CHALMERS
UNIVERSITY OF TECHNOLOGY

Capacity utilisation in liner shipping

Master's thesis in Supply Chain Management

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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2020

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Report No. E2020:036

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SUMMARY
The purpose of the study has been to create a better understanding of capacity utilisation in the shipping industry and explore improvement opportunities for ship operators. This was done by investigating the negative and positive implication of different levels of capacity utilization as well as by mapping out and analysing factors that affect utilisation negatively and strategies to increase utilisation. The study was performed by investigating current practices amongst ship operators within several liner segments, categorising information from the conducted interviews and analysing it with help of previous literature within the topic under investigation. The outcome of the study presents that the planned level of capacity utilization differed between liner segments as their customer preferences and cost structure differ, where RoRo and RoPax ship operators aim for a lower level utilization compared to container and feeder operators. Twelve factors were identified to inhibit ship operators' ability to achieve the desired level of utilisation. The most prevalent factors are a result of industry characteristics such as variations of demand, trade imbalances and schedule characteristics. Identified differences between the liner segments was that the container and feeder companies are more affected by late arrivals, no-shows and cancellations. The RoRo and RoPax segment are mostly affected by the schedule characteristics. The study also identified 14 strategies that companies can employ to increase their capacity utilization. These may be of a strategic nature such as increasing commitment between customers and ship operators or operational such as adjusting routes or frequency of departure to changing demand conditions. The strategy of two-way commitment is the only identified strategy which eliminates the negative impact from the factor late arrivals, no-shows and cancellations. The study indicates that the strategy of cooperative arrangement has highest impact on the utilisation as it counters several factors. The study also mapped out how the factors could be handled by compiling the relationships between the factors under investigation and the analysed strategies. This could be used as a roadmap by ship operators to increase the utilization when experiencing difficulties with any of the factors.

Keywords: capacity utilisation, liner shipping, short sea shipping, deep sea shipping, factors, strategies.

Acknowledgments

This thesis was conducted during the spring of 2020 at the division of Service management and Logistics at Chalmers University of Technology in Gothenburg. The thesis was performed within the master program Supply Chain Management. The master thesis was supervised by Violeta Roso, associate professor at the division of Service Management and Logistics. Your knowledge and encouragement have been of high importance. We would like to thank you for your support and helpfulness.

The thesis project was offered by SSPA and we are thankful for getting the opportunity to perform this thesis. The thesis was performed in cooperation with eight case companies. We are grateful for every ship operating company who took their time to meet us and share valuable knowledge to us. Without you this thesis would have not been possible to perform.

Finally, we would like to thank our supervisor at the research department at SSPA, Vendela Santén. For your immense support during the whole process, in terms of feedback, suggestions and guidance. Your knowledge and encouragement have been of high importance for the outcome of this study. We are grateful for all the things we have learned and hope you find our thesis useful.

Erik Frändberg and Raj Luhar
Gothenburg, May 2020

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1. Introduction

This section gives an introduction to the study which is done by presenting the problem under investigation and motivating the theoretical and practical relevance of the study. The purpose and the research questions are thereafter presented, which are followed by the limitations of the study.

1.1 Background

Globalisation has increased tremendously during the last decades and has been an important factor impacting the logistic service and transportation sector by changing its requirements and conditions (Kherbash & Mocan, 2015). The increased globalisation has also led to an increased share of the total transport being performed by sea (Sthyre, 2010); since 1990 global container transport has grown by 10% annually (Fruth & Teuteberg, 2017). This is supported by Kherbash and Mocan (2015), who state that sea shipping accounts for 90% of the global trade. In order to accommodate the increased demand, the ship operators have had to increase their available capacity and have achieved higher levels of containerisation. The available capacity has however increased at an increased rate compared to the demand of freight transport (Wu, 2012). This is illustrated by Statista (2020), who presents that the quantity of loaded freight increased by 84% from 2000-2018 while the available capacity of container ships increased by over 290% in the same time period. The trend is a result of industry characteristics such as economies of scale and high fixed costs which promotes companies to invest in larger vessels (Sthyre, 2009). Customer requirements for available capacity on demand and fluctuations in demand also create incentives for shipping companies to increase their available capacity which further increases the available capacity in relation to the required capacity (Sthyre, 2009). Fusillo (2003) also states that companies in the liner shipping industry have been struggling to handle excess capacity which could be the underlying reason for operational inefficiencies.

The ratio between available and required capacity is called capacity utilisation and a high value is often strived for in order to have a more efficient transport, since having a high capacity utilisation leads to lower transport costs while at the same time reducing the carbon footprint (Santèn et al., 2018). Further, Styhre (2009) also presents that by having a high capacity utilisation it makes it possible to transfer goods towards sea transportation from less environmentally friendly alternatives such as road transport which creates possibilities for companies as well as the society. As an example, society would benefit in terms of reduced road congestion in densely populated areas, this way, the infrastructure could be used to a larger extent by passenger transportation instead of freight transport (Styhre, 2009). The energy efficiency of transportation increases as the capacity utilisation increases which creates further incentives for stakeholders to improve the load factor (Santèn et al., 2018). Different stakeholders have expressed the need to improve the overall energy efficiency. The Swedish government has set a goal to have 50% more efficient energy use by 2030 (Regeringen, 2016). The shipping industry plays an important role in the reduction of energy use, where new methods and techniques are needed in order to have more efficient operations (Styhre et al., 2014). This indicates that there is interest in improving capacity utilisation for the shipping industry as it results in a more efficient energy use.

There is ample of literature concerning load factor and capacity utilisation within road transport, however, the literature concerning capacity utilisation within sea transportation is more limited. The few studies that have been done within utilisation exemplify the low degrees of load factor that are present in the current sea transport systems (Santén et al., 2018). Styhre (2009) illustrated this in a study conducted on 19 Scandinavian ferry services where the average utilisation was 42%. For vessels to achieve a break-even, a capacity utilisation around 80% is needed in terms of loaded TEU in relation to the max capacity on the vessel (Santèn et al., 2018).

1.2 Purpose and research questions

Considering the low levels of utilisation in sea shipping and the limited knowledge within the area there is a need for research that investigates issues addressed above. The purpose of this report is therefore to create a better understanding of capacity utilisation in the shipping industry and explore improvement opportunities by investigating current practices amongst ship operators within several liner segments. The report also aims to create a framework for ship operators which can be used to improve their capacity utilisation. The purpose of the report is achieved by answering the three research questions listed below.

In order to create a holistic view of utilisation, negative and positive implications of different levels of utilisation are investigated for different liner segments. Therefore, the first research question has been formulated as:

> RQ1 What is the desired level of capacity utilisation for ship operators?

Thereafter, different factors are identified and studied in order to understand how they inhibit ship operators' ability to achieve a high capacity utilisation. Therefore, the second research has been formulated as:

> RQ2 What factors affect capacity utilisation?

Improvement opportunities and strategies to increase capacity utilisation are also studied to understand how they improve capacity utilisation and impact the factors affecting utilisation. The strategies applicability amongst different liner segments is also investigated. Therefore, the third research question has been formulated as:

RQ3 How can ship operators achieve a high capacity utilisation?

1.3 Scope and limitations

The limitations are presented in order to clarify the scope of the study. The study is limited to only focus on the ship operators within the supply chain. Even though these are the actors with the most knowledge and improvement possibilities within the area, there are actions that may be taken by other actors that are not taken into account. An example is the way that the goods are packaged by the beneficiary cargo owners (BCOs) or forwarders which affects utilisation on the packaging level and affects the overall capacity utilisation on the fleet level. This limits the investigation of capacity utilisation to the vessel and fleet level.

The study investigates RoRo (roll on roll of), RoPax (roll on roll of a passenger), container and feeder ship operators. The interviewed ship operators provide liner services within the deep sea- and short sea-shipping industry with offices located in Sweden, Norway and Denmark. The results of the study and their implications are therefore limited to the liner industry.

Given the nature of the study, where all the information from the interviews are qualitative, the analysis is limited to the way that the factors affect utilisation and the ways in which the strategies can be used and in which situations they are applicable. Quantifying the degree to which factors and improvement possibilities impact utilisation has therefore not been possible.

2. Methodology

In this the methodology for the study is presented. The research strategy, process and method are firstly presented. This is followed by the data analysis and lastly the research quality and ethics parts are presented.

2.1 Research strategy

The research strategy can either be qualitative or quantitative (Bryman & Bell, 2011; Patel & Davidsson, 2011). Quantitative projects are more focused around quantitative measurements to find information such as frequency, correlation between variables with the help of statistical methods. In a qualitative study, the research contains the researchers' interpretation of the observations and interviews (Bryman & Bell, 2011; Patel & Davidsson, 2011). This study has a qualitative approach since it makes it possible to investigate and get an understanding of the desired level of capacity utilisation, what factors affect capacity utilisation and what strategies the firms are using to enhance their utilisation. A quantitative approach would not have been able to provide the underlying explanation of the collected data. The qualitative study is performed with the help of case studies with eight different companies. According to Blomkvist and Hallin (2015) when a study aims towards investigating, explaining and describing a case study is a suitable choice. This study has an explanatory nature, since interviews are conducted to understand how different actors are operating with their current operations and strategies which makes a qualitative study appropriate.

2.2 Research process

According to Dubois and Gadde (2002) the scope of the research can be changed, and therefore the process may not be linear. The research process has been iterative as different parts of the study have been continuously updated. In Figure 2.1 below the research process is illustrated. At first, theoretical research was performed to gain knowledge within the research area and establish research questions and an interview template. Thereafter interviews were performed. These stages were performed in an iterative process as can be seen in Figure 2.1, since during the interviews new concepts and strategies were mentioned. This required the frame of reference, research questions and interview questions to be updated. The collected data was later processed by transcribing and organising it. The data from the interviews was used to compile the results in the empirical findings. The findings were later used to analyse the data with the help of the acquired literature. A discussion of the findings was made where future research and implications of the study were presented.

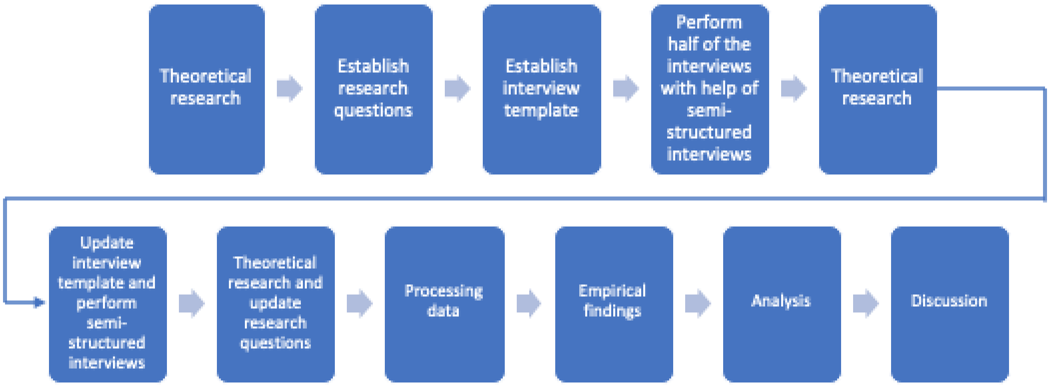

Figure 2.1 The research process for the study.

