1970s using data from companies. It is a structured planning tool that is a structured planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. The aim was according to SRI International (2005) to find out what had gone wrong with corporate planning and to create a new system for managing change.

The structure of the analysis method is as follows:

Internal

- Strengths: are characteristics of the business or project that give it an advantage over others
- Weaknesses: are characteristics that place the team at a disadvantage relative to others

External

- Opportunities: elements that the project could exploit to its advantage
- Threats: elements in the environment that could cause trouble for the business or project

According to Valentin (2001) the SWOT analysis is a used to identify and assess strengths, weaknesses, opportunities, and threats – and that it is intended to yield strategic insights to the business or project. The SWOT analysis method also leads the researchers into ways and indications of realizing the desired alignment and setup of the business or project. However, Valentin (2001) argues that the conventional SWOT analysis method tend to be to general and include only catchall questions which can create lack of distinct theoretical underpinnings. Valentin (2001) further criticize the conventional SWOT analysis method by claiming that the results often are shallow and misleading. Nevertheless, Valentin (2001) claims that the conventional SWOT analysis method shows most lacks when applied on a specific firm.

In order to gain more penetrating strategic insights, Valentin (2001) suggest researchers to follow SWOT analysis guidelines derived from contemporary strategic management theory, especially the resource-based view. Valentin (2001) recommend resource-based SWOT to; Executives on firms who make strategic decisions, students whose assignments require analyzing cases or developing business plans, and educators who teach strategic decision making. The resource-based view overcomes the short-comings of conventional SWOT analysis by focusing on systemic causal issues that afford more perceptive, reliable, and actionable insights.

In order to analyze the market potential and market conditions for the DSSS-concept the authors have conducted a SWOT analysis on the concept based on the findings in previous research on related topics as well as findings in the interviews. As the DSSS-concept can be considered as a non-existing concept the authors find the conventional SWOT-analysis as a sufficient analysis method in the context which contributes to construct the foundation for the conclusions of this research.

3 Theoretical Framework

The chapter aims to describe relevant concepts and previous research within the scope of the conducted research in order to provide a foundation for the study. Furthermore, the environmental legislation in the geographical area of the study is also described and analyzed.

As a starting point for the study the below matrix hypothesis has been used which is presented in table 3.1. An important component in the development of the DSSS-concept is the relationship with and knowledge from the dry port concept. The dry port concept is based on a port operationally and administratively connected to an inland terminal where containers can be delivered and picked up in the same manner as directly to the port. Relatively large cargo flows are connected to this link, which provides the basis for efficient rail transport and rail shuttles. In addition to transshipment of cargo, as provided on conventional intermodal terminal, dry ports offer value-added services such as empty depot handling, repairs, customs clearance and safety inspections.

It is important to emphasize the difference between the DSSS-concept and traditional container feeders. The DSSS-concept aims to create a holistic approach to transport in a longer term perspective to avoid short-term focus on individual solutions. The expected outcome of the concept is to create a more reliable service than the traditional feeder services, both with regards to punctuality but also with regards to longer term relationships. Reliability is important to most customers, and if a service is said to be scheduled for a longer time perspective, it could create value for the potential customers. The characteristics of traditional shipping and feeder services could mean that it is not suitable for time-sensitive goods. This prevents a transfer of goods to the sea, which the DSSS-concept strives to overcome.

Furthermore, the intention is also that the DSSS-concept should be a clearly integrated part of a longer transportation and logistics chains, such as land transport – DSSS-service - transoceanic shipping - land transport and vice versa. Consequently, transport customers could get improved global access to their markets and also an opportunity to better plan their logistical chains. The differences between a traditional feeder service and the DSSS-concept are illustrated in table 3.1. Also, similarities between railway shuttles and the DSSS-concept are shown in the table. The hypothesis of the DSSS-concept, in comparison to traditional feeder and rail shuttle is as follows:

Table 3.1. Hypothesis matrix – comparison between Railway shuttle, DSSS and feeder

	Railway shuttle	**Short Sea Shuttle**	**Traditional feeder**
Time table	Yes	Yes	Yes, often. But can change with short notice.
Frequency	Up to several departures per week	Minimum 1 departures per week	Differs
Punctuality	High, deviation up to 1 hour	High, deviation up to 1 hour *	Low, often deviation up to 24 hours
Time perspective	Long, months up to years	Long, months up to years	Short, weeks up to months
Integration in the transport chain	High	High	Low/Medium

* Not valid during extreme harsh weather

3.1 The Port

The port is a safe place where a ship can load or discharge goods and passengers. It is within this safe area that the commercial operation of loading, discharging and provisioning takes place. These operations can take place alongside, at berth or at anchorage. The port is a scene with activities of various kinds which makes it possible to meet a variety of needs from the port's various stakeholders within the groups, organizations, or systems that may affect or can be affected by a port's organization and its actions. However, to the shipper or passenger the port is the interface between land and water transport and the key requirement for the location. Its vigorousness is a commercial demand for the movement of cargo and people (ICS, 2010/2011).

Ports are of vital importance for the global infrastructure network and play a key role in the transportation of goods and people. The critical importance of the port operations is clear due to the fact that over 80 per cent of international trade by volume is carried by sea transport, which makes ports vital for international trade and commerce (Bichou, 2009). There are a variety of terms describing ports and they can vary from a small quay for berthing one ship at a time to large centers with many terminals and a cluster of industries and services. Over time ports have developed in different ways by various influences such as, economic, spatial, political, social as well as cultural and military. Since the industrial revolution, ports have progressed into becoming manufacturing sites, moving vast quantities of materials and commodities using larger and more expensive equipment (Bichou, 2009). Thus, ports have transformed from labor-intensive merchant ports into capital and technology-intensive enterprises. Though many attempts have been made to find structural models in order to explain port development, no clear pattern of port development has yet been found to exist (Bichou, 2009).

The ports can be described as hubs in the global transport network where the flow of goods stops, meaning that no transportation work is carried out. The stop does not represent something valuable for the customer who has paid for a transport from A to B. But a stop is often necessary due to the fact that the goods has to be handled i.e. discharged, marshalled or loaded. According to Stopford (2009) a port is a geographical area where ships are brought alongside land to load or discharge cargo, usually a sheltered deep water area. This definition does not take all aspects of a port into consideration though. A port is also a place where cargo is stowed, stored and custom cleared (Bichou, 2009). There are fundamentally two kinds of cargo handled in a port: import/export cargo; and transshipment cargo. For a country it is critical to handle import/export cargo in order to develop the domestic economy and industry. The traditional role of a port was naturally focused on import and export cargo for this reason. Transshipment cargo on the other hand is different, such cargo is not vital for a country's economic development. Transshipment gives additional revenue and brings other opportunities to develop a country's logistics industry, based on the resources of the transshipment cargo system. The concept of transshipment is usually defined as the movement of cargo through an intermediate port en route from the origin port to the destination port.

The development of international shipping since the introduction of the container has had a major impact on ports; a transformation from handling general cargo to the handling of unitized cargo (Guthed, 2005). In container shipping the design and capacity of the ports are very important. In order to give the vessels service at a sufficient level it is crucial that the port has the required equipment and facilities. The development in container shipping is constantly moving towards greater volumes; the vessels are built larger and larger which means that the ports also must expand in order to be able to handle the cargo volumes.

For container shipping companies the geographical position of a port is a significant factor when choosing ports for the new line. In order to keep a weekly service it is crucial that the chosen ports do not create unnecessary detours. An important factor in the port analyze is the approach distance from deep sea which determines the approach time and at some extent the required pilot time and pilot cost. The approach time factor has to be taken into consideration when planning the route and deciding which ports to call at. Feeder connections to and from ports is another significant factor. A port with several feeder services connecting to other ports increases the catchment area of the container shipping line.

An important factor for a port in a container trade route is infrastructure, both within the port (internal) and to/from the port (external). In the ports it is mainly the terminal equipment that determines the infrastructure level: cranes, trucks and marshalling areas. The level of the external infrastructure is depending on roads for truck carriers and rails for train carriers. To obtain a good and effective flow of goods through the port it is essential that the internal and external infrastructure is working together with high collaboration. With inadequate external and internal infrastructure congestions may appear which may result in delays for the container shipping companies.

3.2 Hinterland

Hinterland, also called Umland, is a tributary region either rural or urban or both, that is closely linked economically with a nearby town or city. Hinterland is defined by van Klink and van den Berg (1998), as a continental area of origin and destination of traffic flows through a seaport, i.e. the interior region served by a seaport. According to McCalla (1999), hinterland includes the areas behind the port to which the port sends imports and from which it draws exports.

In the late 19th century the word hinterland started to be used as a reference to the backcountry of a port or coastal settlement. By the early 20th century the use of the word hinterland in the above context became more widespread and accepted, and from this time forward, the backcountry or tributary region of a port is usually referred to as its hinterland.

As the study of ports has become more sophisticated, maritime observers have identified export and import hinterlands. An export hinterland is the backcountry region from which the goods being shipped from the port originate and an import hinterland is the backcountry region for which the goods shipped to the port are destined. Furthermore, export and import hinterlands have complementary forelands that lie on the seaward side of the port. An export foreland is the region to which the goods being shipped from the port are bound and an import foreland is the region from which goods being shipped to the port originate. (Encyclopedia Britannica, 2011)

3.2.1 Port-Hinterland Relationship

Over the years the relationship between ports and their hinterland have changed due to a number of factors. Influencing factors of the port-hinterland relationship can be economic development, industrial specialisation, trading relations, military expansion and social migration (Bichou, 2009). Furthermore, Bichou (2009) claims that during more recent years new factors have had an impact on the port-hinterland relationship. These new factors are containerisation, intermodal integration, shipping networks, information technology, environmental sustainability, land use and policy.

As described above there are different ways of classifying a port. One way of doing this is to analyse the ports geographical and spatial markets: i.e. the extent of the land area a port can serve, commonly called the ports hinterland. According to Bichou (2009), when classifying a port by its hinterland the port can be classified either as a local, regional, national or international port. This classification is subject to the size of the specific ports hinterland, which can vary considerably from one port to another. This variation is due to different factors such as the scope of shipping services and port traffic, the quality of port services, the size and efficiency of the inland transportation network and the number of competing ports for the same hinterland (Bichou, 2009).

Beyond the intermediate hinterland a port can serve a wider spatial region. This area beyond the intermediate hinterland is often called the foreland and denotes the geographical area a hub or a network port serves through networking with other feeder ports or through an extended inland transport system (Bichou, 2009). As with hinterland competition a variety of ports can compete for the same foreland. From a spatial and geographical perspective Bichou (2009) argues that the relationship between goods flow and port development is better understood from the concept of gateways, articulation points, freight corridors and distribution centres.

- *Gateways* – Are locations that bring together different modes of transportation along with warehousing and other logistical services.
- *Articulation points* – Nodal locations interfacing several spatial systems and serving as gateways between spheres of production and consumption. The difference between gateways and articulation points it that the latter are viewed from an urban perspective, whereas gateways do not necessarily need to be located at a city interface
- *Freight corridors* – Represent transport links of freight transportation supported by an accumulation of transport infrastructure and activities servicing these flows. Traditionally, flows in freight corridors tended to be fragmented and segmented since each mode tried to exploit its own advantages in terms of cost, service, reliability and safety.
- *Freight distribution centres* - Serve as a location for cargo transfer and distribution to regional or extended markets, depending on corridor capacity and articulation point links. The functionality of a freight distribution is related to the combination of a freight corridor and an articulation point or gateway. (Bichou, 2009)

Bichou, (2009) argues that there is a current on-going process of redefining the concept of port hinterland and foreland, he argues that the traditional concepts of port hinterland and foreland along with the derived port marketing terminology have become less relevant due to the strategic expansion and networking of ports and port operations. Port expansion and networking along with landside extension undermine the significance and application of spatially homogenous port ranges and hinterlands in this sense. In the same context Bichou (2009) discusses the impact on port competition from globalisation, deregulation, and privatisation, which he claims have shifted to the cross-border, cross-industry level. The instigation of new logistical patterns of maritime and intermodal transportation means that modern ports now have the possibility to compete for far-reaching goods with far-reaching counterparts regardless of localisation. Furthermore, the increasing control and bargaining power of ocean carriers in international shipping and logistics that also acts as port owners and operators will in extension put modern ports at a higher risk to footloose relocation and hence recurrent changes in the spatial and functional features (Bichou, 2009).

3.2.2 Types of Hinterland

It is now broadly accepted that a hinterland is an area that a port draws the majority of its business from. Furthermore, all of the traditional definitions of the hinterland have a spatial focus is in common. However, the traditional definition of the hinterland has been taken up to discussion during recent decades.

The raised discussion regarding the traditional definition of the hinterland is due to a number of factors. Wang et al. (2007) name two of these. Firstly the increasingly dynamic nature of the maritime shipping industry and in particular the concept of containerisation does not agree with the static conceptualisation of the term hinterland. Secondly, the development of logistic markets during recent years, along with the discontinuous nature of complex logistical networks, has permitted the emergence of a discontinuous and clustered hinterland. In extension Wang et al. (2007) claim that the term hinterland requires a more functional approach, particularly when integrating the term with issues regarding logistics and supply chains.

In order to understand the spatial and functional nexus that the concept hinterland has become Wang et al. (2007) have divided the concept into three basic sub-components. These three sub-components can be applied in the macro-economic, the physical and the logistical hinterland.

- *The Macro-economic Hinterland* – Tries to identify which factors are shaping transport demand in terms of origin and destination and also the setting in which the actors generating the demand evolve. The macro-economic hinterland can be represented by a set of logistical sites, some focusing on production and some on consumption.
- *The Physical Hinterland* – Is a matter of transport supply from a modal and intermodal perspective. The physical hinterland considers the network of transport infrastructure connecting the port to its hinterland and the means to achieve regional accessibility in freight distribution.
- *The Logistical Hinterland* – Is a matter of flows, how they are organised and how they are taking place in relation to the existing macro-economic and physical settings. Main issues involve modal choice and the synchronisation of maritime and inland freight distribution. Wang et al., 2007)

3.2.3 Port Hinterland Connections

Traditionally, the shipping industry has had its focus on port-to-port activities, therefore the organization of activities related to the port-vessel interface is generally more developed than the port-hinterland interface. According to Guthed (2005) there is an increasing interest in hinterland transit due to market requirements, profit margins and economy of scale opportunities in overall door-to-door transportation.

The introduction of hub-and-spoke systems in the international seaborne trade is a consequence of the shipping industry striving for economy of scale. In extension, the struggle for economy of scale has led to consolidations of goods volumes to hub ports along with changes in the structure of shipping routes. Economy of scale for the shipping lines cannot only be applied in the emergence of hub ports. It is also possible to apply it to a port's hinterland connections as well. Shipping lines have the opportunity to seek economy of scale by integrating the hinterland transit in the overall shipping structure rendering a transport system that encompasses sea voyage, port activities and hinterland transits (Guthed, 2005). On the other hand ports have the opportunity to attract shipping lines by offering efficient hinterland connections with high frequencies to and from a large hinterland.

3.3 The Dry-port Concept

Within the traditional seaport concept port platforms, quays and warehousing areas are expensive and represent a rare resource. Thus, inland platforms such as inland ports or dry ports can be seen as a good compliment to ports as they supply logistic space to otherwise scarce and expensive storage.

Lévêque and Roso (2002) define a dry port as follows: *A dry port is an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can leave/pick up their standardized units as if directly to a seaport.*

The basic idea behind the dry port concept is shown in figure 3.1 and further described in the caption.

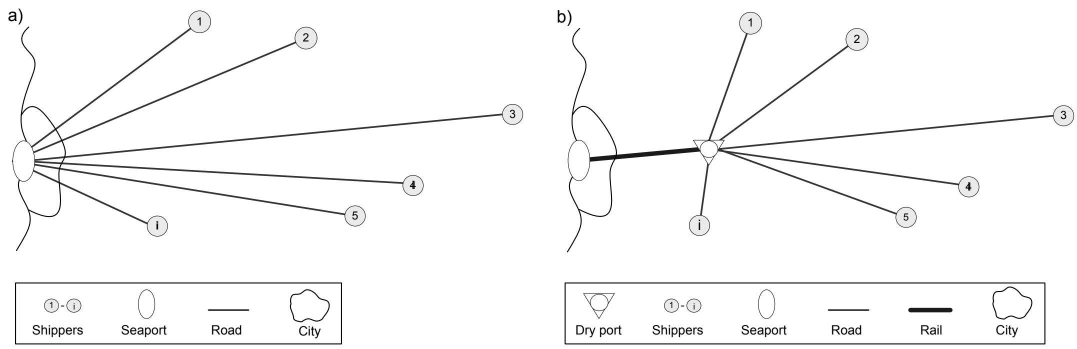

Figure 3.1 Basic idea behind the concept: seaport's inland access a) without a dry port and b) with a dry port (Roso, 2007)

The dry port concept is development of the intermodal transport, where the sea port is connected to a dry port in the inland both operatively and administratively (Roso, 2009). The container can be picked up or handed in by the customer in the dry port in the same way as in the sea port. Relatively large flows of goods are concentrated to the hubs, which create possibilities for effective railroad transport. The railroad connections between the sea port and dry port are often regular train shuttles which give the customers reliable time tables. In addition to what the regular intermodal terminal offers, the dry port offers several other value adding services.

Lévêque and Roso (2002) argue that the differences between conventional inland terminals and dry ports are that the dry port can offer several value-adding activities apart from the basic service, transshipment, which a conventional inland terminal provides. Examples of such services are; storage, consolidation, depot-storage of empty containers, maintenance and repair of containers and customs clearance. What the above services have in common is that they often are offered in the sea port, which partly has given the concept its name: i.e. dry ports.

According to Bergqvist et al. (2007), the benefits with the dry port concept is as follows: for the port less practical problems in the port, handling of cheaper land, the opportunity to sequence loading and prepared document processing, and increased competitiveness against other ports. For port city: less traffic problems, for society more railway access, for the rail operators access to a wider market, for the shippers better access to transport services to and from overseas markets, and for truck operators more short runs to a dry port rather than experiencing traffic congestion on road infrastructure near the sea port. Roso (2009) argues that an additional benefit deriving from the dry port is that it will attract customers to the area of the dry port, which gives the area the possibility to grow economically.

3.3.1 Dry-port Advantages

Roso (2009) states that the dry port concept can be the solution to the sea ports higher need of functional hinterland connections when the flow of containerized goods increases. The dry port concept allows the containers to go faster through the ports, which leads to a decreased risk of traffic congestion in and around the port. It also relieves the marshalling areas and depots in the port from a number of containers which leads to a lower need of labor and a less congested and occupied situation in the port area. The more containers that are left/picked up in the sea port by trucks, the higher is the risk of traffic jams and long waiting times for the road hauliers (Roso, 2009). One major advantage that follows the implementation of the dry port concept is the decrease of negative environmental impact due to emissions, noise and traffic accidents from trucks. The road hauliers does not get paid when standing still in traffic congestions, they get paid for the transport. The dry port gives the haulier the advantages of; shorter driving distances to the dry port instead of the sea port and avoiding emission and crowdedness fee areas in the cities. This gives the haulier the opportunity to take more transportation missions and increase service quality for the customer (Roso, 2009).

According to Roso (2009) the dry port concept also contributes with advantages for the shippers in the shape of; lower transportation costs, a wider selection of value adding services, faster transportations from/to sea port, faster custom clearance, simplified administration and lower storage costs. The storage cost is often lower in the inland terminal or dry ports than in the sea port due to the fact that the land is less expensive and therefore also the storage cost.

3.3.2 Dry-port Challenges

The challenges for dry ports can be divided into two categories depending on their nature; barriers that occur before the establishment is settled and challenges that the dry port operator face in the day to day business. Notwithstanding, the advantages the dry port concept brings for the participants and operators involved in the transportation chain, there are still many barriers for an establishment. According to Roso (2009) the most commonly existing barriers for an establishment are; supply of useable land area, the infrastructure, regulatory obstacles. However, the barrier that range over all the above mentioned barriers is the financial factor. An establishment requires large investments, which due to the nature of the service that the dry port provides not will result in a very high ROI (Return on investment). (Roso, 2009)

The second category of challenges occurs when the dry port is running. The operation of the dry port is heavily dependent on the flow of goods; economy of scale i.e. if there is no cargo, the degree of profit will be low. In periods of recession the cargo volumes decrease which leaves the dry port with less activity. Therefore there will be a constant competition for the operator to attract shippers and their cargo. Alternative and new possible transportation solutions are offered to potential customers that would benefit from using the dry port instead of other means of transport. The dry ports also compete with other dry ports for the same hinterland, which pushes the development of the range of services that the dry ports offer forward (Roso, 2009).

3.3.3 Types of Dry-ports

Dry ports can be categorized into three types depending on their function and the distance to the sea port: Distant dry ports, Midrange dry ports and Close dry ports

A distant dry port is according to Roso, Woxenius and Lumsden (2009) the most conventional of the three and has the longest history. The main reason for the development is simply that the distance and the size of the flow make railway transportation viable from a strict cost perspective and its competitiveness against road transportation is at increases with long transportation distances (Roso, 2009).

Table 3.2 .Potential advantages deriving from dry port establishment and the differences between the types of dry ports. (Roso, 2009)

	Distant	*Midrange*	*Close*
Seaports	Less congestion Expanded hinterland Interface with hinterland	Less congestion Dedicated trains Depot Interface with hinterland	Less congestion Increased capacity Depot Direct loading ship-train
Seaport cities	Less road congestion Land use opportunities	Less road congestion Land use opportunities	Less road congestion Land use opportunities
Rail operators	Economies of scale Gain market share	Day trains Gain market share	Day trains Gain market share
Road operators	Less time in congested roads and terminals	Less time in congested roads and terminals	Less time in congested roads and terminals Avoiding environmental zones
Shippers	Improved seaport access "Environment marketing"	Improved seaport access "Environment marketing"	Improved seaport access
Society	Lower environmental impact Job opportunities Regional development	Lower environmental impact Job opportunities Regional development	Lower environmental impact Job opportunities

3.4 Shipping from a Logistic Perspective

Historically, the shipping industry has been divided into two major sectors; liner shipping and tramp shipping. The liner shipping sector is characterized by time-tabled departures and arrivals between specified ports in a pre-defined area. Furthermore, the vessels occupied in liner traffic usually carry cargo for several different shippers, often unitized in e.g. containers or trailers. According to Styhre (2010) some liner services commute between two ports back and forth and other liner services serves a number of ports on a fixed schedule. Tramp shipping is characterized by irregularity in time and space, without fixed sailing schedule and fixed ports to call. According to Stopford (1997) the vessels occupied in tramp shipping often are chartered to carry a full cargo from point A to B. Furthermore, Christiansen et al. (2004) argues that one more sector can be identified in shipping; when the cargo owner or the shipper controls the vessel, called industrial shipping.

Shipment of general cargo was carried out in a similar way for many years. Cargo handling methods remained unchanged; barrels, bales, cases and bundles of goods were handled piece by piece in the ports and during loading/discharge operations as well as on board the vessels. The need of manual high degree of labor force during cargo operations was due to the cargo handling procedures. The development in the last 60-years has been focusing on unitization. With the implementation of the standard ISO container system the goods could instead be stuffed on pallets that further on were stuffed in containers. The containerization process of global goods transportation saved a lot of labor at the ports and improved the movement between different transportation modes (Liner trades, 2009/2010).

This study has its emphasis on container shipping, which is a type of liner shipping. The other type of liner shipping, according to Styhre (2010), is RoRo-shipping. The two types of liner shipping is divided into two parts depending on how the vessels are loaded and discharged; roll-on/roll-off (RoRo) and lift-on/lift-off (LoLo). The different types of roll-on/roll-off vessels are: RoRo vessels for pure cargo transportation, RoPax vessels that is constructed to carry both cargo and passengers in designated areas, car carriers constructed to carry vehicles, and ferries constructed to carry mainly passengers for pleasure trips.

The RoRo vessels are constructed in order to be able to carry different kinds of rolling cargo, e.g. trailers, trucks, train wagons, cars, roll-trailers (MAFIs), and cassettes. All these types in combination with the design of the vessel eliminate the need of cranes for cargo operation with the result that the loading/discharge operation are time efficient. According to Styhre (2010), the advantages of RoRo-handling compared to LoLo-handling are: quicker turnaround time in port due to faster loading/discharge operation, lower requirements on the equipment level in ports with regards to cranes and trucks.

The type of shipping considered within the scope of this study is liner shipping, with particular emphasis on containerized cargo and container shipping. In container shipping, the development since the introduction of the standards ISO container been that the ships are becoming larger, they can load more and more containers. The largest container ships of today, is the CMA CGM Marco Polo, with a cargo capacity of approximately 16,000 TEUs , which when using the full capacity may mean a very high total cargo value (Liner Trades, 2009/2010). In order to obtain cost effective traffic between the continents with the ocean-going vessels there is a requirement of substantial volumes of goods. If provided, there are possibilities to achieve economy of scale with large vessels; i.e. the more containers, the lower transportation cost per transported container (Lumsden, 2006).

The ports where the large ocean-going container ships call are called hub ports (Styhre, 2010). The hub ports are dredged to a level which is sufficient for these large vessels and are equipped with quays that are long enough as well as equipped with container cranes designed with sufficient lifting height and outreach. To be designated as a hub port there are also a requirement that the volume of goods required are available in the port's catchment area or in combination with transshipment cargo. There are very few ports that have a sufficient catchment area without the need to connect to other smaller and subordinated ports, henceforth called satellite ports, (Paixao and Marlow, 2002; Styhre, 2010). A common way to connect the ports in order to obtain the required volumes of goods is to create a flow of goods to and through the hub port with feeder services. The hub port is fed with cargo from satellite ports to meet its capacity requirements. The feeder transport is executed with smaller container ships with lower TEU carrying capacity per vessel. This obtains the benefit that the hub ports frequency is distributed over to the satellite ports and the consequence is that the two ports will get an increased frequency. The system is called the Hub & Spoke system in which the port where cargo is concentrated illustrates the hub and the spokes are feeder lines to and from the satellite ports. It is possible to connect the base port with new feeder lines to further enhance the volume and frequency (Lumsden, 2006; Stopford, 1997).

According to Styhre (2010) the selection of hub ports are often based on location and port capacity. A problem that frequently occurs when planning the route and deciding which ports to be used as hubs, is that there are very many predefined routes (Christiansen et. al. 2007). Another problem connected to the routing problem is to decide how many voyages to sail along the chosen string of ports, all in order to maximize the profit. If the number of ports are held low, the time for a round voyage will be shortened, resulting in a greater number of possible roundtrips per year and/or that a lower number of vessels are required to be employed for the sailing service. On the other hand, calling a lower number of ports decrease the cargo catchment areas and consequently the total catchment area of the service. According to Styhre (2010) a lower number of visited ports also result in increased costs for feeder services and transshipments in order to reach end-customers and producers

3.4.1 Hub & Spoke System

Intermodal terminals make intermodal transport possible through its function as transshipment location and hub. Within the field logistics there is a concept called the Hub & Spoke system in which the terminals are hubs and the transport between them is the spokes (Lumsden, 2006). The spokes can be water, air, or land connections as rail and road. In order for an intermodal transport to be effective and meet customer demands for delivery time and security the terminals must be effective. All forms of terminal handling mean that the transport stops and the lead time increases (Stopford, 1997). It is therefore important that this part of the transport is carried out in the most time-saving manner possible. However, terminals has evolved to also offer value adding services for the transport buyer e.g. storage, reparation of containers, custom clearance and re-packing.

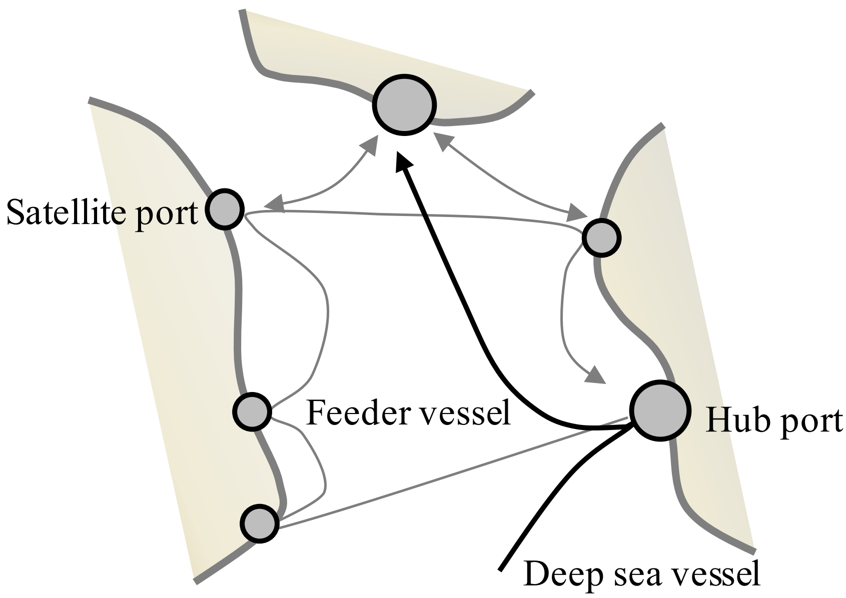

Figure 3.2 Hub and spoke system of direct calls and feeder services Styhre, (2010).

3.4.2 Feeder Service

The feeder vessels are often scheduled in so-called loops, which mean that they have a base port as starting point and operates a line between a number of small ports and then return to the base port. The ship does not only feed the base port but also transport goods between the minor ports and from the base port to the minor ports. There is a constant strive to obtain as high utilization as possible between each port to achieve cost efficiency. This is effectively a large puzzle, which is compounded by the existence of different types of imbalances, such as presence of goods in the various ports. Lack of cargo in a port is often compensated by loading empty containers for transport to a port where the opposite applies, i.e. that there is a shortage of empty containers, but there are large volumes of freight. From an economic point of view, it would be optimal to always carry loaded containers, which in practice is very difficult to obtain. The price to transport an empty container is obviously lower than the price of transporting a loaded, however, empty containers take up the same space on the vessel.

The disadvantage of feeder transport is that it results in increased handling costs and with the extra lift generated by the transfer between the ocean vessel and the feeder vessel. However, this is often a necessary cost to obtain a container to the port desired by the transport buyer (Lumsden, 2006).

Liner Trades (2009/2010) describes a liner service as a fleet of ships operated on scheduled routes between specified ports with required frequency and regularity irrespective of whether the vessel is fully loaded or not. The fleet is offering transport of any goods in the catchment area of the ports.

3.5 Short Sea Shipping

In order to analyze the strength and weaknesses of short sea shipping (SSS) it is of great importance to properly define the concept of SSS to avoid any possible misunderstandings on the subject. This, however, is perhaps not as straightforward as one may perceive at first glance. According to Paxiao, and Marlow (2002) defining SSS is not easy and the definition tend to vary depending on the study. Problems relating to the lack of definition of SSS and the fact that there is to date no academic agreement of the definition are also discussed by Dauet and Cappuccilli (2011) as it has resulted in problems and obstacles for policy making, market analysis, strategic planning and scientific research.

As several definitions can be found in related literature it can be argued that this shows the complexity of the SSS-concept and the possibility that some authors define SSS in terms of what it is not. Marlow et al (1997), explains this complexity by stating that SSS can include various ship types ranging from conventional to innovational vessels. Based on the explanation found in the research by Marlow et al (1997) Paxiao and Marlow (2002) identifies four ship types engaged in SSS trade. Traditional single deck bulk carriers; mainly traded on voyage basis engaged in the carriage of neo-bulk cargoes such as forest and metal products. Container feeder vessels with a capacity carrying high value goods and providing a link for and operated under the schedule of deep-sea container vessels employed in transoceanic trade. Ferries employed in SSS trade which can be seen as an extension of the road network and in some cases also the rail network. Dry-bulk carriers and tankers with cargo carrying capacity of less than 3,000 dwt employed in the trade of conventional dry and liquid bulk commodities. Another fifth type of vessel engaged in SSS trade has been identified by Hoogerbeet and Melissen, (1993), the fifth group of ships constitutes the sea-river ships trading on inland waterways.

According to Paxiao and Marlow (2002) the sub-sectors of the SSS market can be used as an alternative to road transport; the feeder market, the pure intra-European market and the cabotage market. Further, Paxiao and Marlow (2002) concludes that SSS-concept is a complex maritime transport service for unitized and non-unitized cargo performed by five different vessel types and delivered by various channel intermediaries within a specific geographical scope.

3.5.1 Advantages and Strengths of Short Sea Shipping

Compared to road transports SSS have a great advantage in terms of access to the transport network due to the fact that SSS can use the fairways of the oceans more or less at all hours all year round as opposed to trucks which are subject to restrictions such as driving hours and limitations regarding access to infrastructure in some countries during weekends as well as regulations on how much time a foreign registered truck can stay in one particular country (Paixao & Marlow, 2002).

As for investments and maintenance in infrastructure these are, according to Paixao and Marlow (2002), huge when comparing development of road and rail networks as apposed SSS-development. This is many due to the large land space required for these developments. SSS, however, require only the land area of the port as the surface infrastructure although improvements will need to be done over time at the goods entry and exit points to the port in order to avoid bottlenecks and friction costs.

By using SSS as an alternative to road transports this has the possibility not only to reduce the number of trucks congesting the road network but also reduce or remove associated social costs without huge investments in infrastructure (Paixao & Marlow, 2002). The social costs can also be extended to air pollution as SSS produces less CO2 than other modes of transport, counted in ton * km. However, Paixao and Marlow (2002) argue that improvements in SSS are still needed to lower the emissions of NOx and SOx regardless if they are lower than other transport modes.

From a safety point of view a modal shift from road to SSS have the potential to decrease the number of traffic accidents as waterway transports have a relatively good safety record when compared to other modes of transports. Additionally safety advantages with the SSS-concepts with regards to carriage of dangerous goods is another reason for modal shift towards waterway transports (Paixao & Marlow, 2002).

Paixao and Marlow (2002) concludes that given the nature of maritime transports SSS advantages can be categorized into seven main groups; geographical, financial, knowledge and human recourses, energy, environmental, underused capacity and positive effects in ancillary activities. However, fact is that the choice of transport mode is commonly based on economic aspects such as costs, time, flexibility and reliability which consequently are the most common reasons for choosing road transport.

3.5.2 Disadvantages and Weaknesses of Short Sea Shipping

Paixao and Marlow (2002) claim that despite the SSS-concept having many inherent advantages the industry still has to overcome several shortcomings which so far outweighs those advantages previously presented.

One weakness of SSS is the fact that door-to-door transport services can rarely be offered to the market due to the nature of the transport network with the exemption of liquid and dry bulk cargos. This disadvantage derives from SSS being part of a broken chain. Therefore, in order to complete a door-to-door service SSS requires the collaboration of rail and/or road transportation for pre- and end carriage. In addition to the integration with other modes SSS also requires the use of dedicated terminal and a network of well-located inland terminals.

The importance of implementation of organizational culture by shipping companies is discussed by Paixao and Marlow (2002) towards the development of a corporate structure which reflects itself in the new strategies and in extension a definition of best practice which will contribute the improvements of SSS operations and customer service focus. In addition to the change in organizational culture within shipping companies port and terminal operators need to plan and develop the layout of the dedicated terminals in order for the operations to be carried out as smooth as possible and to eliminate any friction costs which extends throughout the entire transport network. Focus on these issues help to reduce the overall transit time of cargo which in certain trade routes is considerably longer compared to single mode transports (Paixao & Marlow, 2002).

Lack of flexibility in terms of service arrival and departures result in additional costs in the SSS-concept which derives from the use of expensive infrastructure namely seaports and dry-port and cargo handling as a result of indirect cargo transfer operations embrace cost expenses incurred at both physical and informational levels. Another disadvantage of SSS compared to road transport is the amount of paperwork required for sea transports, studies have demonstrated that the documentary procedures required for road transports are far less than the once required for SSS.

Additional disadvantages in the port environment are discussed by Paixao and Marlow (2002) with emphasis on the lack and limitation of port capacity expressed in terms of number of berths and length of quays in order to accommodate a number of vessels at the same time, thus, forcing ships to queue before calling the port. Other related drawbacks may include lack of adequate cargo handling equipment and equipment downtime associated with maintenance. When putting these factors together it results in lower efficiency in cargo handling operations and increased costs.

With regards to a marketing viewpoint these disadvantages result in a low level of reliability and lack of service performance indicators (SPI) such as the ones developed for the aviation industry (Paixao & Marlow, 2002).

Paixao and Marlow (2002) conclude that the disadvantages in SSS lie in the areas of port operations, corporate structure and culture, innovation, information systems, marketing and customer service approaches.