2.3 Research method

This section presents how the qualitative study has been performed with help of semi-structured interviews. The methodology for the literature study is also presented.

2.3.1 Qualitative study

The study consists of both primary and secondary data. Primary data was collected by performing face-to-face interviews, phone calls, and video interviews with eight interviewees employed at eight different shipping companies, whose offices are located in Gothenburg, Oslo and Copenhagen. Secondary data was provided by the interviewees in the form of internal documents. According to Patel and Davidsson (2011) it is important that information is acquired from various sources. This was performed by combining primary data and secondary data. Table 2.1 presents information about the interviewed actors. Several ship operators within the container segment had feeder operations. In order to get a better understanding of a specific segment and not mix the results for the segments the interviewees were asked to answer from a container point of view.

Table 2.1 Information about the interviewed ship operators.

Ship operator	Field of Work	Date	Lenght [hh:mm:ss]
RoPax1	Group Business Controller Shipping & Ferries	06/03/2020	01:17:59
RoRo1	Operations director	09/03/2020	01:17:44
Container2	Director, Area Product Management	11/03/2020	01:26:15
Container3	Director of Operations	11/03/2020	00:52:06
RoRo2	Managing Director	17/03/2020	01:11:36
RoRo3	Head of Business Development & Chartering	24/03/2020	02:38:10
Feeder1	Area Manager - Feeder & Network	26/03/2020	00:49:06
Container1	Country Manager	06/04/2020	01:03:03

According to Ritchie, Lewis, Nicholls and Ormston (2013) interviews are used as a main data collection method for case studies as they allow the researchers to ask detailed questions and follow up questions to get a deeper understanding of the situation. Interviews were an effective method for this study to gain knowledge about the interviewees' personal experience regarding general information about their operations, questions about capacity planning, factors affecting capacity utilisation and strategies to increase capacity utilisation. Hague (1998) states that semi-structured interviews give the researchers more flexibility in their interviews. Denscombe (2018) states that in semi-structured interviews the researchers have a list of topics to be addressed and questions that need to be answered. It is important to let the interviewee develop ideas and speak widely about raised issues (Denscombe, 2018). Semi-structured interviews were performed as they gave the researchers more in-depth answers and allowed them to develop their statements further.

The interviews were semi-structured with a low degree of standardisation. According to Patel and Davidsson (2011), having a low degree of standardisation allows the interviewer to change the order of the questions, have follow-up questions and add additional questions during the interview. This was useful as it allowed the researchers to get a deeper understanding of the topics under investigation. The order of the questions could change depending on if the interviewee answered the questions already or if it was appropriate to ask the question on a later stage. The structure of the questions refer to whether or not the questions has a specific answer (Patel & Davidsson, 2011). During the interviews the questions did not have specific answers that were expected from the interviewees. The first questions within the discussed topics were open in order to give the interviewees to give answers based on their own ideas and experiences. Example of the more open questions were: *what factors affect your ability to achieve high capacity utilisation?* or *how do you work to increase capacity utilisation?* More specific answers were asked thereafter in order to cover all the topics under investigation. This resulted in a mixed level of structure.

The interview questions can be seen in Appendix A, the interview was divided into the following four topics: general information about the company, general information about capacity utilisation, factors affecting capacity utilisation and strategies to increase capacity utilisation. After four interviews were performed it was discovered that there was a need to add questions to the interview form, since these questions were brought up during the interviews even though they were not in the interview form. As an example, following questions were added: *How does bad weather affect you? Is there any legislation that hinders you from loading the vessels maximally?* The other added questions are presented in the appendices. The changes in the interview template can be seen in Appendix A. The changes affected the quality of the data and some information might have been missed for the first four interviewed ship operators.

2.3.2 Literature study

The theoretical research was divided in two parts. The first part aimed towards getting a general understanding of the maritime industry and capacity utilisation. Information was acquired by searching for keywords such as: liner shipping, tramp shipping, RoRo vessels, LoLo vessels, capacity utilisation, load factor, maritime + terminology. Chalmers library database and Google Scholar was used. When basic knowledge had been obtained about the maritime industry and capacity utilisation, searches were performed to find information about: factors affecting capacity utilisation, current levels of capacity utilisation and about different strategies to achieve higher levels of utilisation. Chalmers library database and Google Scholar were used to find articles with the following keywords: capacity utilisation + maritime, capacity utilisation, vessel fleet management, vessel fleet utilisation, optimal fleet capacity, excess capacity + maritime, factors affecting capacity +maritime, increase utilisation + maritime. After performing the interviews new concepts and ideas were brought up. Therefore, an additional theoretical research was performed with the following keywords: overbooking + maritime, overbooking + overselling, slow steaming + maritime, marketing strategies, marketing strategies + sales, marketing + increase demand. These searches were performed on Google Scholar, Chalmers library database and ScienceDirect. In addition to the literature gained through the various databases, articles were obtained from the supervisors as well.

2.4 Data analysis

All interviews were recorded and transcribed by the researchers with the approval from the interviewees. Denscombe (2018) recommends researchers to transcribe interviews, since it allows for detailed searches in the collected data and simplifies the process of comparing the data. Transcription is beneficial to perform as it allows the researchers to go through the acquired data on several occasions and allows the researchers to get more acquainted with it (Denscombe, 2018). A transcription was therefore performed which also allowed the researchers to recall information from the interview on later occasions. If there were any uncertainties regarding the answer, the information could be confirmed with the transcribed document.

The information gathered in the interviews was sorted in categories which provided a basis upon which the analysis could be performed. The analysis was performed in an iterative process during the course of the project. This way, the information from the interviews was easier to recall when used in the analysis. According to Patel and Davidsson (2011), performing the analysis concurrently is appropriate in qualitative studies as it give ideas on how to proceed with the study. In order to categorise and sort the information, a table was created in Microsoft Excel where each specific ship operator was listed on one column and the questions from the interview template were listed on one row. After this, the answers from the transcribed documents were inserted next to the most appropriate question. This was done as an answer to one question could be answered several times on different occasions during the interviews. For example, while asking about how different factors affect their ability to achieve a high capacity utilisation, the interviewee could state a solution to the problems directly. Not only answering about the factors when a question regarding this was asked. All the answers to one question could be consolidated with quotes from the interviews in one cell in Microsoft Excel. Creating a table was beneficial, as it made it easier to compare information from the different companies. With help of the table it was also easier to categorise which factors the firms were affected by and what strategies they were using.

When performing the analysis, the collected data was used to explain the underlying reasons for why and how firms are affected by different factors and also to understand when certain strategies were used to counter the factors to increase capacity utilisation. The empirical data was also compared with and contrasted to the frame of reference, to see if explanation to the ship operators’ choices could be described or to see if contradictions were found between the literature and the empirical findings. Different situations in which the strategies are appropriate to use were compiled in the end by presenting the different factors that can be handled by specific strategies in order to reach the desired utilisation.

2.5 Research quality

To achieve a high degree of research quality it is important that decisions and interpretations are well motivated (Bryman & Bell, 2011). A high transparency was aimed for in the report. This was achieved by being objective and presenting the information with several quotes so that the reader could create their own understanding of the situation. According to Denscombe (2018) it is important that the researchers demonstrate accuracy and appropriateness of the data collected in order to achieve a high credibility. The author states that there is not a predefined method to ensure the project has a high credibility. Instead, several different measures can be taken to ensure the reader that the data is to a high extent appropriate for this work. To ensure that the data is accurate and appropriate for this work, the data was validated with the respondent during the interview, where the answers were clarified with the respondents to see if the answers were interpreted right.

Denscombe (2018) states that it is important that the researcher demonstrates and motivates their procedures and their decision making in the report to increase the reliability. This makes it easier for the reader to understand and provide them the opportunity to follow the researchers' decision making throughout the report (Denscombe, 2018). To ensure high degree of reliability in this report each section has been explained thoroughly where the reader can follow the researchers' thoughts and decision making. This increased the reliability in the study.

2.6 Ethics

Research should be conducted in a transparent way and research participants should be informed of the risks and what their participation entails (Ritchie et al., 2013). In order to achieve this, information regarding the project and its purpose as well as the intended outcome was transmitted to the interview objects by email before the interviews and in situ on the day of the interview. The confidentiality of the information provided by participants should also be preserved and the research participants should be kept anonymous (Ritchie et al., 2014). In the report, only information from the participants that was seen as relevant to the study is disclosed, such as the field of work in order to strengthen the validity of their statements. The name of the participants or the companies at which they work is however not disclosed in order to keep their anonymity. The participants were also asked before the interview not to disclose any sensitive information. Information gathered from the interviews such as transcriptions and audio files that could link the interviewee to the information were stored in locations to which only the researchers had access to.

3. Frame of reference

The following section covers concepts and theories that have been developed by researchers in the field of shipping and capacity utilisation. The different concepts are defined and presented in order to build a basis upon which the research questions can be analysed and discussed. The first subsection presents general information about the shipping industry. This is followed up by a section defining capacity utilisation for sea shipping. The following section covers factors that inhibit or facilitate ship operators' ability to achieve a high capacity utilisation. Thereafter, how ship operators can plan their desired level of capacity utilisation is presented. Lastly, strategies that can be used to increase capacity utilisation are presented.

3.1 Description of shipping terms

In this section, terms used within the maritime industry are described. The following terms are defined: deep sea and short sea shipping, liner and tramp shipping, RoRo (roll on roll of) and LoLo (lift on lift off).

3.1.1 Deep sea and short sea shipping

In the shipping industry there are two definitions used to describe what type of distance the ship is transporting goods: deep sea shipping and short sea shipping (Europa, n.d.-a). Deep sea shipping is defined as shipping goods on intercontinental routes (Europa, n.d.-b). Deep sea shipping therefore covers long distances and normally uses larger vessels, and it is most often transporting commodities (Eurosender, 2016). Short sea shipping is referred to as moving cargo and passengers by sea on short distances (ESCA, 2016). Short sea shipping includes transportation which is performed both domestically and internationally, but also along coast and to/from island with the help of feeder services (ESCA, 2016). As many large containerships can only dock at specific high-volume ports, feeder services are required to transport the cargo to the final destination (Ridolfi, 1999). This is done using feeder services which carry cargo from the larger hub-ports to the local spoke ports (MSC, n.d.).

3.1.2 Liner and tramp shipping

The maritime sector has mainly two types of transportation services: tramp shipping and liner shipping. Tramp shipping is described as offering a service with unscheduled transportation as it operates with cargo which has an irregular and unpredictable demand (Bermig & Ritter, 2008). Liner shipping is defined as a service where a vessel or a fleet of vessels operates regularly between predefined ports. In a liner service, timetables and prices have been announced in advance and the vessels sail whether they have been filled or not (Haralambides, 2007; Haralambides, 2004; Tran & Haasis, 2015). The norm is that the service is available to everyone (Haralambides, 2007; Haralambides, 2004; Tran & Haasis, 2015).