3.5.3 Short Sea Shipping Applications

According to Bendall and Brooks (2010) previous research in the field SSS applications in North America suggest that road corridors with certain characteristics are more likely to be successful from an SSS point of view in order to take market shares from road carriers. Bendall and Brooks (2010) claim that by studying freight distance, congestion, availability of secondary ports and weather a competing rail corridor is in place possibilities for SSS can be identified.

- *Freight Distance* - In order to identify SSS opportunities requires determining the distance of the existing or potential traffic moves and possible constraints other transport providers may face e.g., driving hours of service, highway speeds allowed, fuel consumption and other regulations. Shipping was found to be truck-competitive in corridors under 1,000 nm under specific conditions (Brooks and Trifts, 2008). However, in their study land transit time was longer due to the physical network structure and congestion was also an issue.

- *Traffic volume and road congestion* - If there is a significant volume of traffic already travelling on the route by truck and a high level of existing congestion is present on the existing road infrastructure.
- *Availability of secondary ports* - If successful costal shipping operations are contingent on the availability of ports to service short sea operations.
- *No competing rail corridor* - An existing rail corridor needs to be taken into consideration as cargo interests using trucks will switch to rail intermodal rather than SSS.

3.5.4 European Union Approach Towards Short Sea Shipping

According to the European White Paper (2010) Intra-Community maritime transport as well as inland waterway transports are key components when coping with the growing congestion of road and rail infrastructure and of tackling air pollution. However, until now these two modes of transportation have been underused, despite the huge potential for the maritime transports in the Community (35 000 km of coastline and hundreds of sea and river ports) with virtually unlimited transport capacity. The SSS-concepts potential contribution to the achievement of sustainable mobility in the EU was first examined by the European Commission in 1995. Since 1995 the necessity of rapid development of SSS and modal shift from road to sea has been clearly stressed by the European Commission (Dauet & Cappuccilli, 2011).

According to Douet and Cappuccilli (2011) a lot of attention has been directed towards the SSS-concept during the last 15-years from the European Union as SSS is considered to be a favorable transport mode to alleviate road congestions on the road network in the Union. Road traffic EU is forecasted to increase and consequently increasing congestion on the already overcrowded European road network. Recent studies suggest that about 10 per cent of the road network is already affected by congestion and a forthcoming increase is likely to hinder European competitiveness (Dauet & Cappuccilli, 2011).

The EU is now emphasizing an SSS implementation scheme on the waterways of the region as opposed to the previous policies where the main attention and financial resources since the mid-1990s have been invested in restructuring and improving the infrastructure for land transport modes (Dauet & Cappuccilli, 2011). In addition to being an alternative mode of transport in order to reduce the number of truck which on a daily basis congest a considerable level of the road network the EU also considers SSS as a key factor of European cohesion and proximity between regions, namely between East and West Europe.

The EU has identified a number of obstacles hindering SSS from developing faster as a transport mode;

1. SSS is yet to be fully integrated in the door-to-door supply chain.
2. It still has an image of being an old-fashioned industry
3. Complex administrative procedures are required for European SSS-transport which is considered as international transports as opposed to European road transports are considered as community transports.
4. High port efficiency is required for SSS to compete with road transports.

The European Commission wishes to support the implementation of SSS by creating an appropriate framework and keeping the topic continuously high on the political agenda. However, the European Commission relies on the industry for the actual implementation. Therefore, the EU has put in place several programs supporting the implementation of SSS. With these programs the EU demonstrates the role it sets out to play in the implementation of an SSS-scheme. The actions from the EU are divided between constructing of infrastructure, studies regarding feasibility and financing new routes, with mitigated results (Dauet & Cappuccilli, 2011).

Dauet and Cappuccilli (2011) argues that there are several inconsistencies in the EU position and its financial programs display difficulties which are a possible explanation to why the modal shift towards SSS has not yet been successful and why projects are not sustainable. Further, Dauet & Cappuccilli (2011) concludes that the EUs definition of SSS is not consistent with the European Union borders and its position evolves from a "short sea policy" to a modal shift policy based on the concept of "motorways of the seas". Dauet and Cappuccilili (2011) claim it would be useful for the EU to clear up the equivocal interpretations.

Another major underlying difficulty is that the SSS geographical boundaries do not fit with the EU political boarders neither with its economic policies purpose. SSS is considered to be the only transport mode proven able to keep up with the growth of road transport in Europe, performing 39 per cent of all ton km in Europe while the share of road is 44% in the EU-25 for the years 1995 – 2004 (Dauet & Cappuccilli, 2011).

Douet and Cappuccilli (2011) stresses the importance for the EU and national governments not solely focus their policies regarding SSS by boosting the supply of SSS-transports but also to reduce the competitive advantage of the road transports by offering incentives to shippers towards a modal shift. Such incentives can be so called ecobonuses put in place in for example Italy and Spain where direct contribution up to 30 per cent of the sea-tariff offered to road hauliers which is financed by savings related to road maintenance, construction and safety related costs.

3.5.5 Motorways of the Sea

As described above there is a great potential for intra-regional maritime transports in Europe, according to the EU White Paper report (2010) one way of making use of this potential is to build Motorways of the Sea (MoS) which offer efficient and simplified services. MoS can be described as floating infrastructure which moves goods from one EU member state to another with the aim of substituting land motorways in order to avoid congestion on land infrastructure, enable a better integration of waterborne transport with surface modes and give access to countries separated from the EU mainland (Paxiao & Casaca, 2008). Furthermore, the motorway of the sea should provide an international link connecting at least two European ports (Douet & Cappuccilli, 2011), however, the EU is still to provide a clear definition of the motorways of the seas concept.

In the summer of 2004 the EU adopted a political agreement on a common position regarding the MoS-concept (Parantainen & Merliläinen, 2007). By creating Motorways of the Sea the EU aims at resolving the gap between supply and demand by providing door-to-door maritime services that can compete with the road alternative in all four corridors that make up the Trans-European Network of Motorways of the Sea i.e. motorways of the Baltic Sea, of Western Europe, of South-East Europe and of South-West Europe.

The TEN-T guidelines include two types of MoS-projects, horizontal projects and port-to-port projects, where the horizontal projects not only benefit particular ports i.e. icebreaking in the Baltic sea and the port-to-port projects which aim at providing opportunities for log multimodal transport chains between member countries Europe (Parantainen & Merliläinen, 2007)

A motorway of the seas project may apply for financial support from the European Commission up to the highest founding rate of 20%. However, in order to be eligible for the highest amount the proposed project must be of common interest of the trans-European network of motorways of the seas. Furthermore, the network should consist of two ports in two different member states and should not exclude the combined transport of persons an goods (Parantainen & Merliläinen, 2007, European Commission, 2005)

According to the European Coordinator it is certain that Europe needs more transshipment ports, in particular for the connections with the Far-East, better articulation between transshipment and hinterland ports.

3.5.6 Short Sea Shipping Applications in the North- and Baltic Sea-region

The Baltic Sea region is a shipping intense area with several major trading ports for a variety of commodities i.e. oil, containers and cars etc. which result in ships of all sizes trading in the. A definition of what is included in the Baltic Sea Region is found in HELCOM (2009): The Baltic Sea area comprises the Baltic Sea proper, including the Gulf of Bothnia, the Gulf of Finland, and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57°44.43'N. With a total area of about 370,000 km^2, the Baltic Sea area is one of the world's largest brackish water basins.

According to Parantainen and Merliläinen (2007), maritime transports play an important role in the economic development of the Baltic Sea region. The economic growth especially for new EU member states in the region promotes trade, thus, creating a demand for the development of transport connections. Furthermore, Forecasted increase in demand for transports and a consequential response from the shipping industry is to have larger and more vessels calling the port of the Baltic Sea. According to HELCOM (2010) AIS statistics show that vessels entered or left the Baltic Sea via Skaw 62,743 times which is an increase of 20 per cent in compression with year 2006. Approximately 21 per cent of those vessels were tankers, 46 per cent other cargo ships, and 4.5 per cent passenger ships (HELCOM, 2010). Additionally, heavy ship traffic to and from the Baltic Sea area through the 98 kilometer long Kiel Canal linking the Baltic Sea with the North Sea through the inlands of Germany. According to HELCOM (2010) the total number of ships passing through the Kiel Canal in 2009 was 30,314.

The peripheral countries in the northern part of the Baltic Sea region are faced with a number of obstacles which disturbs maritime operations and create barriers to the markets of central Europe. These obstacles include issues such as, long transport distances and seasonal ice coverage of the Baltic Sea. Ice conditions in the Baltic Sea imposed delays in the transport chain which has a negative effect on the efficiency of the transports and in extension lowering the level of accessibility to markets (Parantainen & Merliläinen, 2007)

The Baltic Sea states have been active in the concretization of the MoS-concept, for example a joint task force was established in 2004 (The Baltic Sea Motorway Task Force) consisting of all the Baltic Sea states and the European Commission (Parantainen & Merliläinen, 2007). Furthermore, Parantainen and Merliläinen (2007) have identified following issues as essential for the success of the motorway of the seas project;

- *Differentiation - I*t should be recognized that the four defined motorways of the seas corridors in the EU are quite different i.e some goals can quite easily be achieved in one region but not in another and vice versa.
- *Definition - M*otorways of the seas is not a synonym to SSS. Motorways of the seas should provide additional value in order to deserve their existence.
- *Horizontal projects* - Main attention to the TEN-guidelines has so far been on the port-to-port projects. However, the horizontal projects have a great potential and they deserve more attention in further development of the motorway of the seas concept.

3.6 Costs Related to Ship Operations

3.6.1 Fairway dues

Fairway charges consist of two parts: one is based on the ships' gross tonnage and differs for different vessel types, and the second part is based on the amount of cargo loaded or discharged also differing for various types of cargo (Swedish maritime administration, 2009).

In 2008 the Swedish Maritime Administration decided to increase the charges for fairway dues gradually; an increase of 10 per cent is made for the part based on the gross tonnage and a 25 per cent increase for cargo defined as low valued, and 5 per cent for pilotage gradually in 2011 and 2012 (Vierth and Mellin, 2010). However, the fairway and pilot charges constitute only a small fraction of the total shipping costs. Magnus Kårestedt (CEO, Port of Gothenburg) is very critical regarding the new higher fairway charges and expresses concerns in regards to Swedish ports becoming less attractive for international companies due to those extra charges, which are not required at other European ports. Although the idea of fairway charges may appear as a smart solutions from a Swedish perspective due to potential for multi-million incomes, the same might have catastrophic consequences for Swedish shipping and industry.

3.6.2 Port dues

For a ship to call a port, there are several costs to be taken into consideration. The costs are related to either the vessel itself or to the loading or discharge operation of the cargo and the cargo. Within container shipping there are also terminal costs arising from the physical moves required for the container to be loaded or discharged on or off the vessel, transports inside the terminal e.g. to storage, marshalling lifts on and of trucks or railway wagons. The port terminal is usually charging the shipper a terminal handling cost (THC) which includes all handling of a container as described above. The costs and fees can be divided in these two groups and in sub-groups depending on the type of fee as shown below in table 3.3.

Table 3.3 Division of vessel and cargo related port dues

Vessel related	Cargo related
Fairway dues	Cargo fairway dues
Port dues	Terminal handling cost (THC)
Light dues	ISPS
Pilotage dues	
Mooring dues	
Towage dues	
Agency fees	

3.6.2.1 Vessel related costs

In Sweden the fairway dues are based on the ships' gross tonnage (GT) and differ for different vessel types (Swedish maritime administration, 2009). The berth dues are charged by the port authorities and can be regarded as an infrastructure cost for the operation and existence of the port and is usually calculated based on the GT of the vessel. Pilotage dues occur when the vessel is using pilot on arrival or departure to or from a port or when using a pilot is special transits where local expertise can be of value for the Master e.g. straits or heavily trafficked areas. The pilot embarks the ship outside the port and works as a navigational advisor for the Master of the ship, with in-depth knowledge of the vicinity and the fairways of the port. Pilotage can be mandatory depending on the size and type of the vessel, provided that the captain do not have a pilotage exemption certificate (PEC). With PEC, the captain is allowed to navigate the vessel without pilot to and from the berth. However, in order to receive PEC there are certain conditions in each port that the captain must fulfill, i.e. a set amount of arrivals and departures to the respective ports as well as passing a written examination given by the local maritime administration.

The mooring dues are charged by the linesmen that stand on the quayside and assist the vessel during mooring, unmooring or shifting. The mooring dues are usually tariff based and calculated by the deadweight (DWT) or the GT of the ship. Towage dues are not compulsory for every port call; hence it is a cost that is not relevant to calculate as a fixed cost for the vessels calls in a certain port. Recommendations and regulations regarding towage is based on the ships size, ships navigational equipment e.g. bow or stern thruster, characteristics of the fairway, cargo, actual weather conditions. Towage is performed by tug boats that assist the vessel in narrow straits within the port and when navigating to and from berth. Some ports has a quite narrow design which makes berthing a tricky operation, which might result in that the Master deciding to use tug boats in order to maintain a safe navigation and berthing/un-berthing operation. Smaller vessels equipped with bowthrusters have a good maneuverability and are less likely to require tug boat assistance in port. ISPS dues are charged in ports in order to cover expenses for safety management and pre-cautions.

3.6.2.2 Cargo related costs

The cargo fairway dues are based on the amount of cargo loaded/unloaded and differ for different types of cargo (Swedish maritime administration, 2009).

The terminal handling cost (THC) is calculated per unit and charged by the port terminal to the carriers, who charge the shipper.

3.7 Environmental Legislation in the North- and Baltic Sea Region

3.7.1 Regulations

Effective maritime transport is crucial for Swedish commerce and industry, and for Sweden as an exporting nation. However, shipping faces immense challenges in terms of more strict environmental laws, such as the sulfur directive consequently resulting in higher cost for bunkers or expensive investments in re-fitting of machinery or emission handling techniques.

This part of the study aims to map and analyze how new laws and regulations will influence the competiveness of Swedish maritime transport until 2020. Examples of upcoming changes expected to affect the maritime transport are tonnage tax, new environmentally differentiated port and waterway dues, stricter requirements for the management of ballast water and the sulfur directive. Here the emphasis will lay on the sulfur directive, since it is expected to have large impact on Swedish maritime transport. Even though maritime transport is generally viewed as more environmentally friendly mode of transport regarding CO2 emissions, this is mostly true when looking at bulk transports, and the fuel consumption per ton km is quite different for typical short sea shipping services based on container or RoRo technologies. Furthermore, other emissions than CO2, such as sulfur dioxide, nitrogen oxides and particles, are actually high for shipping, especially when no abatement technologies are used (Hjelle & Fridell, 2010). It is harder to regulate shipping industry than trucking, since it has a lower degree of national control, and regulation must therefore be imposed on international scale to be efficient. As a result of this, emissions of CO2 were exempted from the Kyoto protocol since they were not able to allocate emissions to individual partner states. However, the lately stated Marpol Annex VI regulations will be stricter, especially in the SECA and NECA (NECA=NOx Emission Control Area) areas (Hjelle & Fridell, 2010).

3.7.2 SECA Directive

According to HELCOM (2010) the normal operation of a vessel creates pollution through its exhaust gas emissions. The two major pollutants concerned are nitrogen oxides (NOx) and sulfur oxides (SOx). In addition, HELCOM (2010) add that the release of carbon dioxide (CO2) from the vessel's exhaust contributes to global climate change. The NOx emissions are mainly emitted to the air from the operation of diesel engines, while SOx emissions is a product from the combustion of marine fuels and is directly depending on the sulfur content of the fuel.

Some 11,655 individual ships sailed in the North & Baltic Sea Emission Control Area (ECA) during 2012. 928 out of those were cargo carrying ships that spent 75 per cent or more of their total time within the area. Jalkanen et al. (2012) claim that the sulfur emissions from shipping in the Baltic Sea have decreased from 2010 due to the implementation of SECA and EU sulfur directive requirements which limited the sulfur content in fuel to 1.0 per cent during voyages and to 0.1 per cent during port stays. 2011 was the first year when both requirements were applied throughout the entire calendar year, and research show further decrease of emissions. According to Jalkanen et al. (2012) the reduction of sulfur and particulate SOx in the bunker fuel removed a large fraction of potentially harmful substances from Baltic Sea shipping. HELCOM (2010) states that emissions of sulfur oxides in marine regions designated to be a SOx Emission Control Area (SECA) like the Baltic Sea will be significantly reduced and will consequently result in an air quality improvement and reduced health risks for the population in coastal areas.

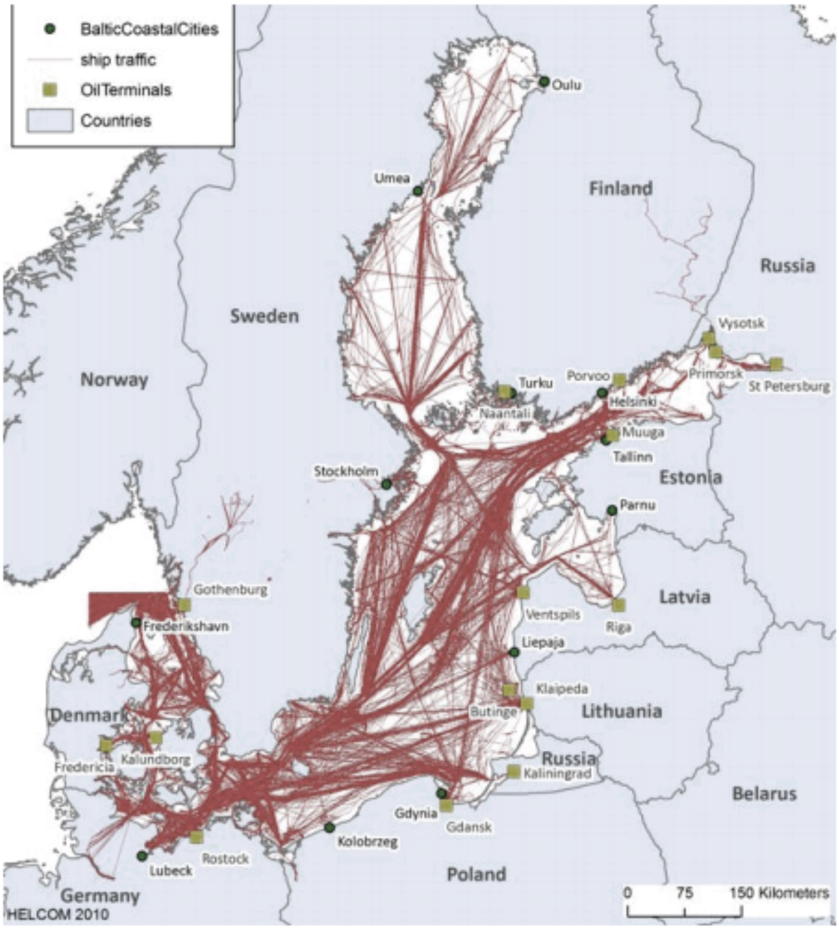

Figure 3.3. Maritime traffic in the Baltic Sea based on information from the HELCOM Automatic Identification System in a period of one week in November 2008 (BRISK, 2010).