According to Zheng, Gao, Yang and Sun (2015) liner shippers may choose to sign a long-term shipment contract or a short-term shipment contract with the customers. The long-term contracts result in a fixed demand for a specific time period as the contract states the estimated volumes that the shippers expect to ship for that period of time (Zheng et al., 2015). Shippers with short-term contracts may however switch ship operators if the service is not satisfactory. The long-term contracts are therefore seen as fixed demand whereas the short-term contracts are seen as variable (Zheng et al., 2015).

3.1.3 RoRo and LoLo

Liner shipping can be divided into two different segments: RoRo (roll on roll off) and LoLo (lift on lift off). The division is based on how the goods are loaded and unloaded. According to Styhre (2010) RoRo vessels transport only cargo that can roll on to the deck such as train wagons, trailers, cars. The RoPax vessel is a type of RoRo vessel which can handle passenger accommodation as well. RoRo vessels do not need cranes for handling the cargo. They also have a shorter turnaround time at the port compared to LoLo ships and are mainly used for short sea shipping (Styhre, 2010). As a result, the RoRo segment is mainly competing against road and rail modes. Benefits such as reducing road congestion and environmental impact have made it a more popular option (Styhre, 2010). LoLo ships include vessels such as deep-sea container- and feeder vessels. The benefit of using LoLo ships is that the unit cost for carrying the transport is low (Styhre, 2010).

3.2 Capacity utilisation in the maritime industry

Capacity utilisation is a measurement that describes transportation efficiency by indicating the degree to which a vehicle or vessel is loaded with goods (Santèn et al., 2018). Capacity utilisation of a vehicle or a fleet of vehicles can be measured using the load factor model developed by Santén (2016). Load factor is defined as *"the ratio of the load carried (required capacity) to the maximum load that could have been carried (available capacity)"* (Santén, 2016, p. 3). The load factor can be measured at several levels such as the packaging level, shipping level, vehicle level and fleet level (Santén, 2016). The capacity utilisation is therefore a result of the load factor at these levels as can be seen in Figure 3.1. The overall load factor can be calculated by comparing the required capacity at the lowest packaging level with the available capacity at the fleet level. A high capacity utilisation is therefore achieved by having a close balance between available capacity and required capacity at every level. Santén (2016) exemplifies this by stating that all the floor space can be covered with pallets even though these may be empty, resulting in a low overall load factor. As the goods have several characteristics that may limit the carrying capacity of a vehicle or ship such as weight, volume or floor space, there are several ways to measure the load factor (Santén, 2016). Measuring one dimension may therefore not provide a realistic picture of the used capacity as other factors may impede further loading of the vehicle (Santén, 2016; Santén & Rogersson, 2018).

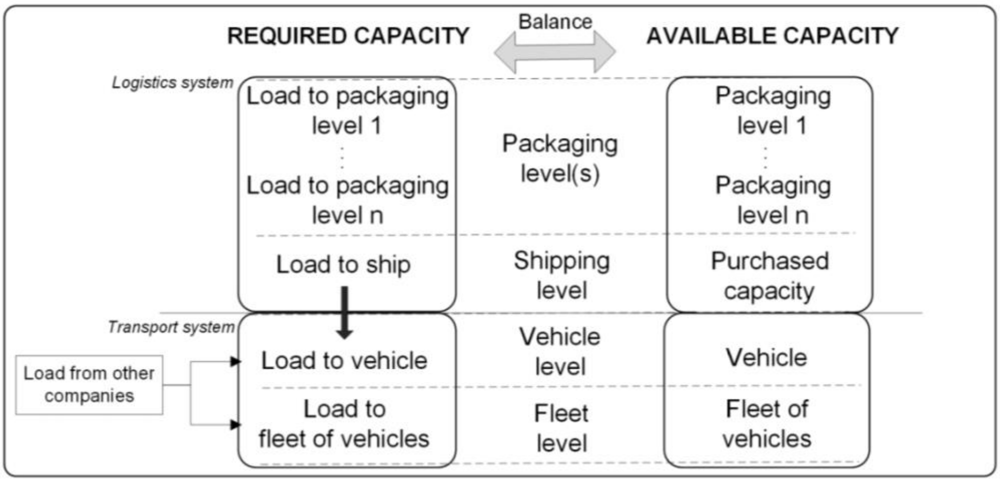

Figure 3.1 The load factor model (Santén, 2016)

Santén et al. (2018) have adjusted the model to fit container shipping and identified the relevant load factor levels for the vessels. Figure 3.2. presents the total load factor is composed of the container level, vessel level and the fleet level. According to Wu (2009) the most common way to measure the available capacity at the container level is slots capacity installed, measured in Twenty Equivalent Unit (TEU). Styhre (2010) states that the most common method for measuring the capacity in RoRo vessels is maximum available lane meters. The capacity utilisation RoRo vessels therefore becomes the ratio between used lane meters and maximum available lane meters (Styhre, 2010).

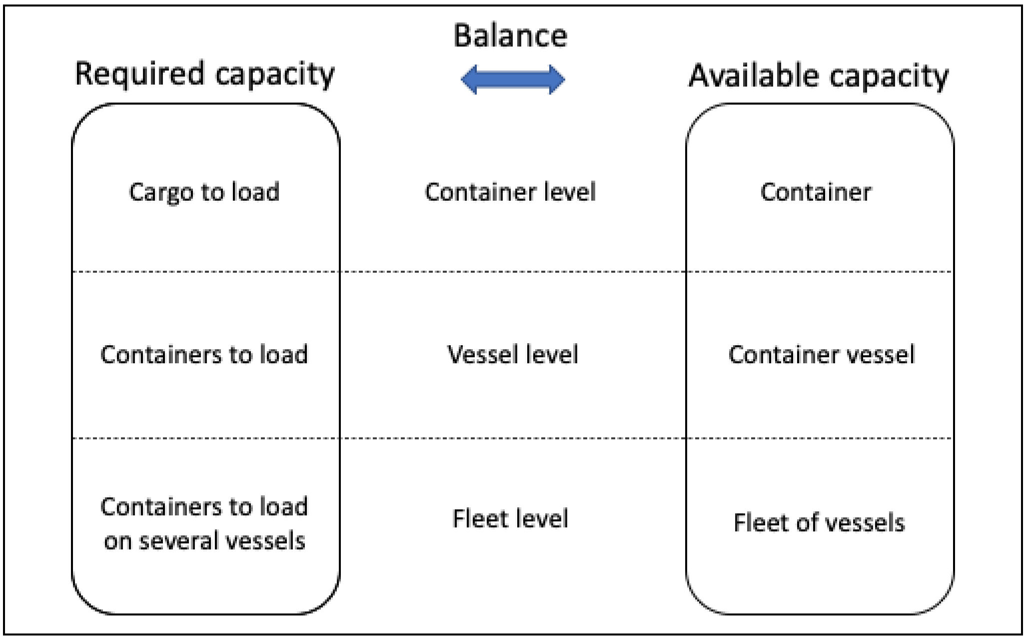

Figure 3.2 The load factor model adopted to container shipping (Santén et al., 2018).

3.3 Factors affecting capacity utilisation

This section presents factors which hinder or facilitate companies' ability to achieve a high level of capacity utilisation. These factors have in turn been categorised into the following areas: market conditions, market structure, market requirements and internal company factors, which is illustrated in Figure 3.3 below.

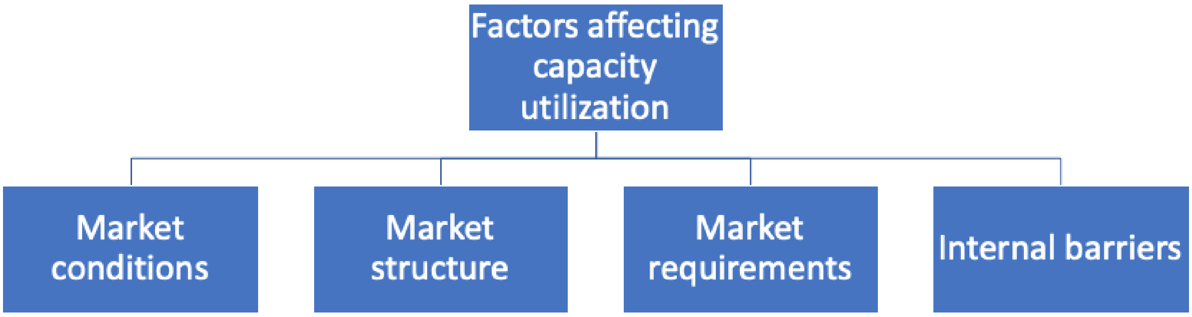

Figure 3.3 Illustration of the categorisation of factors which affect capacity utilisation.

3.3.1 Market conditions

The shipping industry is characterised by having a fixed supply while demand is variable which creates a challenge for ship operators when coping with changes in demand (Fusillo, 2004). When demand varies ship operators are not able to match their capacity with customers' demand at all times. This creates the effect of having excess capacity on the vessels (Fusillo, 2003). This gives rise to core emptiness, which is defined as a mismatch between supply and demand (Fusillo, 2003). The liner shipping segment is especially vulnerable when demand decreases as their schedules are fixed (Fusillo, 2003; Haralambides, 2004). Ship operators cannot delay their departures to wait for more goods to utilise the vessel better or cancel scheduled departures (Fusillo, 2003). This forces them to depart with a low capacity utilisation as they are not able to vary their supply on a short-term perspective (Fusillo, 2003). The market conditions such as the available cargo to transport, trade imbalances and seasonal variations in demand affect the capacity utilisation. (Styhre, 2010; Wu, 2012).

Fusillo (2004) mentions during periods of having low demand it can be more economical to operate the vessels with low utilisation rather than having the departures cancelled, which can be one of the reasons why carriers tend to operate with a lower capacity utilisation than normal. This is also supported by Styhre and Lumsden (2007) who mention that from an economical point of view it can be better to operate with extremely low capacity utilisation rather than withdrawing capacity. In the manufacturing industry when demand is lowered it is common to sell equipment to reduce the fixed cost (Davies, 1983). However, in the shipping industry this is not as viable. The reason for this is that if the vessel is sold, the shipping company cannot longer offer a service with a high frequency (Davies, 1983).

3.3.1.1 Seasonal variation

Seasonal variation is a factor that affects capacity utilisation (Fusillo, 2003). Fusillo (2003) observed that in the Eastbound Trans-pacific area between 1993 and 2003 the inability to meet the variation gave rise to excess capacity (Fusillo, 2004). Styhre and Lumsden (2007) state that in order to cover peaks in demand during the summer, ship operators need to set a capacity that is able to cover the demand. As a result, when demand is lower, excess capacity arises which results in a lower capacity utilisation (Styhre & Lumsden, 2007). The shipping industry is highly affected by customers in the trading and manufacturing sector (Styhre, 2010). Customers affect ship operators' ability to utilise the capacity at a high level, since vacations, production breakdowns and other incidents create fluctuation and instability in demand. Other sectors have as a result a great impact on ship operators and their capacity utilisation (Styhre, 2010).