Emission Controlled Areas (ECA) are areas where the emissions from ships combustion engines are regulated. There two kinds of ECAs;

- Sulphur (Sox) Emission Control Areas (SECA)
- NOx Emission Control Areas, NECA which also regulate emissions of SOx and PM

The controls of emissions are divided between those applicable inside Emission Control Areas (ECA) established to limit the emission of SOx and particulate matter and those applicable outside such areas and are primarily achieved by limiting the maximum sulfur content of the fuel oils as pumped, bunkered, and subsequently used onboard. These fuel oil sulfur limits (expressed in terms of % m/m

– that is measured by weight) are subject to a series of step changes over the years, displayed in table 3.4

Table 3.4 Emission regulations outside and inside ECA areas, step by step (IMO, 2013)

Outside an ECA established to limit SOx and particulate matter emissions	Inside an ECA established to limit SOx and particulate matter emissions
4.50% m/m prior to 1 January 2012	1.50% m/m prior to 1 July 2010
3.50% m/m on and after 1 January 2012	1.00% m/m on and after 1 July 2010
0.50% m/m on and after 1 January 2020*	0.10% m/m on and after 1 January 2015

* depending on the outcome of a review, to be concluded in 2018, as to the availability of the required fuel oil, this date could be deferred to 1 January 2025.

The ECA established are:

1. Baltic Sea area – as defined in Annex I of MARPOL (SOx only);
2. North Sea area – as defined in Annex V of MARPOL (SOx only);
3. North American area (entered into effect 1 August 2012) – as defined in Appendix VII of Annex VI of MARPOL (SOx, NOx and PM); and
4. United States Caribbean Sea area (expected to enter into effect 1 January 2014) – as defined in Appendix VII of Annex VI of MARPOL (SOx, NOx and PM).

3.7.2.1 Economic consequences from SECA-implementation

Regulations regarding the maritime transport mainly occur in international forums, primarily the International Maritime Organization (IMO), which handles the international conventions that form the basis for legislation. In October 2008, IMO adopted stricter limits for sulfur in marine fuel. These new rules state that the limit for sulfur in SECA (SOx Environmental Control Area=Baltic Sea, North Sea and the English Channel) is reduced from 1.0% to 0.1% in 2015, and globally from 4.5% to 0.5% by 2025. Fuels with higher sulfur content will be allowed if exhaust gas cleaning systems are used, so called scrubbers (SMA, 2009). In the southern Europe, the 0.5% will apply in 2020, which will lead to a competitive disadvantage for northern Europe in relation to the countries around the Mediterranean Sea (Trafikverket, 2012). Figure 3.4 show the countries that have whole or parts of their coastline towards the SECA-area.

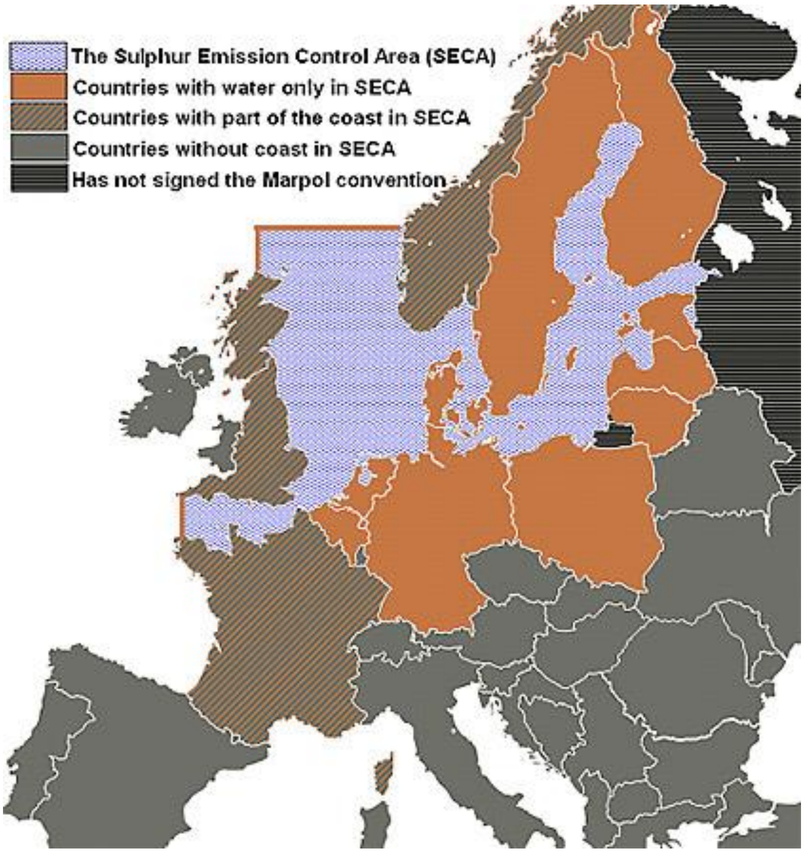

Figure 3.4 Countries affected by SECA (jernkontoret.se)

According to the Swedish Maritime Administration's (2009) calculations the consequences for Sweden and Swedish trade are the following:

- Fuel costs are estimated to rise by between 50 and 55 per cent.
- Fuel costs constitute between 40 and 50 per cent of the total costs of operating a vessel.
- The costs for marine transport increase by between 20 and 28 per cent.
- Per transported ton of freight, the increase is between SEK 20 and SEK 100.

Further consequences include 5-6 per cent increase of transport on rail and road respectively, and 7-10 per cent decrease of shipping transports (Malmqvist & Aldén, 2012).

Since there is a risk of negative effects on the competiveness of the industry due to the costs of new requirements to reduce the sulfur emissions, which could lead to a modal shift from sea to land, member states of the EU may provide support to operators in accordance with the applicable state aid rules if such aid measures are considered to be compatible with the treaty (The Maritime Executive, 2012).

4 Benchmarking

In order to find key features for a possible implementation of the DSSS-concept benchmarking examples have been examined and are presented below.

In order to approach benchmarking examples which could be comparable to the possible implementation of the DSSS-concept in practice the authors investigated similar container shuttle services on global scale to find out if any container shuttle services are currently operated. Three examples where found, namely the Unifeeder "feeder shuttle service" between Gdynia and Kaliningrad, the DFDS container service in Europe and Grand China Shipping domestic service in China. The DFDS benchmarking is performed on their container services as well as on their RoRo service between Gothenburg and Ghent. The Grand China Shipping example is operated in domestic traffic in China, providing a link between the Northern and Southern regions.

4.1 Unifeeder

As described above large and regular cargo flows are required in order to implement a DSSS-service. However, there are examples of feeder services which are currently operating with imbalances and focusing on cargo flows on one leg, for example on the route Gdynia to Kaliningrad transporting large cargo flows of parts to automotive production. The volumes and balance for long term feasibility is of course depending on what price you can receive for the transportation, i.e. the higher the price you can fetch in the market the fewer containers per trip is needed to reach profit. Therefore, it is difficult to precisely define volumes required when the volumes are in such large extent dependent on what the operator gets paid. When studying Unifeeders Gdynia to Kaliningrad service operating schedule, seen below in table 5.2 , it can be seen that the vessel DB Fortaleza departs Gdynia on Mondays and arrives in Kaliningrad on Tuesday/Wednesday and completes the shuttle service by arriving in Gdynia again on Thursdays.

Table 5.2 Extraction from Unifeeder vessel operation schedule for vessel BF Fortaleza on service Gdynia – Kaliningrad (Unifeeder, 2013)

Vessel Name: BF FORTALEZA							
	MO	TU	WE	TH	FR	SA	SU
Day	29.04	30.04	01.05	02.05	03.05	04.05	05.05
Port	GDY	KGD	KGD	GDY	KGD	KGD	
	MO	TU	WE	TH	FR	SA	SU
Day	06.05	07.05	08.05	09.05	10.05	11.05	12.05
Port	GDY	KGD	KGD	KGD	KGD	KGD	
	MO	TU	WE	TH	FR	SA	SU
Day	13.05	14.05	15.05	16.05	17.05	18.05	19.05
Port	GDY	KGD	KGD	GDY	KGD	KGD	
	MO	TU	WE	TH	FR		
Day	20.05	21.05	22.05	23.05	24.05		
Port	GDY	KGD	KGD	GDY	KGD		

The available cargo flows between these two ports are consequently sufficient enough to run a shuttle service and obviously the cargo owner/s pays enough for the transport to support the shuttle financially. There are no restrictions towards transshipments cargo on the shuttle, however, Gdynia is not a big transshipment port so it is mostly short sea cargo which can utilize the service.

4.2 Introduction to DFDS

Short Sea Shuttle benchmarking RoRo example: DFDS Seaways, Gothenburg – Ghent route

DFDS - "Det Forenede Dampskibs- Selskab" was founded in 1866 in Denmark and was from the beginning involved in domestic as well as international trade, transporting both freight and passengers. The International activities started in the North Sea and in the Baltic Sea.

DFDS Seaways in Gothenburg is a subsidiary company to DFDS A/S in Copenhagen, Denmark. DFDS A/S is a shipping company that operates vessels in the North Sea and in the Baltic Sea, partly through subsidiary companies in e.g. Norway, Germany, England, The Netherlands, Belgium, Lithuania, Latvia and Russia. The core business for the group is RoRo shipping, but they are also a player on the cruise market and on the rail wagon shipping market.

4.2.1 RoRo Services

DFDS Seaways offers several RoRo freight services in the Europe, divided into four RoRo route networks, illustrated in figure x; North Sea routes, Cross-channel routes, Baltic Sea routes, France & Med route (DFDSa, 2013). The network handles approximately 1,500,000 trailers, containers, self-drives and abnormal loads each year (DFDSa, 2013). According to DFDS (2013) DFDS Seaways is one of the largest European shipping companies, running one of the region's most comprehensive networks. The fleet executes more than 530 departures per week and the network covers 20 countries with more than 42 destinations. The fleet consists of 51 modern vessels (DFDS, 2013a).

Figure 4.1. Illustration of DFDS North Sea RoRo network. (DFDS, 2013)

4.2.2 Container Services

In addition to these services, DFDS also offers container services to a wide range of ports in Europe, with services between Continental Europe and Ireland, Norway and Rotterdam as well as side port liner services between Scandinavia and Holland, Germany, Belgium, UK, Spain and Ireland.

The DFDS container routes are formed with reliable sailing schedule and in combination with their focus on specialized equipment including 45’ curtainside, 45’ palletwide reefer, 40’ open top, 20’/40’ flat rack and 45’/40’ dry cargo containers, they offer a range of transport solutions.

Figure 4.2 Illustration of DFDS container shipping network. (DFDS, 2013)

4.2.3 The Gothenburg – Ghent Route

DFDS Seaways offer an extensive RoRo shipping network in Europe, with a fleet consisting of ferries, RoRo and RoPax vessels. The service between Gothenburg, Sweden and Ghent, Belgium is performed by 3 RoRo vessels on a weekly sailing schedule with 5 departures from Gothenburg, 5 arrivals in Ghent, 5 departures from Ghent and 5 arrivals in Gothenburg. The crossing takes approximately 32 hours.

The cargo mix on this route includes trailers, lorries with and without drivers, containers, cassettes, machinery, truck chassis and cars. The service offers customers possibility to ship cargo that needs just-in-time precision for major Swedish and continental industries. In particular, the service is focused on handling new cars and truck chassis for Volvo, who has production facilities in the vicinity of both ports.

The inland access from terminals is satisfactory in both ends, from Ghent in Belgium delivery or loading is convenient and the port is only few hours away from major European cities. From the port of Gothenburg there are good connection to the hinterland via motorways in close range form terminal to major cities like Oslo, Stockholm and Malmö. The port of Gothenburg is also connected to its inland hinterland by railway.

According to Hallberg and Wikström (2011) the route between Gothenburg and Ghent mainly derived from the transportation demand that the car producer Volvo had between their production plants in the respective cities. An important cargo volume is steel products from Ghent to Volvo's car production plant in Torslanda, Gothenburg. The steel is produced by ArcelorMittal and is processed into coils in Belgium, for further refinement in the Torslanda production plant. The coils weigh approximately 13000 -15000 kilos each, and are transported to the port of Ghent by truck for transshipment to purpose built cradles on steel cassettes to ensure safe sea transportation. The steel cassettes are positioned from the terminal onto the vessel by a translifter. The volumes on the Gothenburg – Ghent route also consist of manufactured cars and trucks from Volvo's production plants in both ends for transportation towards its respective markets. The large cargo volumes on the route are mainly contract cargo, which is complemented by cargo from smaller clients in order to maximize utilization.

4.3 Grand China Shipping

Chinese coast line is divided into three major economy regions due to the diversity of the industry in each of the regions. The different regions are described below in figure 4.4. The first region is the area around Bohai bay where the major Ports of Dalian, Yingkou, Tianjing and Qingdao are situated. The second region is the Yangtze River Delta, Ports of Shanghai and Ningbo is located in this area. The area around the Pearl River Delta constitutes the third region where the major ports are Guangzhou, Shenzheng and Hongkong.

Figure 4.4. Chinese coast line and economical regions

- Ports in the region around Bohai Bay serve the provinces in the north of China e.g. Beijing, Tianjing, Shanxi, Shandong, Hebei, Heilongjian, Jilin and Liaoling. The major cargo types shipped out from these ports are foodstuff, chemicals, various types of ore and forest products.

- The provinces Shanghai, Jiangsu and Zhejiang provinces situated in the east pert of China is served by the Ports of Shanghai and Ningbo. Cargo shipped out from these regions consists of manufactured forest products, clothing, mechanical and electrical product and advanced building materials etc.
- The Ports of Guangzhou, Shenzheng and Hong Kong serve mainly the southern parts of China i.e. Guangdong and Fujian provinces. The major goods flows consist of floor tiles, clothing, metal products and basic building materials.

Furthermore, the Ports of Shanghai, Guangzhou and Hong Kong also handle large transshipment volumes.

The cargo resources from north China are mainly raw materials and heavy industry products while the east and south regions have light industry products, which suggest that there is enough volumes and good import/export balance for container shuttle services. Companies involved in this market are COSCO Container line, China Shipping Container and Grand China Shipping.

Chinese domestic container shuttle service is not a new phenomenon. The first shuttle was deployed and put into service in 1996. In the following years it has grown to a mature transportation system which connects the north south region of China by maritime transports. The most important reason for the successful implementation is the fact that there are existing large volumes of cargo as well as reasonable balance in the flows due to diversification of industries in the different regions.

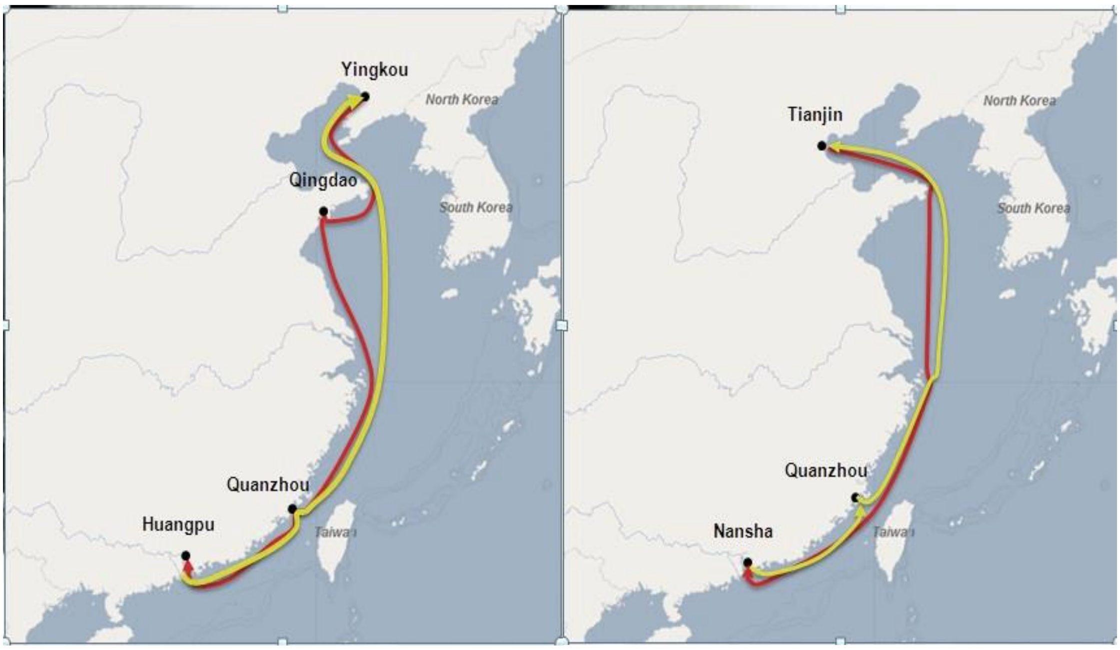

Figure 4.5. Grand China Shipping domestic container shuttle

Figure 4.5 shows two container shuttle routes of Grand China Shipping. Both of them are supposed to connect North and South regions of China. As we described above, the main cargo resources of the routes are food, forest products, coal, raw materials from North and manufactured product, import cargoes from South. Furthermore, the routes are operated by vessels have capacity of about 2500 to 3000 TEU while departure frequencies are 1 or 2 per week in order to satisfy the demand of customers. The characteristic of different industry areas through the coastline makes the route which connects the North and South regions of China have relatively stable and large volume to support container shuttle services.

4.4 Summary of benchmarking

Findings from the benchmarking examples that can be implemented in a DSSS-concept are; connection of two regions with goods flows in both directions, availability of base cargo flow, frequency and punctuality. There are characteristics in both of the benchmarking examples that can be taken as ideas for the implementation of the DSSS-concept i.e. the DFDS RoRo example where the service is built up around the goods flows to and from the Volvo factory.

The Unifeeder example described above differ in terms of balance in volumes between the ports, where one leg is the dominating cargo-wise. Nevertheless, there are sufficient volumes between the ports in order for Unifeeder to deploy one vessel.

Regarding the illustration of the services above, these three examples are just similarities to the DSSS-concept, however, they do provide some insight to a potential implementation of a DSSS-services. The DFDS example has container services between Continental Europe and Ireland, Norway and Rotterdam etc. as well as Ro-Ro routes between Gothenburg, Sweden and Ghent, Belgium. Furthermore, the frequency and punctuality are supposedly constitutes as good example for a DSSS-concept.

From the Grand China Shipping examples there are ideas and design to that can be pointed out as important things to consider when investigating in which areas a DSSS-service could be implemented. Furthermore, the benchmarking examples illustrate that the shuttle concept is able to be operationally possible, provided that there are stable and relatively large volumes on the specific route. Although the market conditions are quite different from North and Baltic Sea area, the large volume and stable balance in both directions are found as critical factor for a possible DSSS-implementation.

Regarding the DFDS container service, in which smaller vessels are deployed in an extensive transportation network covering large parts of Northern Europe, there are no specific shuttle services. The characteristics of their network are more similar to the transportation networks of feeder operators such as Unifeeder and Teamlines, with the difference that DFDS does not market their container services as feeder services. The feeder operators deploy their vessels in schedules between several ports, including a hub port which is connected with satellite ports.

The characteristics of the service that can be pointed out for an implementation of a DSSS-concept are vast network coverage which provides the shippers many possibilities. In order to implement a DSSS-service successfully, it could be suggested to start up in smaller scale and eventually scale up the coverage of the services by connecting several ports with the concept.

5 Analysis of the Interview Results

The empirical results from the interviews are categorized in five sections depending on the characteristics of collected data. The last section of this chapter includes as case study of a DSSS-scenario implemented between the ports of Gothenburg and Sundsvall

5.1 Matrix of Major Findings from Interviews

The major findings from the interviews conducted in this study are presented in below table 5.1 in order to clearly identify any differences in the perspectives from various stakeholders as well as any possible similarities in their view of the DSSS-concept.

Table 5.1.Major findings from interviews based on comments from a sample of stakeholders

Stakeholder	Expected function	Type of cargo	Needed for implementation	Strengths	Weakness
Feeder operator	Modal shift from land to sea	Warehouse-to-Warehouse	Existing cargo flow Operator	Environmentally smart	Increased lead time
Ocean shipping company	Possibility re-position empty containers Additional transport concept in the region Adaptation to fit ocean calls in the hub-ports	Non JIT Low value cargo	Vessels Low handling costs in ports	Capacity to handle large batches Reliable transports between two ports	Increased lead time High handling costs in hub-ports Flexibility
Satellite port	Increased cargo throughput Possibility to develop a reliable transport system.	Manufacturing goods aimed for production Foodstuffs and products for supermarkets	Need for large base customers in start-up process Organized as financially competitive concept	Punctual and reliable mode of transport for customers	Non-existing concept Conservatisms in the industry and amongst potential customers
Hub port	Attract new cargo	All except JIT and production	Cooperation	Increased utilization of the port	Non-existing High costs
Cargo owner	Possibility for cheap re-positioning	Non time sensitive	High integration in supply chains	Standardization and intermodality	Handling costs in ports
Maritime consultant	Modal shift from land to sea	Non time sensitive	Cooperation such as public-private partnership Political will	Free infrastructure	Conservatism
Freight Forwarder	Modal shift from land to sea Additional transport mode	Low value cargo	Well integrated in supply chains Public-private cooperation	Possible environmental benefits	Flexibility

5.2 Expected functions of the DSSS-concept

The interviews have shown that the DSSS-concept has potential to attract cargo from land based transportation modes. This suggests that an implementation of the concept would relieve city areas and roads from congestion and heavy traffic. In addition it can be argued that environmental benefits in these areas would come in place as air pollutants such as SOx, NOx and particles would supposedly decrease as sea transports are generally considered to have less environmental impact than road transports. Furthermore, it is suggested that if implemented the DSSS-concept have potential to decrease the number of traffic accidents taking place annually on the European road network. The potential of saving human lives when shifting cargo transports from road to sea is also described by Paxiao & Marlow (2002).

As opposed to intra-Asian transport the intra-European transport system is to a large extent built up around trailer transports. If deployed the DSSS-concept may work in shifting goods volumes from overcrowded land base infrastructure. Furthermore, truck transports are subject to drivers resting hours which is not the case when transporting cargo on a ship which operates more or less at all hours. Also, when the truck and cargo has come to a standstill it is exposed to security risks i.e. thefts. If the cargo on the other hand is transported in a closed system e.g. a container and stored in port areas the risk of thefts would decrease. The benefits from a security perspective when transferring cargo from road to sea is also discussed by Paxiao & Marlow (2002) and Falkenberg et al (2013) who stat state that sea transportation modes pose higher security levels in the transport chain with regards to carriage of dangerous cargo. With this statement Paxiao & Marlow (2002) argue that the security aspects is reason enough to support the transfer of cargo from trailer transports.

As opposed to means of land transport i.e. truck and rail the DSSS-concept has the potential of carrying larger batches of cargo. This is an advantage for the DSSS-concept as this transport mode is not restricted to the same extent in regards to cargo carrying capacity. Supposedly this would mean that cargo does not have to be put on waiting lists for later departures or spilt into smaller batches which are sometimes the case when transporting on rail or by traditional feeder vessels. Furthermore, if implemented the DSSS-concept may be beneficial for the distribution systems for the forest industry in the North of Scandinavia which are characterized by these large batches of cargo currently handled by industrialized RoRo-systems or bulk shipments as well as rail and traditional feeder transports. A containerized DSSS-concept implemented for this type of cargo flows could benefit the cargo owners as the container vessels in comparison to RoRo vessels with corresponding DWT is more fuel efficient per transported unit with the potential of lowering the overall transport costs. Additionally, these industrialized RoRo-concepts where developed at a time where the bunker costs were much lower than they are today along with the upcoming SECA-implementation a containerized DSSS-concept has the potential of offering a more cost efficient transport system for the Scandinavian forest industry. The importance of efficient transportation for peripheral European countries such as Finland is discussed by Parantainen and Meriläinen, (2007). According to Parantainen and Meriläinen, (2007) decreasing the costs of transportation in the Baltic Sea region is of major importance in order to improve the competitiveness of the regional industries as, for example, the average logistical costs for Finland is 2-3 times higher than in Central European countries.

The concept of short sea container shuttles could create an opportunity for the Scandinavian forest industry to switch transportation system from RoRo. It has been discussed that the industrialized

RoRo transport systems have lost in efficiency in correlation to increased bunker prices in recent years and potentially an introduction of a DSSS-concept with container vessels could be attractive to the forest product industry. Furthermore, it has been argued that container vessels are more efficient than RoRo vessels, both in terms of capacity and cost.

A critical factor for an establishment of a direct short sea container shuttle is that volumes already exist to and from the potential ports. Without a base volume there are small opportunities for the concept to be successful in the long run, however, if implemented many of the respondents have expressed positive benefits towards the development of the concept. Statements such as "*someone needs to start for other to follow"* and *"a concept like this would most likely crate spin of effect"* have been frequent throughout the interviews.

It has been suggested that implementing the DSSS-concept in small scale with little risk could result in the development of a wider network of DSSS-services in the region. As have been the case in the development of the railway shuttles form the port of Gothenburg.

A possible function of the DSSS concept is preferably that it will be a fully integrated link in the transportation network where the shuttles are tightly connected to inland distribution in each port.

5.3 Key factors and Market potential

One of the major key factors towards a successful implementation of a DSSS-concept is found in the balance between export and import cargo to the ports served by the shuttle. In order to achieve profitability and feasibility for a DSSS-concept it is of vital importance that there is a balance in cargo volumes in both directions. It can be argued that a DSSS-concept will not be a long term feasible option if the majority of cargo is carried in one leg. Another important feature in the respect of balanced flows is the need for a stable base flow of cargo for the shuttles and that this base flow does not fluctuate too much over time.

In order to correctly analyze the possible and suitable cargo flows in the region applicable to this study namely the Baltic- and North Sea-region, the region needs to be divided into sub-regions. A suggestion of division is shown in figure 5.1. The general idea of the concept can then be applied on the sub-regions in order to analyze the market potential in each region. The division into sub-regions would help to better grasp the existing goods flows and identify the specific flows that would be interesting for the DSSS concept. If looking at the entire region at the same time, it is hard to identify suitable cargo and routes due to the complex nature of the transportation network. When the goods flows in the regions are identified it is suggested that different regions could be connected to each other and it could be investigated if the goods flows of two regions match for an implementation of a DSSS-service connecting the two regions.

Figure 5.1 Suggest division of geographical area into sub-regions

Furthermore, in order to optimize the design of any DSSS-service the available cargo needs to be analyzed thoroughly as the requirements for the different cargo types vary as well as different customer demands. Possible diversification of potential cargo for a DSSS-service can be formulated as per below in table 5.3.

Table 5.3 Suggested diversification for suitable cargo for the DSSS-concept

Import cargo	Export cargo
Deep-sea transshipment cargo	Deep-sea transshipment cargo
Intra-European cargo	Intra-European cargo
Domestic cargo*	Domestic cargo*

*Intra-regional domestic cargo.

One likely outcome of an implementation of the DSSS-concept is the increased lead times especially compared to trailer transports. However, in trans-ocean trade customers and transport buyers have already adapted to longer lead times caused by slow steaming of ocean going vessels, supposedly, this should mean that there is a flexibility form the customers towards longer lead times for this cargo type. Consequently, cargo imported or exported from overseas market would not likely suffer from increased lead times caused by transporting cargo in a DSSS-concept. In this respect reliability is expressed as more important than lead times for potential customers to the DSSS-concept. Frequency is also a key factor for the success of the concept and departure frequencies in the region of 3-4 per week has been suggested as suitable. If the frequency is lower it will be difficult to compete with trailer transports. This can be illustrated with an example with only one departure per week where the customers face possible waiting times of close to one week if s/he fails to deliver the cargo on time. This example realizes the importance of frequency in the concept. The importance of frequency when shifting cargo from road to sea transports is also discussed by Bergatino and Bolis (2004) in their study regarding freight forwards preferences on RoRo-transports as an alternative to land transports.

In the intra-European trade it is generally difficult for short sea shipping operators to compete with trailer transport due to trailer transport benefiting from shorter lead times, punctuality and flexibility. In the domestic trade the distance of the transport is crucial in order to determine which transport mode is the most suitable. It has been argued that that DSSS is able to compete with land based infrastructure if the distance is less than 300 kilometer which is also discussed by Vierth (2012) in this case with regards to short sea shipping in general terms.

Another important factor for the implementation of the DSSS-concept relates to the risks of starting up a new concept and the related risks of operating in the shipping industry. Suggested solutions for this issue are to split the risk between various stakeholders such as public-private partnerships. The importance of cooperation and support from authorities in an initial stage of the concept implementation process has also been pointed out. Operating shipping companies in general is related to large financial risks which is connected to the fact that the industry is capital intensive, this can be viewed as a weakness for the implementation of a DSSS-concept, however, Paxiao and Marlow, (2002) also discusses this as a strength in developing new shipping concepts as the players in the market already possesses tremendous competitive advantage as the already have experience from operating in the shipping industry. Nevertheless, the question on how to operate a DSSS-concept is challengeable as competitiveness in the market from active players and conservatism from various stakeholders as well as customers may cause issues which could result in a reluctance to use the DSSS-concept if implemented. It has been suggested that a DSSS-operator should be a neutral part or at least as neutral as possible and that actual ownership of resources is of secondary nature, this should be viewed in the context of what is actual presented to the market.

As this concept can be considered as a new transport system the implementation needs to be simple as conservatism from the customers should not be underestimated, statements such as *"Why should we change transport solution – current set-up has worked for many years"* have been frequent throughout our interviews. On the other hand, it has been pointed out that upcoming new environmental regulation, with particular emphasis on the SEAC15 implementation, higher bunker prices as well as the financial state of the European economy can be drivers for a structural change and, thus, favorable for the implementation of the DSSS-concept in order to change current transport set-ups. Furthermore, the number of handling points should be kept at a minimum as these are costly and can damage the cargo ,specially the risk of vertical lifts as described by Lumsden (2006) as well as the fact that not all customers have experience and possibility to handle containers at their terminals etc. In this context in should be pointed out that the easy handling of loading and unloading as well as flexibility is a major strength of the trailer transport concept.

Transport price is most often the major factor behind choosing transport mode as stated by Vierth (2012) and also re-confirmed by the respondents in our interviews. If the DSSS-concept can be developed as a competitive and cost efficient transport solution the respondents have argued that the concept have great potential for successful implementation.

5.4 Cargo types and cargo flows

As described above the concept has potential to carry and handle large batches of containers, which often is a shortcoming for a rail shuttle with regards to capacity. Within the forest industry it is common with large batches containing such cargo as; sawn timber, pulp and paper, if not shipped by sea transport in bulk the batch size is restricted by the capacity of the land based transport mode. Consequently, it can be argued that the short sea container shuttle concept has potential to become a solution for parts of the transportation demand deriving from the Scandinavian forest industry with emphasis on export countries outside Scandinavia but also intra-regional transports.

As one expected outcome of a potential implementation of a DSSS-concept is that lead times in the logistic chains may increase as well as less punctuality compared to land base transport modes. Thus, the concept can be considered as unsuitable for just-in-time cargo aimed to be inserted in production shortly after arrival at destination. The interviews have on the other hand revealed some suitable cargoes for the concept such as, steel and forest products, chemicals, consumer goods for example household appliances, material for the construction industry. With regards to the before mentioned types forest and steel products these are low value cargo which would supposedly not suffer so much from increased lead times. One key component in the goods characteristics which has been mentioned by a number of the interviewees is the suitability of warehouse-to-warehouse goods for the concept.

Potential cargo flows for the concept are for example the large flows of transshipment cargo routed through continental European ports to and from Scandinavia by feeder. It has been pointed out that some parts of these flows potentially could be transferred to the DSSS-concept and connected to ocean-going vessels at a hub port in Scandinavia for example Gothenburg. The annual throughput of containerized cargo transshipped to and from Scandinavia via European continental ports amounts to millions of TEUs. The current transport solution for this cargo flows is divided amongst the existing container transportation modes; traditional feeder, rail and truck transports.

The container feeder operator Unifeeder has been successful in attracting trailer goods to their short sea transportation concept as a compliment to their core business which is container feeder services. In order to offer a competitive service to intra-European trailer customers the company has implemented 45’ pallet wide containers which are customized for their European clients. The size of the 45’ container is optimized in accordance with the European standard pallet size (EUR pallet; 1200 mm x 800 mm) which makes it possible for the 45’ container to accommodate 33 EUR pallets. This makes it possible to offer transport customers to shift their cargo from traditional trailer transportation systems to the short sea transportation with supposedly financial and environmental benefits. When the 45’ containers have been discussed with the respondents they see potential for the DSSS-concept to be more competitive towards land based transportation modes if 45’ containers are introduced to the concept, it can also be argued to be a prerequisite in order to attract cargo from trailer transportation systems on intra-regional and domestic transports including a relatively short sea leg.

Today repositioning of empty containers is a large cost for the ocean liners and these empty containers may be a possible cargo for the DSSS-concept. It should also be noted that there is not only imbalances in the cargo flows but also the cargo carriers themselves, i.e. the size of containers. Some of the sub-regions in the geographical area of scope have an imbalance of imported goods in 20' TEUs and export of 40' TEUs. The Swedish port of Gävle is one example where a large amount of coffee is imported in 20' containers and the export cargo from the same port is mainly in 40' containers, cargo in this case is mostly forest and steel products. Re-positioning of these empty containers has been described as a necessary evil and container carriers are often looking for cheap solutions for these transports. It has been argued that the DSSS-concept would be suitable and economical way of the re-positioning.

For short-sea container operators it has been expressed that it is easier to compete with trailer transports on the European gods flows in East to West corridors and vice versa. This is likely to be connected to the fact that the trailer transport in North to South directions are relatively cheap as the export cargo in this direction is not as time sensitive and there is an abundance of trailer capacity seeking return cargo to the continent as discussed by Vierth (21012).

5.5 Potential customers

The potential customers for the short sea container shuttle concept are customers with non-time-sensitive cargo, e.g. warehouse to warehouse cargo and customers with low value goods. Other potential customers are companies in the forest industry with need transportation for shipments of large batches.

A large part of the forest products from North Finland and Sweden are shipped in bulk to continental ports where the cargo is unitized and shipped further. If the unitization is moved to the production plants the unitized cargo could be shipped on a DSSS-service from a port close to the production plant to a hub port in the region for further shipment to overseas destinations.

Regarding transshipment cargo to and from the port of Gothenburg there is a risk that the ocean container liner companies have a conservative approach towards this new concept and would if implemented nevertheless continue with their current set-ups i.e. own feeder, commercial feeder or by their ocean going vessels.

The intra-regional cargo and supply chains in Europe is to a large extent constructed with trailer transportation as a fundamental base with RoRo as a complement. These transport set-ups can be hard to change difficult to attract cargo from due to the fact that the solutions are already implemented and have been established for many years. Conservatism among potential customers should also not be under-estimated.

Short sea container services are available on the intra-European freight market today, often this service is combined with feeder services for example Unifeeder's short sea service "Dort-to-Door service". In order to create a feasible short sea service frequency precision is needed in the service schedules. It has been described that the feeder operators also offering short sea container services struggle with the degree of service precision in the short sea segment of their market due to the fact that they are also dependent on the feeder volumes in the transport corridors. This results in revised service schedules when the trans-ocean shipping lines change their own schedules. When offering a short sea container transport to the market it is needed to find customers who can benefit from the advantages with shipping containers at sea compared to traditional trailer. On the other hand, operating a combined feeder and short sea alternative it is not possible to attract cargo from all customer segments as the service will most likely not be precise enough to serve the customer needs and will likely not be able to provide reliable punctuality in the range of hours or even days in some cases. Potential customers for a short sea container service described above are customers who values following characteristics.

- *Environment* - Sea transport are generally considered as more environmental friendly transport mode that road transport.
- *Security* - Lower risk of theft when transporting in containers compared to trailer as well as safer transport of dangerous goods.
- *Cargo capacity* – Transportation modes ability to handle large bookings in a short time i.e. there is often higher degree of access to large volumes of containers than trailers with short notice.
- *Customer control* – Customers who desire to control their loading and unloading times. Container can be stored in a port for a few days without cost, thus, providing a possibility to adjust the loading and unloading times to suit the customer. Common term to describe this characteristic is "floating storage"
- *Price* – Sea transports are usually cheaper than trailer transports, at least under normal circumstances.
- *Flexibility* - The sea transport alternative can offer various sizes off cargo carriers e.g. 20' DV/HC, 40' DV/HC, 20'/40' FR and 45' PW etc.