3.3.1.2 Trade imbalances

Styhre and Lumsden (2007) state that trade imbalances are a factor that negatively affects capacity utilisation for ship operators. Differences between export and import numbers are difficult to handle since they are influenced by internal trade patterns which affects the capacity utilisation (Styhre and Lumsden, 2007). Ting and Tzeng (2004) mention that there are large imbalances in the container shipping industry, especially in Asia, Europe and in the transpacific trades. The trade imbalances also create an uneven flow of containers in different directions which creates a need for liner ship operators to transport empty containers in some directions, as containers need to be available where transportation is needed (Ting & Tzeng, 2004). Haralambides (2007) points out that the empty positioning of containers is one of the main cost drivers for liner carriers. According to Ting and Tzeng (2004) the empty positioning reduces the capacity utilisation of the ships as they need to be filled with empty containers that need to be repositioned.

3.3.2 Market structure

According to Porter (1981) there is a relationship between the structural characteristics of a market and the way that companies behave in the market. Porter (1981) states that the way that companies behave given the structural characteristics in turn affects the performance of the companies in the market. The company structure refers to the context in which companies in the industry compete (Porter, 1981). Examples in the shipping industry are entry barriers, industry concentration and economies of scale (Yip, Lun & Lau, 2012). The market structure affects the company's conduct, which refers to the company's strategic choices regarding key decisions such as price and capacity and how they interact with other companies in the market (Yip et al., 2012). Figure 3.4 presents the relationship between the structure, conduct and performance.

Figure 3.4 The relationship between industry structure, conduct and performance (Porter, 1981).

3.3.2.1 Cost structure

The liner shipping industry is to some extent similar to a public transport service as it provides a service to its customers to ship goods on a regular basis between specific ports according to predefined timetables (Haralambides, 2004). Providing this service requires companies to perform large investments in infrastructure such as a fleet of vessels, equipment and cargo handling facilities (Davies, 1983; Haralambides, 2004). Davies (1983) states that when the schedule is determined, costs which would otherwise have been seen as variable in other industries are seen as fixed. Examples of this are crew wages, maintenance and repair since they cannot be changed in the short run and do not vary with volume carried. Haralambides (2004) states that the only variable costs are terminal handling charges for loading and unloading operations.

The cost structure results in a majority of the costs being fixed, even though the relationship between fixed and variable costs depends on the capacity utilisation (Davies, 1983). A higher capacity utilisation results in a larger portion of the total costs being variable costs as the terminal handling charges increase but the fixed costs are the same (Davies, 1983). As a result, the average fixed costs decrease as the capacity increases. The average variable costs are on the other hand constant until the capacity utilisation reaches around 90%, where diseconomies of scale result in higher variable costs per unit (Davies, 1983). According to Styre (2010) the diseconomies of scale are a result of increased turnaround time in the port and administrative expenses. The variable and fixed costs result in the figure 3.5 below, illustrating the average total cost and short run marginal costs (Styhre, 2010). The marginal costs are defined as the additional cost of carrying another trailer or container and is equal to the short run average cost (Styhre, 2010). Figure 3.5 indicates that the cost structure in the shipping industry results in a low marginal cost if the ship does not have a high capacity utilisation, meaning that there are large economic incentives to increase the capacity utilisation. If the transported amount of goods increases above a certain limit, the short run marginal cost increases significantly which reduces the shipping operator’s willingness to increase the capacity utilisation even further.

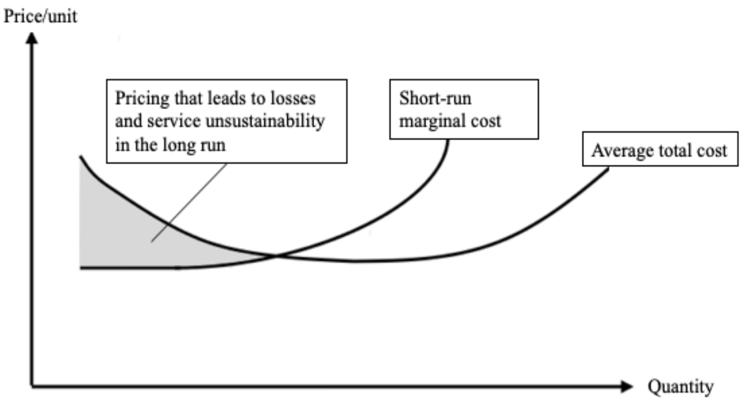

Figure 3.5 The short-run marginal cost and the average total cost in the shipping industry (Styhre, 2010).

The cost structure of shipping has implications for ship operators to incentives to adjust their freight rates, as well as the interaction with other ship operators (Fusillo, 2004). Haralambides (2007) argues that if a customer wants to make a shipment, the ship operator is willing to transport it at a price just above the short run marginal cost, since the expenses for carrying it are covered on a short-term perspective. This drives freight rates to the short run marginal cost under perfect competition. If companies aimed for this pricing strategy, the market would go towards destructive competition. Haralambides (2007) states that ship operators would not be able to cover their long run-average cost since capital costs such as repair of vessels and equipment costs would not be covered. This would make the market unsustainable in the long run (Haralambides, 2007).

3.3.2.2 Lumpy capital

As demand grows over time, liner companies need to increase their available capacity (Fussilo, 2003). The capacity investments are lumpy as they involve large capital investments. As a result, companies tend to increase their capacity in discrete units at specific intervals. When choosing the adequate capacity to invest in, firms often adjust the capacity increment to the market requirements without taking into consideration other actors on the market (Fussilo, 2003). As several firms disregard each other, the industry will face a situation with excess capacity resulting in a lower capacity utilisation. As the cost of increasing capacity is lower the higher capacity increment, companies may opt to increase their capacity in bigger steps at less frequent intervals which further increases the excess capacity (Fussilo, 2003).

3.3.2.3 Economies of scale

Tran and Haasis (2015) state that there is a trend among ship operators to acquire larger vessels in order to achieve economies of scale. Styhre (2010) points out this trend has not only been seen for ocean shipping but also for short- and medium-distances. According to Cullinane and Khanna (2000) the unit cost decreases as the size of the ship increases, meaning that economies of scale can be achieved by employing larger vessels. Cullinane and Khanna (2000) describe the main reasons for this being that the larger vessels allow ship operators to carry larger volumes of goods on the ships. The marginal savings achieved by acquiring larger vessels diminishes as the ships become larger due to diseconomies of scale in port operations (Cullinane & Khanna, 2000). Midoro, Musso and Parola (2005) found that an 8 000 TEU super post-Panamax vessel spent 24 % of its overall time in ports compared to a 4 000 TEU Panamax vessel which only spent 17% of its time in ports. This is a result of the increased call size, meaning the number of containers that need to be handled in the port (Midoro et al., 2005). Cullinane and Khanna (2000) also state that the economic benefits are higher if the routes are longer, since the ships spend more time at sea reaping economies of scale and less time at port where there are diseconomies of scale. Besides providing a lower unit cost, larger vessels can operate at a faster speed which allows the ship operators to provide their customers with a better service. The economic benefits provided by larger ships provide a short-term competitive advantage which creates incentives for ship operators to invest in larger vessels if the benefits exceed the negative implications (Cullinane & Khanna, 2000). According to Styhre (2010) companies are only able to reap the economic benefits of large ships if they are loaded to a high degree. A service with smaller ships is able to have more frequent departures (Styhre, 2010). As a result, there is a trade-off between economies of scale and frequency.

The economic benefits of the increased ship sizes have resulted in the employment of large ships in the major trade routes by ship operators (Wu, 2009). This has resulted in that the available capacity has increased at a greater pace than the required capacity, which therefore has increased the risk of having excess capacity on the vessels. Wu (2009) states that the competition amongst the ship operators to deliver low freight rates and larger ships has therefore resulted in a deterioration of the load factor and therefore a lower capacity utilisation.

3.3.2.4 Cooperative arrangements

In order to avoid destructive competition ship operators have been part of collusive arrangements called conferences (Fussilo, 2004). Within the conferences fixed prices are set on a specific route that are above the long-run average cost and therefore also sustainable from a long-term perspective (Fussilo, 2004). Discussions agreements have been found as a substitute to conferences in several trade routes (Fussilo, 2004). The discussion agreements benchmark prices for different routes but does not oblige a ship operator to have a predetermined rate for their services, as opposed to conferences. Until 2008, the liner shipping industry was exempted from complying with European Union regulations that inhibited actors in a market to fix prices and exchange information that would reduce the competition on the market (Bermig & Ritter, 2008). New laws were established in 2008 by the European commission which removed the exemption, making it illegal for ship operators to fix prices (Bermig & Ritter, 2008). This has resulted in conferences being illegal for all the routes that include a port stop in the European Union (Europa, 2008).

Wu (2012) states that the capacity utilisation amongst shipping lines has increased since 1998. The author states that this is partly a result of the OSRA (Ocean Shipping Reform Act), which was implemented in 1998 and has encouraged ship operators to take part of and create shipping alliances. Shipping alliances are described as *"formal agreements among carriers operating on global routes to share equipment including vessels and portside infrastructure"* (Fussilo 2004, p. 223). Taking part in alliances allows companies to offer their customers an increased service frequency (Panayides and Cullinane, 2002). It also alleviates the issue of fixed capacity for the alliance members as they are able to allocate capacity without investing in new vessels or chartering vessels (Fusillo 2004; Cariou 2008). Panayides and Cullinane (2002) state that this can be done by having slot sharing agreements. Fussilo (2004) states that carriers may also coordinate their sailing schedules. By having more flexible capacity and coordinated sailing schedules amongst members of the alliance, carriers are able respond to changes in demand more effectively and therefore increase their capacity utilisation (Wu, 2012).

Being part of an alliance also reduces the financial risk for the alliance members when investments in new vessels are made together (Fussilo, 2004). Investing in newer and larger vessels with members of the alliance therefore allows carriers to share the investment cost and achieve a lower cost per slot by reaping economies of scale (Midoro et al., 2005). This allows them to deploy larger and more efficient vessels on the major trade-routes. Styhre (2010) states that the creation of formal alliances with formal agreements amongst the members of the alliance also reduces destructive competition as the prices are not pushed towards marginal costs. A drawback may however be that it can be difficult to coordinate the different partners in the alliance (Cariou, 2008). Panayides and Cullinane (2002) state that taking part of an alliance may also give rise to difficulties as the organisations may have individual objectives that may affect the cooperation among the partners.

3.3.2.5 Market concentration and vertical integration

Fussilo (2003) states that the shipping industry has several characteristics that are representative of industries that go towards a monopoly. Examples are economies of scale and having an increased number of firms producing a certain output reduces the cost effectiveness (Fussilo, 2003). This can be seen in the shipping industry as the number of ship operators in the industry has been decreasing the last decade (Santèn et al. 2018). Midoro et al. (2005) state that there is a trend of firms integrating horizontally in the shipping industry over the past decades as companies acquire each other through mergers and acquisitions. According to Yip et al. (2012) this has been performed in order to achieve a larger market share and establish a more competitive position against other actors in the market. As a result, the concentration ratio of the shipping industry has increased considerably (Midoro et al., 2005). According to Luo and Kou (2015) total carrying capacity is used to calculate the market share of companies in the shipping industry. Between 1996 and 2006, the market share of the 20 biggest carriers increased from 39 % to 62 % in terms of slot carrying capacity (Midoro et al., 2005).

According to Midoro et al. (2005) fewer ports are able to cope with the increased requirements of the larger vessels. This has increased the contractual strength of stevedores which in turn has increased the stevedoring costs for ship operators (Midoro et al., 2005). The increased vessel sizes have also resulted in increased time at port and increased transhipment costs. In order to achieve a higher control over the stevedoring costs and increase the schedule reliability, ship operators have started to integrate vertically and control terminals (Midoro et al., 2005). Panayides and Cullinane (2002) state that container liner companies are also diversifying their activities by offering inland transportation and providing their customers with a door to door service. According to Panayides and Cullinane (2002) this is a result of lower freight rates, competition for market share and customer requirements. Due to increased vessel sizes, the sea leg represents a low part of the total cost of transportation, which motivates container shipping lines to offer a wider variety of logistical services (Panayides & Cullinane, 2002). Integrating vertically allows companies to achieve larger market shares, increased coordination and increased routing flexibility (Panayides & Cullinane, 2002).

3.3.2.6 Entry deterrence

Ship operators may leave excess capacity on their vessels on purpose as a strategic motive (Fusillo, 2003). The reason for this is that when a competitor is entering the same segment or making a market expansion, the company can then reduce their prices with help of the excess capacity to deter them from entering the market and keep their market share (Fusillo, 2003; Wu 2009). Therefore, it is important to have a buffer of excess capacity for these situations (Fusillo, 2003; Styhre & Lumsden 2007). Having larger ships allows ship operators to not reject customer, which can give them an advantage over their rivals. This may involve higher costs, however it does not imply that it is an unprofitable option. The excess capacity is only beneficial until the incremental costs of operating with excess capacity exceeds the incremental benefits (Styhre & Lumsden, 2007). Cullinane and Khanna (2000) state that economies of scale allow ship operators to achieve excess capacity at a low unit cost, which provides an advantage to larger ship operators.

3.3.3 Market requirements

This section presents how market requirements such as: service levels and frequency affect ship operators utilisation level on their vessels.

3.3.3.1 Service level

According to Styhre (2009) service level is an important factor which plays a significant role for the capacity utilisation. From a short run perspective, it is beneficial to have a high capacity utilisation, since it increases the revenues (Styhre, 2010). However, operating with levels close to 100% capacity utilisation might in the long run not be beneficial for the shipping companies, as it provides competitors opportunities to take market shares on the trade. When operating with a lower capacity utilisation, companies are able to provide a high service level for existing customers but are also able to find new customers (Styhre, 2010). Styhre (2009) mentions that having a strategy with a utilisation above 90% can lead to dissatisfied customers since they might have to reject customers when there are peaks in demand. Davies (1983) also points out that operating at capacity utilisation levels close to 100% is not practical, since this can have a negative impact on the customer relationships. This is partly a result of the loading operations, as all goods may not be loaded before departure if utilisation is too high. If this happens several times it may have a negative impact on their relationship and give their competitors the possibility to increase their market share (Davies, 1983). Therefore, it is important to have excess capacity on the vessels (Davies, 1983). The excess capacity can be seen as an intangible asset, as it allows the ship operators to serve their customers better (Davies, 1983).

3.3.3.2 Frequency

According to Styhre (2010) liner services which had a higher departure frequency had a lower capacity utilisation compared to services which had lower frequency. Five routes were identified with a high frequency of more than 100 departures per week which on average had a capacity utilisation of 34% on the vessels. The low utilisation was a result of the high frequency. Increasing the frequency however increases the total amount of goods that are shipped during a year (Styhre, 2010). By providing a service with a high frequency and at the same time a low utilisation rate, customers are not obliged to plan their transportation on forefront and book slots in advance on the vessels. This has led to the customer having different requirements on these routes since they are expecting the high frequency with almost available space for every departure (Styhre, 2010).

3.3.4 Internal barriers

According to Styhre (2010) there are internal factors within the company's management that affect the extent to which a high capacity utilisation can be achieved on the vessels. Within the company it is important that different functions and departments are communicating with each other, and at the same time use the internal resources by combining knowledge from the management side and from the employees on the vessel (Styhre, 2010). This makes it easier for the company to create a holistic view and work to achieve a higher capacity utilisation (Styhre, 2010). Christiansen and Fagerholt (2004) present three different levels of planning for the liner shipping segment. In the strategic planning optimal routes and schedules are established. In the tactical planning the vessels are assigned to their schedules. Lastly, in the operational planning, decisions regarding if cargo being accepted from customers is performed. Working cross functionally and communicating between these different levels can have a better impact on the capacity utilisation on the vessels (Styhre, 2010).

3.4 Capacity planning

The desired level of capacity and capacity utilisation varies between different ship operators. From a short-term economic point of view there are benefits of trying to achieve a capacity utilisation of close to 100% due to economies of scale and low marginal costs. However, there are several factors that affect companies' willingness and ability to constantly have 100% utilisation which was presented in the previous sections. One example is service level, which is reduced as capacity utilisation is maximised (Styhre, 2010). This incentivises competitors to enter the market or to increase their market shares (Davies, 1983). Styhre (2010) states that having extra capacity available allows ship operators to ship the goods without delays, which is important for companies working on a just-in-time basis. Styhre (2010) states that market share and competitive situation also affect the companies' willingness to operate at full capacity. High levels of competition create incentives for companies to operate at full capacity whereas companies operating in markets with low competition often have lower levels of capacity utilisation (Styhre, 2010).

Styhre (2010) has identified two strategies that companies can adopt when deciding upon appropriate levels of capacity utilisation. Figure 3.6 illustrates the first strategy, the cut peaks strategy which cuts the peaks in the demand variations to achieve a high capacity utilisation. This strategy utilises current vessel capacity to a high degree but results in missed opportunities for the company when the demand increases above the maximum carrying capacity. This may result in loss of market share if the market is growing. The strategy can be achieved by having a low maximum capacity or by increasing the market share. This strategy is suitable when there is a high variation in demand and high trade imbalances, when a market is highly competitive and has low levels of growth, and when customers can choose other options and there are low freight rates.

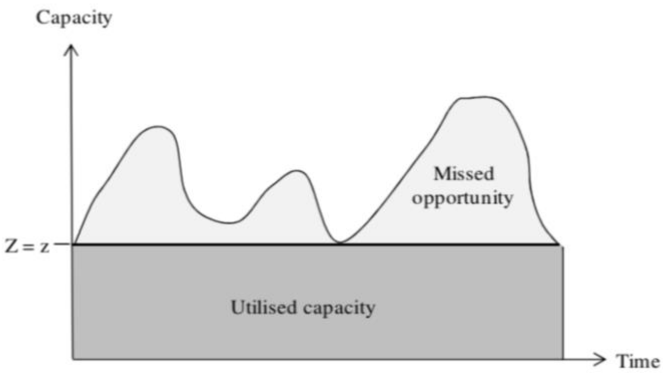

Figure 3.6 The cut peaks strategy, where Z is the maximum capacity and z is the average utilised capacity. The maximum capacity Z and the average utilised capacity z coincides when the capacity utilisation on the vessel is 100%.

Figure 3.7 presents the second strategy, the never say no strategy, in which companies establish a maximum capacity that is able to cope with the maximum peaks in demand

(Styhre, 2010). The strategy results in a low average vessel capacity utilisation as there is always available space on the vessel for more cargo. The strategy provides a high level of flexibility, service and reliability as there is always space available on the vessel. This capacity utilisation strategy is suitable in situations where there is time sensitive cargo, customers with long-time relationships, growing markets and situations in which there are assignments on the spot-market with high freight rates (Styhre, 2010).

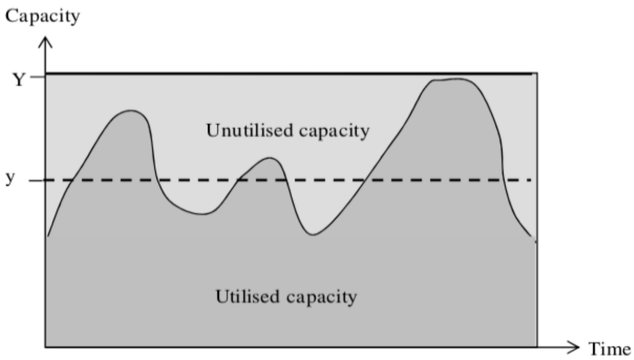

Figure 3.7 The never say no strategy. Y is defined as the maximum capacity and y is defined as the average utilised capacity (Styhre, 2010)

Fussilo (2003) states that companies choose to have excess capacity if the cost of missing transport assignments is higher than the cost of carrying excess capacity. According to Styhre (2010) the cut peaks strategy and the never say no strategy should be seen as extremes and a balance between both should be opted for based on the company's specific circumstances. The strategy results in the ship operator not being able to cope with the highest peaks of demand while having excess capacity when demand is low. Figure 3.8 below illustrates the mixed strategy.

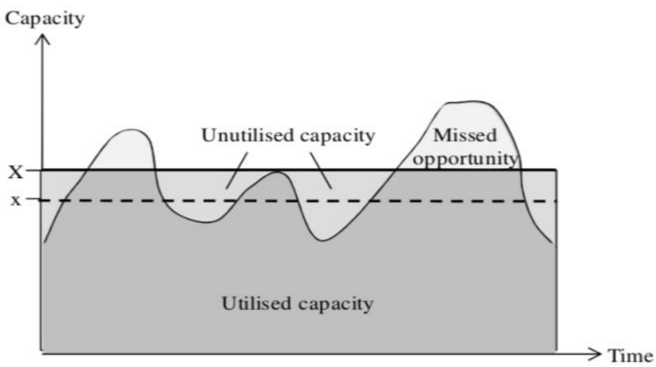

Figure 3.8 A combination of the cut peaks strategy and the never say no strategy, which allows some peaks to be cut but keeps unutilised capacity for the rest of the time. X is defined as the maximum capacity and x is defined as the average utilised capacity (Styhre, 2010).

3.5 Strategies to increase capacity utilisation

This section presents different strategies that aim towards increasing the capacity utilisation.

3.5.1 Pricing strategy

According to Styhre (2010) using price differentiation allows ship operators to increase capacity utilisation. The author states that some customers are more prone to change supplier if prices increase. By adjusting the rates to the specific customers, ship operators are able to keep their customers and increase utilisation. Price differentiation may therefore be used in situations where ship operators can charge their customers with different prices. Having knowledge of the prices that ship operators can charge their customers and their price elasticity allows ship operators to use price differentiation. Price elasticity is defined as the change in demand caused by a change in price. A high price elasticity results in a big change in demand if prices are changed (Pass, Lowes & Davies, 2000; Styhre, 2010).