5.6 Vessel type and size

As the shipping industry is characterized by economies of scale the respondents argue that operating larger vessels in the concept would result in a lower cost per transported unit. It has been suggested that vessel sizes below 500 TEUs are generally not an economically feasible in a long term perspective. It has been a tendency among container feeder operators that the vessel sizes are continually increasing. As for example the smallest vessel in the Unifeeder fleet is the 'Emilia' built 2006 with a capacity of 600 – 699 TEUs. In this context a working horse in the fleet of a commercial feeder company has been described as a container vessel with capacity about 1,000 TEUs. In addition container vessels with capacity less than 500 TEUs are rather old with outdated equipment and high fuel costs which decreases the operational efficiency.

Generally the existing tonnage of smaller container feeders available in the market in size between 300 – 1,200 TEUs are old and to some extent outdated which is shown in table 5.4 below. This is mainly due to the fact that there are very few new-buildings in this segment. Also, the lack of modern small container vessels is a result of a phenomenon described as "cascadation" as there is a focus in the shipping industry on building larger container vessels in order to lower the slot cost per transported container, consequently, the influx of modern tonnage is mostly in this segment. As a result the existing large vessels are pushed down to routes where smaller tonnage is needed creating a situation where the small container vessels are being replaced by larger ones and no modern small tonnage is introduced to the market.

Table 5.4 Age profile of world fleet of container vessels with cargo capacity under 1,000 TEUs from 1969 - 2012

Age profile **Mar-13**							
		-1969	**1970**	**1971**	**1972**	**1973**	**1974**
No of ships	< 1,000 TEU	7	8	5	2	4	2
TEU	< 1,000 TEU	1 142	1 615	624	299	1 110	302
		1975	**1976**	**1977**	**1978**	**1979**	**1980**
No of ships	< 1,000 TEU	4	3	3	6	6	8
TEU	< 1,000 TEU	593	1 522	870	2 412	2 400	3 007
		1981	**1982**	**1983**	**1984**	**1985**	**1986**
No of ships	< 1,000 TEU	9	13	14	14	16	8
TEU	< 1,000 TEU	3 091	7 373	7 919	7 249	9 628	5 066
		1987	**1988**	**1989**	**1990**	**1991**	**1992**
No of ships	< 1,000 TEU	4	4	11	13	25	24
TEU	< 1,000 TEU	2 213	2 113	6 432	7 995	12 409	15 134
		1993	**1994**	**1995**	**1996**	**1997**	**1998**
No of ships	< 1,000 TEU	19	43	61	66	59	75
TEU	< 1,000 TEU	8 030	21 183	32 310	35 594	36 341	43 596
		1999	**2000**	**2001**	**2002**	**2003**	**2004**
No of ships	< 1,000 TEU	33	27	21	28	37	43
TEU	< 1,000 TEU	18 646	16 987	12 767	20 803	23 971	30 177
		2005	**2006**	**2007**	**2008**	**2009**	**2010**
No of ships	< 1,000 TEU	57	66	71	71	43	19
TEU	< 1,000 TEU	39 826	50 264	54 683	54 430	24 902	14 483
		2011	**2012**				
No of ships	< 1,000 TEU	20	17				
TEU	< 1,000 TEU	7 716	10 236				

Furthermore, the vessels characteristics have been highlighted by the respondents with regards to trading in Northern Europe, in particular the Baltic Sea. In order to withhold a reliable and punctual service on a year-round basis the vessels in a DSSS-concept need to be constructed to cope with the ice-conditions in this area during the winter season. Hence, it has been suggested that DSSS vessels in this area should hold ice class 1A standards to be able to trade 12 moths per year. Vessels with high ice class are often subject higher purchase prices in the market due to limited supply as well as higher operational costs due to higher bunker consumption. In addition to the ice class characteristics the challenges for shipping companies with regards to stricter SECA-implementation 2015 have been pointed out by the respondents. The shipping companies will have to face the new regulations in order to be able to trade in the SECA area, which will either result in increased bunker costs (change to fuel with lower sulfur content) or a cost deriving in a modification of the vessel's emission cleaning system e.g. scrubber. The feasibility from a financial perspective on major investments to situate the stricter emissions regulations on a relatively old vessel has been argued as a weakness for the DSSS-concept.

5.7 SWOT analysis of DSSS-concept

The SWOT analysis conducted in this study is based on results from the interviews and the workshop with the findings during the literature studies as a foundation. The diversity of the stakeholders interviewed including representatives from ports, carriers, freight forwarders, feeder operators, maritime consultants create an overall picture of the strengths, weaknesses, opportunities and threats related to the possible implementation of the DSSS-concept. The complete list of findings from the SWOT analysis is divided into their respective categories in the matrix illustrated in table 5.5, and further discussed in the Discussion chapter (Ch. 7).

The strengths of the DSSS-concept that have been identified in this study are related to different features of the complex situation where the concept could be implemented i.e. ocean carriers, feeder operators, rail shuttle operators and road hauliers. The freight of containerized cargo is to a high extent closely related to intermodality and a world wide open system where containers can be transported with several modes of transport. A strength of the DSSS-concept highlighted during the interviews is the standardization and intermodality that the containerization provide. This creates a foundation for the concept to be a fully integrated part of the customers' supply and transport chains. The vessels potential to move large batches of containers are, in comparison to rail, large and could be a selling point towards cargo owners when the concept are to be promoted. In connection to the constraints met in the railway shuttles, a DSSS-service could be a complement and relief to and for the railway shuttles. The cargo carrying capacity of the vessels are also a suitable tool for one of the challenges in container transportation i.e. the positioning of empty containers from the import port to the port where suitable export cargo are available. This would also relieve the rail shuttles and free capacity for loaded containers on the rail shuttles, which ideally could provide benefits for all stakeholders in the transportation network. The increased usage of the free infrastructure of the sea that an implementation of a DSSS-concept would create, provided that the cargo shipped on the shuttle vessels are moved from land and not from feeder vessels, benefits the society with regards to environmental and safety aspects. If cargo is moved from land to sea at a higher extent, previous studies show that the risk of traffic accidents on land would decrease. The environment in the cities would also benefit if cargo is moved from land to sea, through the decrease of heavy transportation, lower noise and pollution near densely populated areas. An implementation of a DSSS-concept is also considered to be a technology driver, meaning that the concept could open up new opportunities and give cargo owners options for new transportation solutions as well as possibilities to change their supply chain structure. The DSSS-concept picks the best features from the rail shuttles and the feeder concept, which has potential to add value for the cargo owners. Furthermore, the concept has strength in the ability to take large batches of containers on one departure, which can provide reliability for the cargo owners and transport buyers.

Opportunities for the DSSS-concept are focused on the potential of the concept, and based on the fact that the shuttles have higher cargo carrying capacity then land based modes of transport. The shuttles could potentially increase the competitiveness in regional industry and production as well as provide an opportunity to overcome the problems faced by regional industries with regards to their geographical position. A DSSS-concept implementation could relieve inland infrastructure and congestion near ports and in cities. Furthermore, the DSSS-concepts potential ability to relieve inland transportation modes could also create synergy effects for these transportation modes, by increasing capacity in the total transportation network. The outcome for the cargo owners could potentially be a win-win situation where both a new option is implemented as an alternative for transportation, and the inland alternatives also will be more reliable due to the relief from the DSSS-concept implementation. Another opportunity that an implementation would offer is a possibility for cheaper positioning of empty containers to more strategic locations. The features of the DSSS-concept has potential to be an integrated part of supply and transportation chains, in the intermodal, world wide open system that the containerization brings. DSSS-services could be connected to inland access in the ports and by that to inland dry ports and terminals, offering the cargo owners possibilities for well integrated transportation chains where the DSSS-services play an important part. An implementation would possible also attract new cargo flows, if proven effective. In a longer perspective, the concept could also attract new producers and industries to the areas where the shuttles are introduced, based on the possibility that the DSSS-concept would improve the logistic position of the port and hinterlands where the DSSS-services are implemented.

The weaknesses of the DSSS-concept is connected to the non-existence of the concept in the region which result in that the full picture of an implementation is hard to point out. There are factors that are not known, and the start-up risks are considered to be large, especially with regards investments in ships in an initial part of an implementation. The barriers of entry are high, due to the fact that the concept does not exist in the region. Furthermore, in order to reach a profitable business, or even an economically defendable business, there must be suitable cargo flows on the relevant route/routes. An initiator of the concept would benefit from investment cooperation among stakeholders around the concept, which would decrease the barrier of entry for the shuttle operator. The fixed capacity in the transport system which the DSSS-concept provides can be viewed as a positive perspective as well as a negative feature. However, a strength for the DSSS concept is that the capacity can be scaled up and down with regards to the number of ships, but with the long term perspective and reliability that the DSSS- concept is thought to provide, it could be a problem to scale down when committed to the market and the customers with a certain service level.

Threats for the DSSS-concept are focused on costs and the uncertainty of profitability. The fact that the concept is non-existing in the region, also, there might be conservatism among cargo owners and transport buyers towards the new concept. Most cargo owners and transportation buyers has their well settled set ups with hauliers and transportation companies, which might result in that the most convenient solution for the cargo owner is to stick with the “old” solution that has worked before. Conservatism could also be a threat regarding the concepts potential to attract trailerized cargo to be shifted to container transport. Cargo moved on roads in trailers between Scandinavia and the continent has potential to be shifted to container-based transport instead, however those transportation solutions are traditional. The possibilities to market the new concept is limited due to the non-existence, and might inflict on the possibilities for the concept to attract cargo.

Table 5.5 SWOT-matrix based on the finding from the interviews

Strengths	Weaknesses
• Potential for large volumes and batches • Move from road to sea • Free infrastructure • Available infrastructure & vessels • Availability of infrastructure i.e. fairways open mostly 24/7 • Environmentally friendly Decrease of congestion on inland infrastructure • Technology driver • Potential reliability • Open system worldwide (containerization) • New system which picks the best features from feeder and rail shuttles • Lower emissions	• Non-existing concept • Increased lead time • Lower frequency then rail shuttles • Poor adaption to variation • Big start-up risk, Barriers to entry • Initiator (who will take the lead?) • Poor adaption to variations • Port dues for the capacity • Inappropriate IT • Complex documentation and administration in comparison to intra-European truck and rail transport
Opportunities	**Threats**
• Regional development • Reduction of investments in inland transport network • Lower external costs • Empty positioning • Possibility to help Scandinavian industries to overcome geographical position • Attract new volumes • Offer a better concept to cargo owners • Vessel capacity • Reduction of investments in road/rail • Less accidents • Lower congestion • Lower emissions • Lower external costs • Vessel size	• Cost • Hard to market • Loose customers • Implementation of SECA regulation • Conservatism (old system works fine) • Old tonnage in suitable size

6 DSSS-Scenario

6.1 The Swedish Freight Market and Cargo Flows

The patterns on the Swedish freight transport market are relatively stable. However, there is segmentation in certain dimensions where the main part of the transport can be related to a specific transport mode (Banverket, 2007). During recent years an increased use of unit loads has been identified, for example the use of containers. The increased use of unitized cargo carriers of this kind increases the possibility of using intermodal transports.

Swedish transport is primarily structured around particular main patterns between large production and consumption areas, as illustrated in figure 6.1. During the years of 1998 and 2003 the Swedish governmental body for communication analyses (SIKA) determined six main freight patterns for transport in and through Sweden. 75 per cent of the heavy and long distance transport was identified to be within the main transport patterns. Heavy and long distance transports was defined as follows; the length of the transport should be a minimum 25 km long and the weight of the total freight should be no less than 8 million tons per year or to a value of 200 billion sek per year. Air freight not included (SIKA 2007).

The main transport routs were,

- *Route 1* – North to South from Luleå via Mälardalen to Malmö/Trelleborg, the rout meets the demand for both weight and value.
- *Route 2* – Runs along the Baltic coast line and meets the demand for weight.
- *Route 3* – Runs between Gothenburg and Stockholm and extends on both sides by sea transport. The route meets the demand for both weight and value. A shift towards rail transport was detected on this route between 1989 and 2001, most likely due to an increase of intermodal transport.
- *Route 4* – From the North part of Sweden to Gothenburg via Hallsberg, meets only the demand for weight.
- *Route 5* – Runs between Svinesund in Norway via Gothenburg to Trelleborg, extended in the north the Oslo region making it Norway's most important route.
- *Route 6* – Is integrated with a large Norwegian route running between Narvik and Luleå.
- *Route 7* – Structured around a large freight flow to and from the ports in Blekinge. (SIKA, 2007)

Figure 6.1 Freight transport patterns from the Swedish Railway Administration's future plan (Banverket, 2005)

6.2. Cargo flow in Swedish ports

According to Sveriges Hamnar (2013) the amount of goods handled over quayside in Swedish ports in 2012 equaled to 136 193 000 tons, which was a decrease of 3 per cent compared to year 2011 (141 079 000 tons). The port that handled most cargo was the Port of Gothenburg, where 41 148 000 tons were handled. The statistics of all the goods handled over quaysides in Swedish ports can be found in appendix 1.

The statistics from Sveriges Hamnar (2013) also show the amount of unitized cargo handled over quaysides in Swedish ports. In 2012, the total number of units handled over quayside in Swedish ports were 3 615 292. The total number includes containers, cassettes, trailers, lorries, trucks, railway wagons and other RoRo cargo. Compared to year 2011, there was an increase of 2 per cent (3 681 384 units handled in 2011). The container units constitute a major part of the units handled, which 2012 equaled to an amount of 1 524 623 TEUs (1 521 899 TEUs in 2011). The statistics of all TEUs handled in Swedish ports can be found in appendix 2.

Table 6.1 presents the container volumes handled in the major container ports in Sweden in the year 2012.

Table 6.1 Amount of TEUs handled in Swedish ports 2012 (Sveriges Hamnar, 2013)

PORT	Handled TEUs
Port of Gothenburg	921,772
Port of Helsingborg	177,044
Port of Gävle	117,188
Port of Norrköping	40,945
Port of Södertälje	40,729

The number of TEUs handled in Swedish ports is concentrated to a few ports, as shown in table 6.1 and in appendix 2. The port of Sundsvall handled 25,778 TEU in 2012, which compared to the previous year 2011 when 19,231 TEUs was handled, this corresponds to an increase of 34 percent.

6.3 Gothenburg Hinterland Connections via the RailPort Scandinavia

The electrified railway in the Port of Gothenburg is the most frequently operated goods track in Sweden. The port railway station is the largest in the country, where over 70 trains arrive and depart to the largest cities in Sweden and Norway every day. Furthermore, the port of Gothenburg is linked to its hinterland with 24 daily rail shuttles (Portgot, 2011).

The port of Gothenburg has developed a concept called RailPort Scandinavia, with the aim of connecting train shuttle operators closer to the port by allowing the operators to manage customs clearance, warehousing, documentation and other services. RailPort Scandinavia is a Railway shuttle system connecting the port of Gothenburg with important consuming and productive areas in Sweden. When the RailPort Scandinavia project started in 1998 it was a unique concept. There had never before been a train shuttle within the scope of intermodal transport in Sweden. The companies cooperating in this first set up were LBC Frakt, BK-tåg and Vänerhamn.

The first system was structured by rail shuttles between the port of Gothenburg and Karlstad for further distribution with trucks covering the rest of the Värmland district (Nisslert & Aronsson, 2010).

According to Bertilsson and Olsson (2009), the rail shuttle system can be compared to public transport, but is a service for goods. This makes the system highly dependent on the quality of performance. The concept of RailPort Scandinavia aims at improving the flow through the port in more efficient ways. The growth limits of the shuttle system are, besides physical limits of the port area, the length restrictions for trains on Swedish railroads. The standard in Sweden is set to 630m long trains, however all investments in infrastructure are made to handle trains with a length up to 750m (Bertilsson & Olsson, 2009)

The shortest shuttle operating from the port of Gothenburg is only 12km and runs from the port to the city of Gothenburg. Another short shuttle is destined for Skaraborg. Why the shuttles operating in the short distance segment can be operated without loss is explained by time savings compared to truck transport getting stuck in traffic jams in road connections to and in Gothenburg (Bertilsson & Olsson, 2009). The destinations served by the rail shuttle system are shown in figure 6.2.

Figure 6.2. Rail shuttles to port of Gothenburg

6.4 Case Study; DSSS-scenario Gothenburg – Sundsvall

In order to investigate the findings of the study a case study of a fictive DSSS-service has been conducted and is present below. The relation chosen is two domestic ports in Sweden namely the Ports of Gothenburg and Sundsvall. The Port of Gothenburg would in this particular case serve as the hub port for the service.

6.4.1 Distance, speed and time

The distance between the two ports is 688 nautical miles and the geographical positions are; port of Gothenburg, South West coast of Sweden and port of Sundsvall; North east coast of Sweden as shown in figure 6.3

Figure 6.3 Route map port of Gothenburg – port of Sundsvall (Searates, 2013)

6.4.2 Vessel characteristics

The vessels chosen to illustrate this scenario are inspired by typical feeder vessel of smaller type with a capacity of 700 TEU. In this respect the fleet to be deployed on the service consist of three sister vessel i.e. the vessels will have identical particulars.

Table 6.2 Characteristics of vessel deployed in DSSS-scenario

Characteristics of a DSSS-scenario vessel	
Flag:	Swedish Flag
Port of registry:	Gothenburg
Build Year:	2007
Ice Class:	1A
LOA (Length Over All) :	130 meters
BM (Beam):	20 m Max
Draft:	7,4 meters
NT (Net Tonnage):	3000
GT (Gross Tonnage) :	7500
DWAT (Deadweight All Told) :	8300
TEU Capacity:	700
Reefer capacity **:**	120

6.4.3 Port costs

The costs related to the vessels calls to the ports two ports are based on official tariffs where applicable, where official tariffs cannot be used the authors have made assumptions regarding the respective costs based on their own experience in in the area of ship operations. Port cost and associated costs when calling a port are generally based on the size and type of the vessel. In this case the costs calculation is based on the particulars mentioned in above table. Furthermore, the cost calculations presented in the below table 6.3 are divided into two separate calculations. The cost for customary port calls are based on maximum amount with regards to port dues, pilotage and towage. However, there are various possibilities to reduce the port costs if the ship operator implements measures to lower the vessels environmental impact e.g. SOx and NOx emissions. Also there is a possibility to apply for pilot exemption certificate for the Captains mastering the vessels, furthermore, a well-equipped vessel with regards to maneuverability with the above size should rarely need towage assistance when berthing and unberthing. Hence, a cost calculation with the maximum reductions of the port costs as well as limiting additional costs (pilotage, towage, agency fee) has been specified.