Figure 3.9 illustrates the price per unit for different customers and services (Styhre, 2010). Most of the customers are found in group B and C. These customer groups have a low elasticity of demand and provide stable volumes to ship operators. The low-price elasticity means that the customers are not price sensitive and volumes do not decrease if prices change (Pass et al., 2000; Styhre, 2010). The freight rates are therefore stable for these customer groups. Group B are highly important customers as they have freight rates over the long run average cost (LRAC). When there is space which is not utilised on the ships, customers in group D should be targeted. However, this should be limited as the freight rates are just above the marginal costs which is not sustainable from a long-term perspective. Customers who are in Group A have a low-price elasticity of demand and are important, as higher freight rates can be charged to these customers (Hummels, Lugovskyy & Skiba, 2009). These are normally customers with high value cargo such as project cargo (Styhre, 2010; Hummels et al., 2009)

According to Styhre (2010) an increased number of competitors reduces the freight rates and the applicability of price discrimination. Alternative transportation modes such as rail or air-based transportation increases the elasticity of demand as customers are prone to use other alternatives if prices increase (Styhre, 2010). Lam, Yap and Cullinane (2007) state that a company's market power determines the degree to which it can use different pricing policies such as price discrimination. Market power is defined as *"a company's ability to set prices above the marginal costs"* (Lam et al., 2007, p. 361). Lam et al., (2007) state that market power can be exercised by having barriers to entry.

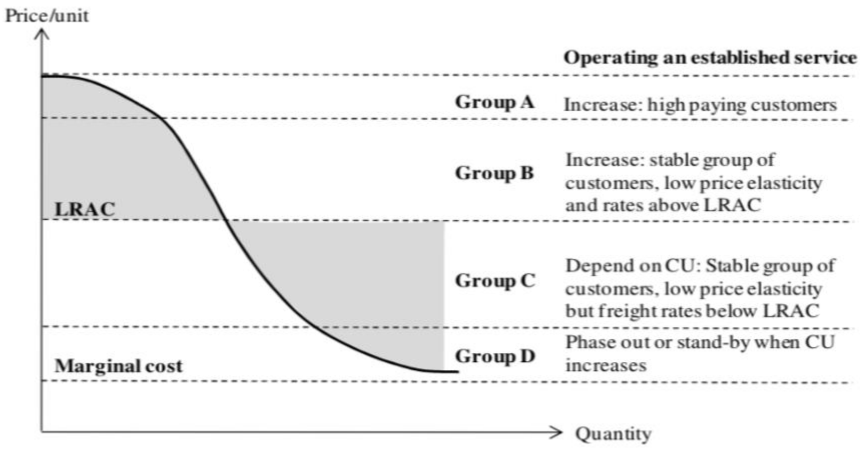

Figure 3.9 Price differentiation which can be used to increase capacity utilisation when operating in an established service (Styhre, 2010).

Styhre (2010) states that imbalances in the physical volume that is transported in both directions can also be handled with the pricing mechanism. This is done by setting lower rates on the direction that has a lower demand. This does however require companies to increase the freight rates on the high demand leg as profits would deteriorate otherwise (Styhre, 2010).

3.5.2 Marketing

Increasing demand for ship operators own service is a way to increase capacity utilisation (Styhre, 2010). Marketing products and services is an effective way to increase the demand for a company's products (Czinkota & Ronkainen, 2006). When using marketing to market a company's services it is important that the communication is effective and efficient. Having efficient communication allows companies to inform customers about what service is available and convince them to not opt for competitors offering (Czinkota & Ronkainen, 2006). It is also important to work with awareness, since this is the first step when finding new customers. However, the awareness is also important to remind potential customers about the existence of the offered service (Feltenstein, 2010). An example of a way that marketing can be used to increase demand on a service is to use sales promotions, which can be short-term incentives with premiums and discounts to stimulate customers' purchases (Zeithaml, Bitner & Gremler, 2009).

3.5.3 Rescheduling standby cargo

To improve capacity utilisation, shipped cargo can be evened out through several departures in order to be able to handle variations in demand (Rogerson and Santén, 2017; Jonsson 2008; Styhre, 2010). This allows ship operators to provide more space on the attractive departures for new customers or new cargo, since other cargo is being shifted to other departures (Styhre, 2010). As an example, if a Monday departure has a high utilisation while the Wednesday departure has low utilisation, some of the cargo from the Monday departure can be moved to the Wednesday departure (Jonsson 2008;

Styhre, 2010; Rogerson and Santén, 2017). This increases the overall utilisation of the vessels, which can be seen in Figure 3.10 below (Styhre, 2010). According to Styhre (2010) this is easier to perform with base cargo which has lower rates for transportation. Base cargo is mainly cargo from loyal customers who can accept movement of goods and get compensation for this, i.e. lower prices. However, this may not be suitable with cargo that is time sensitive.

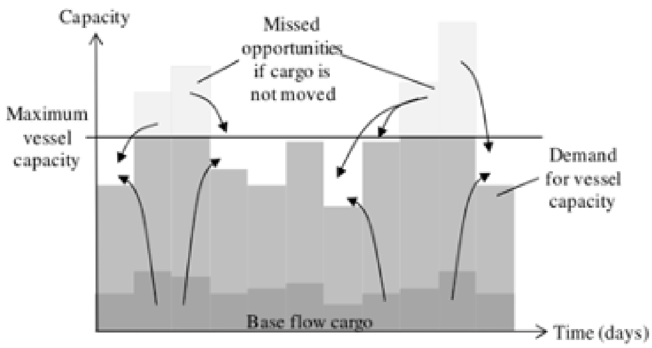

Figure 3.10 Illustration of how cargo can be rescheduled to another departure in order to increase capacity utilisation (Styhre, 2010)

3.5.4 Adjusting capacity

Capacity utilisation can be increased by increasing capacity in more frequent and smaller steps as illustrated by Figure 3.11 down below (Styhre, 2010). Three strategies can be used to adjust the capacity, the first one is to change the capacity within the existing fleet, the second one is to increase the vessel capacity by smaller steps, the third option is to invest in new vessels (Styhre, 2010).

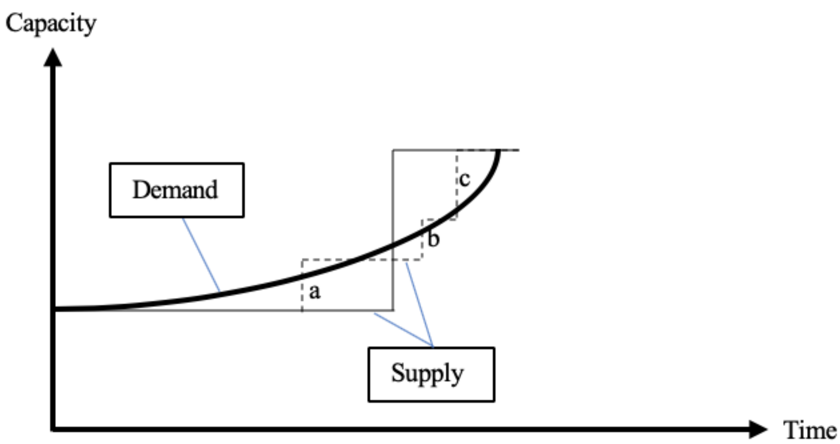

Figure 3.11 Increasing capacity in smaller and more frequent steps in order to increase capacity utilisation (Styhre, 2010).

An example of how a ship operator may change capacity within the existing fleet is to shift vessels between the different routes when there is a change in the demand, but also to work with the network of the routes instead of focusing on one individual route

(Styhre, 2010). Having flexibility in the capacity management is therefore important since utilisation may be increased without high investment costs (Styhre, 2010). If the current fleet cannot fulfil the need of the capacity, the ship operator can increase capacity in smaller steps before a new large vessel is acquired. This can be achieved by chartering vessels for a shorter time period (Cariou, 2008). Cariou (2008) mentions that this is standard practice as it allows ship operators to have more flexibility where they can increase or decrease capacity fast, without having the need of making larger investments. If the ship operators see a trend of increased cargo in the market, they invest in new vessels to expand their capacity from a long-term perspective (Styhre & Lumsden, 2007). This increases the level of unutilised capacity and excess capacity for a shorter time, however, if a recession comes, the levels will stay low for a longer time (Styhre, 2010). Another characteristic in the shipping industry to increase their available capacity in the network is by mergers and acquisition, however this is a more costly option (Cariou, 2008).

3.5.5 Strategic alliances

According to Cruijssen, Dullaert and Fleuren (2007) horizontal cooperation can be performed with competing companies where win-win situations can be identified to increase the performance in their supply chain. As explained by Wu (2012) strategic shipping alliances may help ship operators to increase their capacity utilisation on their vessels. An alliance makes it easier for ship operators to allocate their capacity on vessels without having additional vessels through chartering or purchasing (Fusillo 2004; Cariou 2008). According to Wu (2012), ship operators can coordinate their services within the alliance and achieve increased flexibility in their capacity. This increases the flexibility for the actors involved as they can react to changes in demand more efficiently. This can in turn help ship operators to increase their capacity utilisation on the vessels (Wu, 2012). When operating on the same routes with similar schedules of departure, two or more actors can create a strategic alliance by having slot sharing agreements (Panavides & Wiedmer, 2011). This means that the competitors have a fixed percentage of capacity on each other's vessels. Being part of an alliance does however not include having joint sales of the service and not interfering in each other pricing and marketing strategies (Panavides & Wiedmer, 2011).

3.5.6 Speed

Slow steaming is defined as operating a vessel at a lower speed than it is designed for (Finnsgård, Kalantari, Roso & Woxenius, 2020). Slow steaming results in a lower frequency of departure if the same number of vessels are used as the route takes longer time to complete (Finnsgård, Kalantari & Raza, 2018). As the frequency is reduced, the total capacity in the string is reduced. Slow steaming can therefore be used as a tool to reduce capacity if demand decreases in order to increase capacity utilisation (Finnsgård et al., 2018; Maloni, Paul & Gligor, 2013; Dere & Deniz, 2019; Faber, Freund, Köpke, Nelissen 2010).

Raza, Woxenius and Finnsgård (2019) point out that slow steaming is mainly used for deep-sea shipping and is not suitable for short sea shipping when having RoRo or RoPax vessels. Customers within the RoRo and RoPax segments are more sensible to changes in frequency. If slow steaming is to be used, the ship operators would need to deploy more vessels which is not always a viable option (Raza et al., 2019). Slow steaming can have a negative impact on the service level, since it results in increased lead times and affects the customers inventory levels (Finnsgård et al., 2019; Finnsgård et al, 2018).

3.5.7 Overbooking

Overbooking is defined as intentionally selling more capacity than what is available (Smith, Leimkuhler & Darrow, 1992). Overbooking is used in the shipping industry to offset the effects of abandonments and cancellations (Qvartz, 2017). It is stated that shippers can abandon bookings without any cancellation fee which creates incentives for them to use these strategies (Qvartz, 2017). This strategy is therefore used as customers often fail to claim their booked capacity (Biyalogorsky, Carmon, Fruchter & Gerstner, 1999). By overbooking the departures, the negative effects of no-shows and cancellations are countered, and capacity utilisation can be increased (Smith et al., 1992). Biyalogorsky et al. (1999) state that overbooking is beneficial to use when there are differences in customers willingness to pay a higher price, when high-paying customers are expected to enter the market at a later stage and when there is an uncertainty in number of customers in the market. In these cases, the capacity has a low flexibility and cannot be adjusted easily.

4 Empirical findings

This section presents the empirical findings from the eight interviewed ship operators. Firstly, general information about the ship operators is presented, thereafter how they perform their capacity planning is presented. The identified factors are presented to understand how they impact capacity utilisation and lastly the strategies are explained in order to understand how they can increase their utilisation.

4.1 RoRo1

RoRo1 is operating within the RoRo and RoPax segment, transporting goods and accommodating passengers on their vessels. They have targeted the segment short sea shipping. In total the company transports 4-5 million lane meters per year, the interviewed department is responsible for 1.5million lane meters transported per year. The company operates over the whole Europe area. In Northern Europe their fleet consists of a pool of 250 vessels, which consists of several different sizes. In general, the company charters 10% of their vessels from external parts and 90% of the vessels are owned by themselves. The department that was interviewed was responsible for their trades between Sweden and England as well as between Sweden and Belgium. To operate on these specific routes, the company has deployed nine vessels which have departures twice a week.

RoRo1 mainly targets two types of customers: forwarders and BCOs (beneficial cargo owners). 60-70% of the total volume that is shipped are goods from forwarders and the other share is from BCOs. For their customers it is important that the service is reliable and that the goods are delivered within the promised time frame. They have both loyal customers but also customers who switch between several ship operators. Their largest customers book space through a yearly contract where they define the amount of volumes they are going to send and where the price is decided for the service. The customers also share their forecasts with the shipping company. RoRo1 also allows last minute bookings up to 30 minutes before departure, however, this is uncommon. With their schedules with two departures per week, they have one prime departure which has a higher price, and the second departure is less attractive with a lower transport rate.

RoRo1 mentions capacity utilisation is the most important key performance indicator (KPI) for them, however, rate per lane meter is important for them to calculate the revenues. Working with capacity utilisation is important both from an economic and environmental perspective. RoRo1 measures capacity utilisation by taking used lane meters divided by total available lane meters, which is followed up on every voyage on a daily basis.

4.1.1 Capacity Planning

When RoRo1 plans their schedules, a budget is created where the expected amount of cargo which is going to be transported is taken into consideration. The interviewee mentions planning is performed 6-12 months ahead, allowing them to see what volumes they are expecting. Also, to see if any new flows are adding up in their network or disappearing. By doing this they can increase or decrease the available capacity on the market. In their long-term planning seasonal variation is accounted for as demand will be lower or higher for certain periods. In order to handle the peaks, the company plans for overcapacity to some extent. As an example, before summer vacation in Sweden there will be a demand peak in demand. RoRo1 does not necessarily handle this by having an extra vessel or a larger vessel, the capacity utilisation will instead increase slightly for a certain period of time from for example 80% to 85%.

If RoRo1 could operate with 100% capacity utilisation they would, however, the interviewee mentions that high levels of utilisation make the system vulnerable and not sustainable from a long-term perspective. The interviewee mentions there is a need to operate around 80% capacity utilisation to handle variations throughout the week. For example, their flexibility will be too low if they are operating at 100% and face harsh weather, resulting in diseconomies of scale.

The headquarters of RoRo1 has in total 250 vessels which can be redirected between different routes if there are any changes in demand. If they are experiencing a short fall of cargo on a specific route, the larger vessel can be exchanged for a smaller one. This is performed to achieve a better capacity utilisation on the new vessel and the larger ship will be moved to a route which has a need for more capacity. However, in certain situations when a ship gives overcapacity, the company may decide to maintain that overcapacity on the specific route until the demand will increase again, since there might not be any option to exchange the vessel to a smaller one. The company also charter vessels to other ship operators if they are not using the vessels themselves.

4.1.2 Factors affecting CU

Variation in demand

In the interview it was stated that RoRo1 is affected by the industries in the Gothenburg region, where there is a peak in demand before the summer vacation. After this there is a regression for a shorter period.

Trade Imbalances

For the routes Sweden-UK and Sweden-Belgium, RoRo1 does not see trade imbalances as a hindrance for them to achieve a high utilisation on their ships. This is stated by the interviewee: *"We do not have that much imbalance right now"*. Customers are shipping goods both ways, by doing this they have reduced the number of empty trailers in the system.

Weather conditions
Bad weather conditions have a negative impact on their capacity utilisation, since it leads to longer lead-times between ports which in turn will create delays at the terminal. The reason for this is that they will not have the needed amount of resources at the terminal and loading and unloading speed is therefore reduced. This will lead to a lowered capacity utilisation on the ships.

Ports
The ports are a limiting factor as mentioned before when they are facing harsh weather conditions, as the weather may cause delays in the loading and unloading operations.

Service level
If RoRo1 would have 100% capacity utilisation on their vessels, their system would become vulnerable. Having this level of utilisation would negatively affect their service level as they would not be able to provide their customers with a service that has a high availability. This could lead to customers changing suppliers.

Schedule characteristics
The interviewee mentions they have several departures during the week. They need to maintain the given frequency in order to provide their customers with a good service. However, during weekends they have a lower demand which results in a lower capacity utilisation for the departure and lower weekly figures.

Internal barriers
The interviewee mentions that they have no internal barriers within the company which hinders them from achieving a high capacity utilisation on the vessels. They have a close dialog with the ships and the stevedores which makes their operations more efficient.

4.1.3 Strategies

Increase demand
RoRo1 mentions pricing is not used as a tool to attract more goods when there is a situation with low levels of capacity utilisation on their vessels. RoRo1 tries to maintain the same price policy, since it is believed their service with the given frequency shall have the given price. The interviewee also states that: "*We would not go out and just lower the price just to get more trailers, because we do not think there are many more trailers in the market".* Instead, building strong relationships with their customers is believed to be more important rather than just lowering prices. Lower prices may however be offered to customers which have goods that are not time sensitive as it gives them a higher flexibility. The reason for this is that they may be used as standby cargo which allows them to move goods between departures.

In their service they have some prime departures that have a higher price and other departures which have lower prices. By doing this they can even out the demand and move cargo from prime departures to the less attractive ones.

Standby cargo

The ship operator has standby cargo to increase the utilisation on their vessels. RoRo1 experiences that there is a percentage of the trailers that do not make it on time to the vessel. Therefore, they have a waiting list, so that they can optimise their transportations. An example is industrial cargo, which does not have a fixed date for when the cargo is scheduled. Instead, the cargo will be loaded on departures which are less attractive in their service or loaded onto vessels when the capacity utilisation is low. This makes it possible for them to achieve a higher capacity utilisation on their vessels.

Cooperative arrangements

RoRo1 cooperates with one of their competitors on a route where they have a vessel sharing agreement. This means that a fixed percentage of lane meters are booked on each other's vessels. This reduces the necessity for RoRo1 to deploy more vessels on this route, since they can have more departures now. This partnership will give benefits of economies of scale but also a better capacity utilisation on each other's ships. The interviewee mentions it is important to remember the following: "*The only thing we are sharing is space on our ships. That is all we are sharing*".

Vessel allocation

If RoRo1 is experiencing a lower demand on a route, the vessel can be exchanged to a smaller vessel within their network. This allows them to increase their capacity utilisation by matching supply better with demand.

Frequency

Throughout the year the frequency of the departures is varied. During eastern time the company has less cargo to transport. In order to adjust to the reduced demand, the frequency of departure is reduced. If demand is too low, blank sailings are performed. This means that a vessel that should have departed on a specific route does not leave on that route. Towards summer in June and July there is an increased demand in the region before the summer vacation. Therefore, the frequency will be increased before the vacation. When the vacation comes, demand is lowered and therefore the frequency of their service will be reduced.

Routing

The company does not visit any additional ports during their route to pick up more goods to increase the capacity utilisation. This is explained by the following statement "*The schedule we have does not leave time to make other calls, so it is a fixed schedule*". Their customers also have expectations on the company to have the same departure on a specific time without any changes.

Speed
When their demand is reduced, slow steaming will not be implemented to withdraw excess capacity from their fleet. It will lead to lower bunker cost, however it will have a negative impact on their customers. The reason for this is the lead-time for the transportation can be increased with 50%. Increased lead-times will lead to the following:

> *We will have a trailer that will be sitting on a vessel 50% longer, and that means that in that system they would need more trailers to cover their business, because it is occupied for a longer time on the ships.*

The interviewee also mentions slow steaming is more beneficial for longer hauls and not for short sea shipping. Reducing speed in their operations would entail there will be a need for one additional vessel in the system to maintain the same capacity. This strategy would lead to lower bunker cost. However, the cost for an extra vessel will increase while the revenue streams are the same. Therefore, this option is not seen as viable.

Ports
In the port of Gothenburg, the interviewed department owns 65% of the terminal whereas the other 35% is owned by another ship operator. Overall the company owns a large number of terminals. The reason for this is they believe that they can achieve a better efficiency in their operations by having more control.

4.2 RoRo2

RoRo2 is operating with the RoRo segment and performs short sea shipping. RoRo2 was founded by a merger between two ship operators, where each partner owns 50% of the firm. They operate in the Nordic Baltic sea and in the North Sea. The shipping company transports 1.5 million ton of goods per year. The interviewee mentions RoRo2 is the only operator in the region who offers a liner service available for everyone. Their fleet consists of three vessels which are owned by themselves. Two more vessels have been ordered and will arrive in 2022.

RoRo2 works mainly with BCOs, however, all types of customers are allowed to use their service. For their customers it is important that the service has a good frequency, security and flexibility that is based on a market price. Their customers are loyal due to the long contracts. Prioritising of customers on departures are performed after what has been negotiated on their contracts. The interviewee mentions that the large BCOs are competitors to each other, so it is important to be objective and allocate space fairly among them and to smaller customers as well. It is also mentioned that cargo from BCOs with e.g. paper pulp is less time-sensitive and can be prioritised for later departures. Cargo from third-party logistics may be more time sensitive and is prioritised on their departures. Their customers book space on their vessels through long-term agreements, which stands for 65-70% of their cargo. There are also customers who book space on the vessels on a spot basis when project cargo is going to be shipped. RoRo2 can take bookings 5-6h before departure.

For RoRo2 important KPIs are capacity utilisation and revenues. A high capacity utilisation allows the company to achieve its financial goals and the environmental impact can be reduced. Capacity utilisation is to a large extent measured in lane meters. However, when project cargo is being transported, the utilisation is also measured in tons. As a result of this, the capacity utilisation is calculated with a formula that uses a mix of both tons and lane meters. Next year project-cargo will not be transported, instead RoRo2 will target trailers. This will result in the capacity utilisation being measured in TEU then. The capacity utilisation is followed up on each departure as well as on a weekly basis. When calculating capacity utilisation empty containers are included, and with their new ordered boats operating, around 30% of their utilisation is expected to consist of empty containers. The interviewee mentions that on average RoRo vessels never have a capacity utilisation above 80-85%, where the reason can be imbalances in the system and less attractive departures during the week. The interviewee also mentions that an optimal level for them would be to fill their ships to maximum to achieve 100% capacity utilisation.