Table 6.3 Estimated customary port cost and possible reductions for DSSS-scenario

Port of Gothenburg		
Port costs	**Customary**	**Reduction**
Fairway dues		
Port dues	14500,00	12500,00
Light dues		
Pilotage dues	22500,00	
Mooring dues	5000,00	5000,00
Towage dues	15000,00	
Agency fees	1500,00	
Total cost	**58500,00**	**17500,00**

Port of Sundsvall			
Port costs	**Customary**	**Reduction**	**Winter surcharge**
Fairway dues			
Port dues	23000,00	21000,00	20000,00
Light dues			
Pilotage dues	22500,00		
Mooring dues	5000,00	5000,00	
Towage dues	15000,00		
Agency fees	1500,00		
Total cost	**67000,00**	**26000,00**	**20000,00**

Furthermore, handling charges per container when loading and discharging the vessels is presented in table 6.4. The cost calculation is based on official tariffs and general assumptions based on the authors experience in working in the container shipping business.

Table 6.4 Terminal handling charges per container when loading or discharging in the Ports of Gothenburg and Sundsvall.

Terminal Handling	
Cost item	**Cost per TEU**
Receipt/delivery	340,00
Cargo dues inc security	300,00
Loading/Discharging	750,00
Total cost	**1390,00**

6.4.4 Schedule

With regards to the distance between the Ports of Gothenburg and Sundsvall, speed and assumable weather factors, the authors have created a schedule for the DSSS-scenario. In order to maintain a sufficient service level based on the findings from the interviews and previous research which in this case I s suggested to be 3 departures per week from each port 3 vessels needs to be deployed in the service.

The distance between the ports is 711 nautical miles (1,317 km)(Searates, 2013) the sailing time at 12 knots (22,224 km/h) will be 2 days and 11 hours. External factors which affect the vessel whilst at sea is taken into consideration by adding a weather factor of 5 per cent to the sailing time between the ports. Examples on external factors are wind and current.

711,43 nm * 1,05 = 747

747/12 kn = 62,25 hrs / 24 = 2,59 days

Based on above distance and time calculation, the authors have created an operational master schedule for the three vessels between the two ports connected by the DSSS-service. Furthermore, the port turnaround time has been taken into account when constructing the schedule, which mean that slight variations in actual arrival and departure days might occur, e.g. Vessel 1 loading in Gothenburg (SEGOT) on Monday (MON) on voyage 1 (VOY 1) and departs Monday PM, plus 2,59 days sailing, arriving in Sundsvall (SESDL) Thursday (THUR) early AM. Depending on the rate during discharge/loading operation the vessel might depart from Sundsvall Thursday PM or Friday AM. Hence, the arrival/departure date in Gothenburg for voyage 2 has been set to Sunday/Monday (SUN/MON). This provides flexibility to the schedule and adds some time margins for the service, with regards to possible delays in ports due congestion, and also unexpected events/obstacles on the sea voyages.

Table 6.5 DSSS-scenario schedule between ports of Gothenburg and Sundsvall

DSSS-scenario schedule Port of Gothenburg - Port of Sundsvall				
Voyage #	**Port**	**Vessel 1**	**Vessel 2**	**Vessel 3**
1	SEGOT	MON	WED	FRI
1	SESDL	THUR	SAT	MON
2	SEGOT	SUN/MON	TUE/WED	THUR/FRI
2	SESDL	THUR	SAT	MON
3	SEGOT	SUN/MON	TUE/WED	THUR/FRI
3	SESDL	THUR	SAT	MON
4	SEGOT	SUN/MON	TUE/WED	THUR/FRI
4	SESDL	THUR	SAT	MON
5	SEGOT	SUN/MON	TUE/WED	THUR/FRI
5	SESDL	THUR	SAT	MON
6	SEGOT	SUN/MON	TUE/WED	THUR/FRI

Compared to the DFDS RoRo service between Gothenburg and Ghent were three vessels are employed on a weekly sailing schedule with 5 departures from Gothenburg, 5 arrivals in Ghent, 5 departures from Ghent and 5 arrivals in Gothenburg. The major difference is the crossing time, that takes approximately 32 hours, compared to the sailing time between Gothenburg and Sundsvall of about 62 hours. The distance and sailing time between the ports result in the lower frequency that in the DSSS-scenario between Gothenburg and Sundsvall will provide.

6.4.5 Potential cargo

Potential cargo for the DSSS-scenario is assumed to be available in both directions. From the port of Gothenburg there are possibilities to attract import cargo for further distribution to the North of Sweden. The DSSS-service would also have a potential to attract intra-regional cargo from the South of Sweden to the north, which currently is shipped by land based transportation modes, i.e. rail or road. Furthermore, the capacity of the vessels would create possibilities for container shipping companies to position empty equipment to Sundsvall, and by connecting land based infrastructures further to the industries and production sites in the hinterland of the Port of Sundsvall. Results from the interviews conducted within the framework of this study proves the hypothesis regarding lack of suitable empty equipment in the Northern parts of Sweden, mainly due to the generally lower consumption in this region compared to Southerly parts, where the population is higher.

From the port of Sundsvall, the DSSS-service will provide an opportunity for shippers in the region to transport their goods to the Port of Gothenburg. The most common goods types exported out of northern Sweden are raw material, mainly forest products for export via the port of Gothenburg. The DSSS-service would provide a distinctly differentiated transportation alternative for the shippers compared to land based modes i.e. rail and road. Nevertheless, a negative differentiation that signifies the DSSS-scenario compared to the land based alternatives is the lead time.

The geographical coverage of this DSSS-scenario has some similarities to the benchmarking example taken up earlier in the text. The Grand China Shipping shuttle that connects the Northern and Southern parts of China is also signified with heavy industries in the North and more consumption and lighter manufactured goods areas in the South. The big difference is the available capacity provided by the services, where the Grand China Shipping service is operated by vessels in the size of 2500-3000 TEU. This is ultimately a result of the differences in size of the areas between Sweden and China, as well as the huge difference in population and thereby production, consumption and demand for transportation.

7 Discussion

When investigating a suitable implementation for the DSSS-concept in the North- and Baltic Sea region it should be recognized that the investigation would benefit from a division of the region into sub-regions, a suggestion on division is presented in figure 5.1 . Within these sub-regions cargo flows and suitable cargo types would be identified in order to pinpoint suitable ports for the shuttles. As warehouse-to-warehouse goods have been identified as suitable cargo for the DSSS-concept a suitable approach would be to identify major warehouses in the region as well as the cargo flows to and from these terminals. Furthermore, potential customers are to be analyzed in each region and approached. Such major concept customers have suggested being in the area of forest, steel and manufacturing industries. An analysis of the current transport set-up for these potential customers should be conducted in order to investigate any possible benefits of changing form current set-up to a possible DSSS-concept.

When developing a DSSS-concept it is also of importance to identify suitable port for handling the shuttles with regards to shore equipment, availability of berths, traffic congestion and vessel size restrictions. Generally many of the ports in the area of study have the possibility to handle containerized cargo, however, with regards to equipment in ports it is preferred to use dedicated container handling cranes although it is not a necessity. Most general cargo cranes and mobile cranes can handle containerized cargo. There have been examples of ports in the area where general cargo cranes have been used for handling containers until the cargo flows have reached a critical mass which has justified investments in new shore equipment. Furthermore, the ports capacity to handle containers on the shore side is also important to analyze with regards to such items as storage area, hinterland connections, efficient handling methods, possibility to offer value-adding services etc. One limiting factor when identifying suitable ports is the vessel size restrictions in the ports and the approaches. These restrictions may be with regards to vessels draft, length, beam and ice-class during different periods of the year.

During the discussion regarding an implementation of the DSSS-concept in the area of scope the availability of suitable vessels have been discussed and recognized as a possible problem for an implementation of the concept. Statistics have shown that there is indeed available container tonnage under 1,000 TEUs on the international market, however, the available vessels are in general of old design and standards which would imply that second-hand vessels employed in the concept would suffer from relatively high operational costs mainly due to high bunker consumption but also maintenance. Furthermore, the statistics does not revile in what part of the world these smaller container vessels are currently trading. As intra-Asian cargo transportation is generally more containerized it can be implied that this would also be the main trading area for most of the vessels presented in the statistics.

Throughout the interviews the timing of the development of the DSSS-concept has been described as beneficial due recent and upcoming event such as a dramatically increase in bunker fuel prices during recent years as well as the upcoming stricter SECA regulations in the area of study. The major increase of bunker prices is putting pressure on the transport systems in the region to be more efficient. This is also the case with the SECA regulations where ship owners are facing increased costs due to investments in new technology or high bunker prices being the case when ship owners and operators chooses to operate vessels on cleaner fuels with lower sulfur content. Furthermore, increased efficiency of sea transportation system with regards to emissions and price is in line with

EU opinions on shifting transports from road to sea. This would impose that there is support to be found for the DSSS-concept from governmental directions.

The factors which influence the shippers choice of road transports over short sea shipping is identified by SKEMA (2009) and is also re-confirmed throughout the interviews conducted in this study. According to SKEMA (2009) the cost differential is a major influencing factor, as road transport is often preferred although the costs are up to 10 per cent higher than sea transport. The rationale for the cost differential factor is that the uni-modal link has potential to be more reliable for the customer. The reliability and punctuality factors have been discussed in the interviews, and have been highlighted as important. On shorter distances it is often both cheaper and more reliable to choose road transports over short sea shipping which in many cases will impose an intermodal chain of transport where several vertical lifts will add cost, e.g. road or rail transport the sea port, DSSS-service, road or rail transport to the final destination. Another factor highlighted in SKEMA (2009) is the predicted increase in delivery time that a DSSS-concept would create on most distances and relations where a DSSS-service is a rational alternative to land based transportation. This was also investigated during the interviews where increased lead times and pro-longed delivery time where discussed. In the SKEMA-report (2009) increased lead times of one additional day is used as an example, caused by using sea transportation instead of road transport can be unacceptable for some shippers. The flexibility of the transport is another factor that is highlighted by SKEMA (2009), where it is stated that some shippers want to change the point of delivery during transport. In this aspect, road transports has an advantage compared to sea transport and also to rail transport where the point of delivery is less flexible.

The disadvantages of road transports compared to short sea shipping identified by SKEMA (2009) focus on restrictions in the road transportation network, e.g. road tolls, circulation restrictions, working time and rest limitations, lack of suitable road infrastructure in certain corridors and speed limits. These factors could influence the shippers to choose a DSSS-service instead of road transportation. If the 45' pallet wide containers are taken into consideration in addition the DSSS-concept could have more benefits for the shipper. The comparison of land based infrastructure and the free infrastructure at sea have been made throughout the research and also discussed at the workshop the 26th of February. Of course, there are limitations and restriction implied on sea transportation that has potential to be a differentiator for the shipper when the transportation mode is to be decided. The limitations of short sea shipping compared to road transports highlighted in the SKEMA-report (2009) can be connected to the topics addressed in the interviews, meaning that scheduling of DSSS-services is limited in terms of flexibility. The vessel is affected by the perils of the sea (Cullinane and Li, 2003) and is planned for certain time windows in the ports. Delays at sea could cause further delays due to that the time slot in port is taken by another vessel.

A factor that in some aspects can be viewed as positive and in some aspects negative is the vessel size. On the positive side, the size of the vessel allows for larger batches of cargo and ability to carry large amounts of goods which create possibilities for economy of scale and imposing a lower cost per transported unit as well as allowing for a better environmental performance for the specific DSSS-service as the environmental effect per unit would decrease. On the negative side which is pointed out in the SKEMA-report (2009) as well as re-confirmed in the interviews is that the ships size is fixed and cannot adapt to change in trade volumes. This can be related to importance of existing volumes when investigating at a possible implementation of a DSSS-service. If base volumes exist on the specific relation the vessels are occupied with cargo for the time being, however, if the situation changes and volumes are re-routed or cancelled vessel is still burdened by the same costs.

Suitable vessel size was discussed with the interviewees, and suggestions regarding the most optimal size for a DSSS-vessel varied depending on which routes the vessel is intended to trade. Based on results from the interviews and data collection it can be concluded there are not many small container feeder vessels being built tat present time. Partly, this I due to a phenomenon defined as "cascadation", meaning that bigger and bigger container vessels are built and the vessel which are being replaced are pushed down into routes served by smaller tonnage resulting n that the smallest feeder vessels are phased out and replaced by bigger tonnage. The availability of suitable tonnage for the DSSS-concept to be implemented in the North and Baltic Sea could thereby be regarded as limited, based on the fact that the northern waters require the vessels to be certified with a high ice class. Furthermore, the SECA 2015 regulations will implement emission regulations for the vessels trading in the area which will impose even stricter requirements for the constructions and technical features of the vessels.

In order to implement a new concept like the DSSS-concept it is crucial to take all existing and potential factors into consideration. The factors that are influencing the possibilities to implement the concept can be divided into internal factors and external factors. In order to identify the factors affecting a potential implementation of a DSSS-concept a SWOT analysis was made in this study. The division between strengths and weaknesses as internal factors, and possibilities and threats as external factors created a matrix showing an overall analysis of the features and pre-requisites of a potential implementation. One of the major strengths in the DSSS-concept was the concepts potential to handle large volumes and land big batches of containers, which can be considered as a restriction on other types of transportation i.e. truck and railway.

A pre-requisite for the concept to be efficient and feasible both from an operational and economical perspective is the existence of cargo volumes. A DSSS-concept should not be primarily implemented on a route where there is no existing base cargo flow or to a route where base cargo flows cannot be re-routed. There must be a demand for transport between the two ports of interest in order for a DSSS-service to be feasible. The cargo volumes can be considered as the most critical factor when investigating a possible implementation of a DSSS-concept. The critical fact of existing volumes can be found in the example of "feeder Shuttle" between Gdynia and Kaliningrad where a large cargo flow in one direction has created a demand for the service operated by one single feeder vessel of 700-799 TEUs size. The service is operated on a weekly basis, with departure from Gdynia on Mondays and Thursdays each week. The key factor for Unifeeder in this case is the base cargo flow in one direction; however the most optimal would be to have cargo flows in both directions in order to reach a high utilization and a sustainable profit. In order for a DSSS-concept to be as profitable and long term feasible it is recommended that a service is implemented on routes where there is a base cargo flow in both directions. However, 100 per cent balance between the cargo flows is considered as very difficult to achieve. Furthermore, another challenge in all container shipping is the handling of empty containers. The equipment used for import cargo to one area does not always match the need for the export cargo from the same area. One example of this is the import of coffee to the port of Helsingborg in South Sweden, which is carried out by using 20' containers, mainly from Africa and South America. In order to maintain a high utilization of the equipment, the carriers aim to find customers with export goods to stuff the containers with when the containers are stripped. If there is no suitable cargo for the export leg, the carrier is faced with some options regarding the empty equipment;

- *Storage* - Store the equipment in an empty depot in or near the port and await export bookings.
- *Domestic re*-positioning - Empty position the containers to another domestic port where suitable export cargo is available.
- *International re*-positioning - Empty position the containers to a continental port, e.g. bigger transshipment port such as Hamburg, Antwerp, Rotterdam or Amsterdam.

The DSSS-concept could serve as a solution for container carriers with issues regarding imbalances as described above, thus, providing a cheap transport capacity for both loaded and empty containers. In comparison to e.g. railway transports the DSSS-concept will have more capacity and consequently they will be able to maintain a higher flexibility with regards to ability to transport loaded containers versus to transport empty containers.

An additional indicator of the importance of an existing base cargo flow is shown in the DFDS RoRo benchmarking example, where the Gothenburg - Ghent route is mainly created due to the existing cargo flow and transportation demand deriving from the car and truck manufacturing company Volvo. The base cargo for the service is steel in coils for the production plants, and manufactured cars and trucks for the respective markets. The vessels are transporting the base cargo as a foundation for the service and un-utilized space is filled up with balance cargo to highest possible extent. The utilization on a vessel is crucial for a shipping company, and certainly also what freight rate is possible to apply towards the customers.

In addition to above, there is also a demand for transportation companies to be reliable and to keep a punctual schedule. The punctuality of a vessel is often lower than land based transportation modes mainly due to the higher amount of factors affecting a vessel at sea. However, if punctuality is not a key factor for the customer a sea transportation alternative could be a possible solution for the transportation need. Although lead times generally increase when shifting cargo from land to sea which would imply that some customers would not consider the DSSS-concept as a suitable transport alternative for their specific needs. However, in trans-continental container trade there have been major changes over the last years with regards to lead times where many shipping companies have introduced slow steaming on certain routes in order to decrease fuel consumption and thus lowering the operational costs for the vessels. According to the findings from the interviews the increased lead times where not welcomed at first, but that the industries and customers adjusted and adapted relatively quickly to the increased transit times for the cargo.

Large cargo volumes suitable for the concept have been identified in the North of the Baltic area consisting of forest products and other low value goods e.g. steel products. However, these areas are characterized of low consumption thus problems with regards to cargo balance can be predicted.

8 Conclusions

In this context the DSSS-concept is defined as a timetabled container shuttle service with a fixed schedule between two specific ports. The definition of a network DSSS-services can be formulated as follows: *A reliable shipping service with fixed schedules with daily or weekly departures between a hub port and a number of strategically located ports. The shuttles providing a complementary service to existing rail shuttles for improved transport and trade opportunities.* Furthermore, the DSSS-concept aims to be a clearly different transportation solution as an alternative to traditional feeder, where shuttles will be a well-integrated part of a longer transport chain.

With regards to the findings of this study, it can be concluded that the DSSS-concept can be considered as an interesting transportation system with at least theoretical potential based on the finding in the interviews conducted in this study. In order to implement a successful and long term DSSS-concept in the region on study several factors including potential customers and cargo types, suitable vessel types and sizes as well as available infrastructure needs to be taken into consideration.

If implemented there are possibilities that cargo transport would shift from land transportation modes to the DSSS-concept, thus, relieve constrained land based infrastructure and move road transports from the city areas. On society level the advantages of moving cargo from land based infrastructure to sea is that constrained and expensive land based infrastructure is relived in favor for cheaper and almost unlimited sea based infrastructure. Furthermore, the timing of the development of the DSSS-concept can be considered as beneficial as the overall transport system in the North and Baltic Sea region is to date facing dramatically increased bunker costs as well as upcoming events such as the stricter SECA regulations. Due to the expected increased cost for sea transportation in the region suggest that during forthcoming years is a good time to develop the concept as potential customers are open for new ideas with potential cost savings in supply chains which would counteract any conservatism towards the DSSS-concept.

In the initial stage of the study questions and doubt regarding the availability of suitable tonnage for the DSSS-concept was raised, namely the lack of small container feeder tonnage in the market. Data collection have shown that there is indeed available container vessels with capacity under 1,000 TEUs, however, the age profile of the available vessels suggest they are un-modern which would imply that the operational and maintenance costs for trading the vessels would be high. Furthermore, the data collected does not confirm the trading area of the identified vessels.

Previous research have identified transport price as a major factor when customers chose transportation mode which has also been re-confirmed in the present study. On this basis it can be concluded that the s DSSS-concept needs to offer cost efficient transportation to the market in order to be a competitive and long term feasible transport alternative in the region. Increased lead times which have been identified as a likely outcome when shifting goods from land based infrastructure to the DSSS-concept have been discussed as secondary issues, especially with import and export cargo to and from overseas markets as customers have already absorbed the increased lead times inflicted in recent years due to ocean liners policy towards slow-steaming. It has been suggested that the reliability, punctuality and frequency of a DSSS-service would counteract the negative impact of increased lead times for concept suitable cargo.

Suitable cargo for the DSSS-concept have been identified as cargo with characteristics such as, low value, non-time sensitive, cargo where both origin and destination is a ware house, empty containers for re-positioning. Examples of such cargo are forest products, steel products, non-food products for supermarkets, construction material, chemicals etc. Large volumes of concept suitable cargo have been identified in north of the Baltic Sea-region, although, these areas are characterized by low consumption. Thus, problems relation to cargo balance is predicted for a DSSS-service implemented in this region.

The hypothesis matrix containing a comparison between railway shuttle, the DSSS-concept and traditional feeder vessels was the starting point of this study and has through the study proven to be mainly accurate, as shown in table 8.1.

Table 8.1 Final matrix based on findings of the study

	Railway Shuttle	**Short Sea Shuttle**	**Traditional feeder**
Time table	Yes	Yes	Yes, often. But can change with short notice
Frequency	Up to several departures per week	Min 1/week. However, low competitiveness towards truck/rail if frequency is less than 3-4/week	DIffers
Punctuality	High, deviation up to 1 hour	High, deviation up to 1 hour*	Low, often deviations up to 24 hours
Time perspective	Long, months up to years	Long, months up to years	Short, weeks up to months
Integration in the transport chain	High	High	Medium
Empty positioning capacity	Low	High	Medium/High
Batch size ability	Low/medium	High	Medium/High

*Not valid during extreme weather conditions

The important characteristics for a DSSS-concept to be successful are identified throughout the study, and are well in line with the hypothesis matrix drawn up as a starting point of the study, The DSSS-concept is argued to be set-up with a fixed sailing schedule in order to be a reliable and punctual transportation solution for the customers/cargo owners. In addition, it is suggested that the schedule should be based on the suitable number of vessels that are required on each specific route to maintain a pre-determined frequency. The punctuality and reliability of a DSSS-service is argued to be crucial for its attractiveness, however weather and ice conditions must be taken into account. In order for the DSSS-service to attract contract cargo, it is of high importance that the service is implemented with a long-term commitment i.e. that the customers can rely on the service to be available and reliable. Furthermore, the interviewees highlighted the integration in the transport chain as a key factor for the concept to be successful and sustainable. If the service connects to ports and further to dry-ports and terminals in their hinterland, the concept is argued to be more likely to succeed.

The lead times are likely to increase, however that can be battled with high frequency as problems with lead times have not been expressed as a major problem in the interviews. High frequency can allow customers to have "storage in transport".

Provided that the DSSS-concept links only two ports to each other, compared to feeder vessels that often are operated in so-called loops between several ports, a DSSS-service have potential to be more attractive for large batches. When operating in a feeder loop, the container quantity must be matched with previous ports and forthcoming ports in the loop, which can decrease the ability to carry large batches. In order to maintain effective cargo handling and operation the cargo must be planned and loaded in sequence, depending on their respective discharge port. In the DSSS-concept, however, there are possibilities to load bookings of various sizes without consideration of cargo from other port calls, due to the nature of the DSSS-concept.

A DSSS-service has potential to be a complement to existing railway shuttles in the Swedish transportation network, provided that the suitable routes are identified.

9 Recommendations

Future investigations regarding the implementation of a DSSS-concept in the North- and Baltic Sea would likely benefit from a division of the region into sub-regions in order to identify suitable routes for a potential DSSS-service. A suggested division of sub-regions have been presented earlier in this study it is, however, not claimed by the authors that the presented division is optimal and should be considered as a possible option only.

In each of the sub-regions cargo flows which would possibly benefit from an implementation of a DSSS-service should be identified. The authors recommend that cargo owners and potential customers handling large volumes especially in big batches is to approached and interviewed further regarding their interest of an implementation of a DSSS-concept in their region and between their loading/discharge ports.

In the present context of the development of the DSSS-concept questions regarding the actual management of the services have been highlighted. The actual ownership of resources deployed in the DSSS-concept as well as construction of management of the same needs further investigation. It has been suggested that actual ownership is of secondary nature and the most important factor is what is presented to the market. However, neutrality has been a recommended approach in order to avoid any conflict of interest from potential customers, e.g. if a DSSS-service is operated by a ocean liner a competing ocean liner may be reluctant to book cargo on the service due to conflict of interest.

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Appendix 1

Tabell 2 Gods (över kaj)

2012 och 2011 (tusen ton)

Hamn	Totalt Summa			Totalt Lossat			Totalt Lastat			Utrikes Lossat			Utrikes Lastat			Inrikes Lossat			Inrikes Lastat		
	2012	2011	förändr (%)	2012	2011	förändr (%)	2012	2011	förändr (%)	2012	2011	förändr (%)	2012	2011	förändr (%)	2012	2011	förändr (%)	2012	2011	förändr (%)
Delta Terminal	93	89	4	68	60	14	25	29	-14	68	57	19	18	9	90	-	3	-100	7	20	-64
Falkenberg	629	466	35	177	208	-15	452	259	75	177	206	-14	430	259	66	1	2	-74	22	-	
Gotlands hamnar	877	880	-0	474	505	-6	403	375	8	54	77	-30	17	22	-23	420	429	-2	386	353	9
Gävle	3 947	4 325	-9	2 788	3 065	-9	1 159	1 261	-8	2 228	2 419	-8	1 114	1 241	-10	560	646	-13	45	20	129
Göteborg	41 148	41 311	-0	20 836	21 355	-2	20 312	19 956	2	19 924	20 461	-3	18 229	18 025	1	912	894	2	2 084	1 931	8
Halmstad	2 446	2 012	22	1 415	1 414	0	1 031	598	73	1 022	1 010	1	552	553	-0	393	404	-3	479	44	987
Hargshamn	623	572	9	234	392	-40	389	180	116	217	376	-42	309	79	292	17	16	8	80	102	-21
Helsingborg	7 908	8 145	-3	4 355	4 580	-5	3 553	3 565	-0	3 995	4 265	-6	3 425	3 501	-2	361	315	15	128	64	100
Husum	2 061	1 906	8	1 149	1 051	9	912	855	7	1 121	1 006	11	886	808	10	29	45	-37	26	47	-46
Kalmar	1 008	1 007	0	634	689	-8	374	318	18	488	509	-4	312	291	7	146	180	-19	62	27	131
Kapellskär	2 387	2 590	-8	1 168	1 327	-12	1 219	1 263	-3	1 168	1 327	-12	1 219	1 263	-3	-	-		-	-	
Karlshamn	5 153	5 671	-9	2 805	3 097	-9	2 348	2 575	-9	2 435	2 691	-10	2 282	2 522	-10	370	405	-9	66	53	24
Karlskrona	1 443	1 783	-19	619	704	-12	824	1 079	-24	604	701	-14	636	558	14	15	4	302	188	521	-64
Landskrona	535	603	-11	393	470	-17	143	133	7	342	405	-16	124	104	19	51	65	-22	18	29	-36
Luleå	8 250	8 979	-8	2 680	2 865	-6	5 570	6 114	-9	1 907	2 026	-6	4 333	4 435	-2	774	839	-8	1 237	1 679	-26
Lysekil	116	113	3	91	73	24	25	40	-36	91	73	24	25	40	-36	-	-		-	-	
Malmö	8 884	8 038	11	5 100	4 720	8	3 784	3 318	14	4 587	4 002	15	3 505	3 088	14	514	718	-28	278	230	21
Mälarhamnar	2 588	2 665	-3	2 146	2 205	-3	442	460	-4	1 583	1 559	2	327	374	-12	563	646	-13	115	86	34
Mönsterås	1 281	1 497	-14	734	936	-22	547	560	-2	565	707	-20	547	549	-0	169	229	-26	-	11	-100
Norrköping	3 390	3 645	-7	2 223	2 511	-11	1 166	1 133	3	1 366	1 551	-12	994	1 007	-1	857	961	-11	172	126	37
Norrtälje	53	68	-23	49	54	-10	4	14	-71	49	50	-2	-	3	-100	-	4	-100	4	12	-64
Nynäshamn	1 185	1 189	-0	628	640	-2	557	549	1	512	525	-2	389	387	0	115	115	0	168	162	4
Oskarshamn	863	934	-8	170	228	-26	694	706	-2	32	87	-64	329	305	8	138	141	-2	365	401	-9
Oxelösund	4 040	5 665	-29	2 533	3 597	-30	1 507	2 068	-27	1 413	1 988	-29	1 348	1 892	-29	1 121	1 608	-30	159	177	-10
Piteå	1 626	1 437	13	798	722	11	828	715	16	723	668	8	761	657	16	75	54	38	67	58	16
Skellefteå	1 580	1 613	-2	805	720	12	775	892	-13	700	659	6	654	720	-9	105	62	70	121	172	-29
Skärnäs terminal	991	884	12	433	284	52	558	599	-7	430	279	54	404	589	-31	3	6	-51	154	11	1 341
Stockholm	4 293	4 542	-5	2 911	3 110	-6	1 381	1 432	-4	2 189	2 348	-7	1 358	1 373	-1	722	762	-5	23	59	-62
Strömstad	162	189	-14	46	60	-23	116	129	-10	46	60	-23	116	129	-10	-	-		-	-	
Sundsvall	2 017	2 131	-5	970	1 038	-7	1 046	1 093	-4	879	922	-5	1 039	1 036	0	91	116	-21	7	57	-87
Söderhamn	745	688	8	277	316	-12	469	372	26	153	206	-26	464	372	24	123	109	13	5	-	
Södertälje	1 295	1 440	-10	1 105	1 200	-8	190	239	-20	831	967	-14	178	230	-23	274	234	17	13	9	36
Sölvesborg	1 115	1 245	-10	637	763	-17	478	482	-1	637	757	-16	458	408	12	-	6	-100	20	74	-73
Trelleborg	10 696	10 808	-1	5 628	5 436	4	5 068	5 372	-6	5 116	5 395	-5	5 067	5 371	-6	512	41	1 159	2	1	58
Uddevalla	846	1 102	-23	413	521	-21	432	581	-26	375	503	-25	387	417	-7	38	18	111	46	164	-72
Umeå	1 765	1 798	-2	798	836	-5	967	962	1	616	653	-6	965	952	1	182	183	-0	2	9	-79
Wallhamn	504	518	-3	176	196	-10	328	322	2	138	164	-15	327	322	2	38	33	15	1	-	
Varberg	1 698	1 710	-1	723	777	-7	975	933	5	672	699	-4	965	901	7	51	78	-35	10	31	-67
Vänerhamn	1 264	1 294	-2	619	648	-4	646	647	-0	564	553	2	606	619	-2	55	95	-42	40	27	46
Västervik	338	414	-18	293	340	-14	45	74	-39	190	238	-20	24	68	-64	103	102	1	21	6	260
Ystad	2 904	3 017	-4	1 432	1 479	-3	1 472	1 537	-4	1 429	1 479	-3	1 448	1 495	-3	3	-		24	42	-43
Åhus	601	698	-14	442	518	-15	159	180	-12	431	501	-14	152	176	-14	11	17	-35	7	3	107
Örnsköldsvik	840	1 395	-40	463	880	-47	376	515	-27	412	750	-45	341	443	-23	51	131	-61	36	72	-50
Totalt	**136 193**	**141 079**	**-3**	**72 442**	**76 596**	**-5**	**63 751**	**64 483**	**-1**	**62 481**	**65 880**	**-5**	**57 062**	**57 593**	**-1**	**9 961**	**10 716**	**-7**	**6 689**	**6 889**	**-3**

Appendix 2

Tabell 4A Enheter i antal och TEU per hamn
2012 och 2011

Hamn	Totalt antal enheter 2012	Totalt antal enheter 2011	Totalt förändr (%)	Containers, flak, kassetter antal enheter 2012	Containers, flak, kassetter antal enheter 2011	Containers, flak, kassetter antal enheter förändr (%)	Containers, flak, kassetter TEU 2012	Containers, flak, kassetter TEU 2011	Containers, flak, kassetter TEU förändr (%)	Trailers, lastfordon, släp mm antal enheter 2012	Trailers, lastfordon, släp mm antal enheter 2011	Trailers, lastfordon, släp mm förändr (%)	Järnvägsvagnar antal enheter 2012	Järnvägsvagnar antal enheter 2011	Järnvägsvagnar förändr (%)	Övrigt ro/ro-gods antal enheter 2012	Övrigt ro/ro-gods antal enheter 2011	Övrigt ro/ro-gods förändr (%)
Delta Terminal	-	-		-	-		-	-		-	-		-	-		-	-	
Falkenberg	-	-		-	-		-	-		-	-		-	-		-	-	
Gotlands hamnar	41 319	42 245	-2	-	-		-	-		40 936	41 753	-2	-	-		383	492	-22
Gävle	70 282	72 479	-3	70 218	72 479	-3	117 188	118 837	-1	64	-		-	-		-	-	
Göteborg	1 028 194	1 065 419	-3	547 397	547 760	-0	921 772	913 886	1	419 043	444 067	-6	299	-		61 455	73 592	-16
Halmstad	18 376	17 458	5	18 376	17 458	5	28 799	25 261	14	-	-		-	-		-	-	
Hargshamn	73	6	1 117	70	6	1 067	114	7	1 529	3	-		-	-		-	-	
Helsingborg	540 623	558 546	-3	117 701	116 180	1	177 044	174 525	1	422 922	442 308	-4	-	41	-100	-	17	-100
Husum	14 695	13 384	10	-	-		-	-		14 695	13 384	10	-	-		-	-	
Kalmar	114	-		114	-		228	-		-	-		-	-		-	-	
Kapellskär	163 032	173 406	-6	-	-		-	-		163 032	173 406	-6	-	-		-	-	
Karlshamn	63 845	57 342	11	-	-		-	-		63 845	57 342	11	-	-		-	-	
Karlskrona	84 441	80 415	5	126	321	-61	225	328	-31	84 310	80 094	5	-	-		5	-	
Landskrona	-	-		-	-		-	-		-	-		-	-		-	-	
Luleå	-	-		-	-		-	-		-	-		-	-		-	-	
Lysekil	-	-		-	-		-	-		-	-		-	-		-	-	
Malmö	246 016	233 454	5	19 944	20 282	-2	31 220	30 298	3	226 071	213 172	6	-	-		1	-	
Mälarhamnar	13 747	15 498	-11	13 747	15 498	-11	21 704	24 697	-12	-	-		-	-		-	-	
Mönsterås	-	-		-	-		-	-		-	-		-	-		-	-	
Norrköping	23 833	25 994	-8	23 833	25 994	-8	40 945	44 570	-8	-	-		-	-		-	-	
Norrtälje	4	-		-	-		-	-		-	-		-	-		4	-	
Nynäshamn	80 587	80 679	-0	-	-		-	-		78 605	78 620	-0	-	-		1 982	2 059	-4
Oskarshamn	19 535	20 590	-5	-	-		-	-		19 322	20 409	-5	-	-		213	181	18
Oxelösund	10 843	14 004	-23	10 843	12 940	-16	14 164	18 360	-23	-	945	-100	-	-		-	119	-100
Piteå	591	467	27	591	323	83	1 098	478	130	-	144	-100	-	-		-	-	
Skellefteå	-	-		-	-		-	-		-	-		-	-		-	-	
Skärnäs terminal	4 271	4 601	-7	4 271	4 601	-7	8 052	10 109	-20	-	-		-	-		-	-	
Stockholm	201 048	191 491	5	23 445	18 660	26	35 833	28 432	26	177 603	169 896	5	-	2 935	-100	-	-	
Strömstad	10 107	11 047	-9	-	-		-	-		10 107	11 047	-9	-	-		-	-	
Sundsvall	25 086	14 133	77	13 309	11 087	20	25 778	19 231	34	11 777	3 046	287	-	-		-	-	
Söderhamn	-	-		-	-		-	-		-	-		-	-		-	-	
Södertälje	25 462	33 481	-24	25 281	33 397	-24	40 729	52 815	-23	181	84	115	-	-		-	-	
Sölvesborg	-	-		-	-		-	-		-	-		-	-		-	-	
Trelleborg	648 991	670 141	-3	-	-		-	-		613 307	634 023	-3	35 684	36 118	-1	-	-	
Uddevalla	115	159	-28	21	75	-72	33	122	-73	94	84	12	-	-		-	-	
Umeå	21 637	21 252	2	9 418	9 896	-5	18 912	19 687	-4	12 213	11 349	8	-	-		6	7	-14
Wallhamn	5 776	5 711	1	5 776	5 711	1	9 359	8 950	5	-	-		-	-		-	-	
Varberg	45 825	44 086	4	4 947	5 160	-4	8 301	9 075	-9	40 878	38 926	5	-	-		-	-	
Vänerhamn	-	-		-	-		-	-		-	-		-	-		-	-	
Västervik	-	-		-	-		-	-		-	-		-	-		-	-	
Ystad	193 261	200 587	-4	-	-		-	-		180 936	186 711	-3	12 325	13 876	-11	-	-	
Åhus	13 563	13 309	2	13 563	13 309	2	23 125	22 231	4	-	-		-	-		-	-	
Örnsköldsvik	-	-		-	-		-	-		-	-		-	-		-	-	
Totalt	**3 615 292**	**3 681 384**	**-2**	**922 991**	**931 137**	**-1**	**1 524 623**	**1 521 899**	**0**	**2 579 944**	**2 620 810**	**-2**	**48 308**	**52 970**	**-9**	**64 049**	**76 467**	**-16**