4.2.1 Capacity Planning

RoRo2 is expecting delivery of new vessels in 2022, for these ships an excess capacity of 20-25% is planned. The reason for having excess capacity is based on the fact that RoRo2 is expecting their customers having growth in their volumes in the future. Therefore, the excess capacity will have to cover the increase of the goods that are being shipped. However, the interviewee mentions that ships are supposed to last for 30 years, and it is impossible to plan on a longer horizon. It may be that the excess capacity has already been covered by increased volumes when the new vessels are deployed. RoRo2 performs short-term planning on a horizon of 6 months. If there is a capacity shortage the next step will be to purchase an additional vessel. RoRo2 continuously works with investigating the market for available vessels, if there would be a need for an additional vessel. In the future RoRo2 may charter vessels, since benefits are that you can always hand back the vessel at the end of the contract and reduce the capacity.

4.2.2 Factors affecting CU

Variation in demand

Fluctuations in demand affects RoRo2's ability to fill their vessels. BCOs have large fluctuations in their production: *"From our large BCO customers and industrial cargo owners, their production chart looks like an EKG from a man having a heart disease"*. RoRo2 experiences that more goods are being shipped in the first quarter without knowing why. Further, there is also a peak in demand before the summer vacation in Sweden.

Trade Imbalances

Trade imbalances have a negative impact on RoRo2's capacity utilisation. The interviewee gave the following statement *"In general it is clear and obvious there is more cargo going southbound than northbound"*. By this the trade imbalance is identified and RoRo2 has to handle 30% of empty containers in their system. A constant challenge is to find cargo going northbound is mentioned by the interviewee: *"We are filling the vessel very good going southbound, but the challenge is to find cargo going northbound"*

Lumpy capital

RoRo2 plans for having 20-25% excess capacity when purchasing additional vessels to be able to cover for increased demand in the future.

Ports

RoRo2 sees the ports as an important factor which limits their ability to fill their vessels. The interviewee mentions *"It is one of our biggest problems when developing sea trade, especially domestic sea trade, where the flexibility in the ports are lousy".* The reason for this is that the terminal cannot ensure to have terminal operators available in the evening or nights, this has resulted in ports having low flexibility and reliability. This in turn affects their ability to fill the vessels. As an example, if a vessel arrives late to the port it might have to wait till the next shift when the terminal staff will return to work. This will create delays for the ship operator and may lead to having to skip a stop on their route to cover for the delay in the system. This will affect the amount of loaded cargo on the vessels.

Service level

Operating at 100% utilisation will affect their service level as it has a negative impact on the flexibility. The interviewee also mentions that operating at full capacity will result in some cargo being rejected for transportation. However, this is seen as beneficial and not only negative, since then the rates on their service can be increased when the utilisation is high. Therefore, it will be possible to increase their power in negotiations.

Schedule characteristics

The interviewee mentions their service has several departures throughout the week, where some of their departures have a high capacity utilisation. However, their Sunday departure has a low demand. This results in low capacity utilisation for this departure and a lower average capacity utilisation.

4.2.3 Strategies to increase CU

Increase demand

In general, RoRo2 does not use pricing to attract more cargo, since it is believed a lower price will not create more available goods to be shipped. The interviewee exemplifies that with the following statement *"On a Sunday departure [...] there is no demand for cargo being shipped. So, it does not matter if you offer a price with 20% lower rate. There will be no more cargo just for that".* The interviewee mentioned that if their liner service is competing against sea or land-based transportation then pricing can be used as a tool to attract more goods.

Standby cargo

The interviewee states standby cargo is important for them with the following statement:

> *Such cargo is insanely grateful to have what we call standby cargo, that does not have to be shipped on a special departure but can wait for the next one. That is the key to being able to really optimise the vessels in a good way.*

Rescheduling of cargo can be performed with industrial cargo from BCOs. E.g. for one route they had 40% of volume from their BCO and the other 60% volume booked by forwarders. The forwarders had certain departures which suited them better, and these vessels were loaded with their cargo. As the cargo from the BCOs was not time sensitive, they could be put on hold for 2-3 days and loaded on the Sunday departure where the demand from the forwarders was low. By doing this they could achieve a capacity utilisation of 98% on their vessels. With some customers they have a system which allows them to see the time with which specific goods can be delayed. With other companies they need to have a close dialogue where they continuously ask if the cargo can be rescheduled for the next departure.

Frequency

If they have noticed an increase in demand, the company may add another vessel to increase available capacity which results in a higher frequency on the route. However, if demand is lowered the vessel may be removed from the route to reduce capacity which reduces the frequency.

Routing

RoRo2 added an additional port to their route, since they signed a contract with a new customer. Current volumes on this port are low, however adding this port was a strategic move. The reason for this is that they believe growth in volumes with their current customer but also to find new customers which in turn will lead to a higher capacity utilisation. Adding ports on a permanent basis is performed on the long-term planning. Ad-hoc modification can be performed, for example once they visit an additional port to load on two trailers. This was due to it being dangerous cargo, which is charged with a high rate.

Ports
The company does not own any terminals and only purchase the stevedoring services from other actors. The reason for this is that it would require large capital investments.

Cargo
RoRo2 constantly tries to search for different types of cargo which can be shipped on the low-volume sea leg to reduce the trade imbalance in their system.

Overbooking
Overbooking is used by the company. By identifying different patterns in their departures, they can calculate the percentage of overbooking they shall use. E.g. on Tuesdays, 15% cargo will not make it on time to the port, then they can use 15% of overbooking.

4.3 RoRo3

RoRo3 is a short-sea operator and operating all over Europe. The routes often have several departures a week and the vessels go on a seven- or fourteen-day rotation. It is jointly owned by two larger deep sea RoRo3 operators. 90% of all the goods that RoRo3 carries are cars. The company ships around 1,4 million cars per year and operates 16 ships, ranging from a capacity of 1000 to 4700 car-equivalent units. The vessels are either designed or adapted for short sea trade and can carry rolling goods as well as high and heavy cargo. Nine of these vessels have been built to ice class specifications meaning that they can operate under harsh conditions in the northern waters. Some of the vessels are PCTC vessels (Pure Car/Truck Carrier) which are specifically designed to carry cars or trucks on its decks. Some of the vessels are as a result specialised whereas they also have ships that are able to carry high and heavy cargo.

The ship operator’s customers are mainly BCOs, but they also have forwarders. RoRo3 states that their customers main aim is purchase a service for a low price. As there has been an overcapacity in the market the last years, the customers have gotten the frequency they wanted. The overcapacity has put the BCOs and the forwarders in an advantageous position where they can ask for lower prices as there are several options available for them. RoRo3 states that the customers are prone to change suppliers if there are large price discrepancies between the current provider and an alternative. If the current relationship is working, the customer may stay with the current provider even though the prices are slightly higher. The customers have long term contracts with RoRo3, whereas for the high and heavy there are some exceptions where they look for goods on the spot market. The customers can book a spot on the vessel right before departure. The customers provide RoRo3 with forecasts up to six months before with expected volumes. The customers may however arrive with a different amount than previously stated.

The most important KPI for the company is volume. RoRo3 is trying to keep its position in the market by signing contracts for specific volumes in order to be able to provide a good frequency to their customers. If they lose a contract for a specific volume, they would not be able to operate with the same number of vessels as this would result into a low capacity utilisation. This would in turn reduce the frequency of the departures which would incentivise the remaining customers to change supplier, further reducing the capacity utilisation. The interviewee states that in order to stay competitive, they have to make the best use of the tools that they have and utilising the vessels to a high degree is usually the way of achieving that.

The company measures capacity in stowed square meters, meaning the actual square meters that are used. This is however changing slightly towards weight as more electric vehicles are transported than before. The electric vehicles weigh more than vehicles with combustion engine and the weight is now becoming the main restriction to load more cars onto the vessel. Capacity utilisation could also be measured in volume, as loading vehicles which are below 1,6 meters in height does not utilise the space on a deck that is 2,6 meters to its full potential. RoRo3 measures capacity utilisation at specific ports for every single trip.

4.3.1 Capacity planning

RoRo3 wants to fully utilise the ship on every departure but does not dimension the system to be at 100% when they plan for available capacity, as this would be to cost full and result in a poor service for the customer. The interviewee states that:

> *If you have 50 trucks going to pick up cargo and you know there is more cargo coming next week, it is easier for a trucking company to send 60 trucks next week. For a shipping company it is very difficult if you have 104 % utilisation, and you can only have one vessel or you can have two vessels, or you can have six vessels or you can have seven vessels so, the next step of capacity is extremely high. Obviously if you have 104 % utilisation and you need to send the vessel to pick up 4%, you will just be burning money. So, long-term, it is very difficult to be sustainable if you have 104% because then at some point every single customer will complain, and at some point, you would just lose contracts.*

In areas where there are several competitors with excess capacity RoRo3 is able to plan for a higher capacity utilisation, as they are able to load goods on the competitors' vessels. In routes with a high network density, RoRo3 might be able to pick up goods that did not fit in the vessel with other ships passing close to the port. The planned capacity therefore needs to be adapted to the specific route. The company dimensions their available capacity so that the vessels on average are 85-98% utilised. The company charters around 50% of the vessels. This gives them a higher flexibility in their available capacity as they can reduce it without scrapping vessels which is more costly. Many of the charters are one-year contracts or shorter which gives RoRo3 the ability to reduce their available capacity quickly if needed. Some of the vessels that are operated are owned by the companies to which RoRo3 belongs to.

One of the company's greatest advantages against competitors is that they have vessels ranging from 1000 – around 5000 car-equivalent units. This makes it possible for them to exchange vessels within their own network to adapt to changes in demand. If RoRo3 sees a need to increase or decrease capacity, they are able to exchange vessels within their own network. The size of the vessels also affects the company's cost and flexibility. RoRo3 states that having larger ships allows them to drive down costs but restricts their ability to lower their capacity. If they opt to have smaller ships, then it is possible to remove one ship out of the system if volumes fall, which would not be possible if the company operated with only one ship on the route. Smaller ships also make it easier to increase capacity if necessary, without incurring high costs. Having the right vessel for the route is also seen as important. Having excessive amounts of capacity allocated to a specific route makes it difficult for the company to get enough volume to fill the ship. RoRo3 also exchange vessels with other actors in the market to increase or decrease capacity. Some vessels may however be adapted to specific terminals with specific ramps and may not be able to load and unload on specific ports. Ports located in canals may also not be able to cope with big vessels that have too much draft or vessels that are too high. This restricts the company's ability to swap vessels between routes. In routes where there are several vessels operating on the same string, if utilisation drops, they may also drop capacity by removing one vessel from the string. Capacity may also be increased by chartering vessels. The charters can be made for time periods of only one week if necessary. Adding vessels to a route by ordering new ones is also done to increase capacity which also increases the frequency of departures. Swapping vessels or exchanging them for bigger ones is done gradually as production in a certain region increases over a long period of time, whereas adding new vessels is often done in situations where demand increases due to new contracts or more sudden increases in demand.

4.3.2 Factors affecting CU

Variation in demand

RoRo3 has tender documentation which gives them information on the expected demand that the customers are going to ship. The actual demand for their services is however unknown as the customers may produce more or less cars than expected. This makes it difficult for the company to match available capacity with the demand as the latter is unknown, reducing the capacity utilisation. This is seen as the biggest challenge for the company when trying to achieve a high capacity utilisation, as the actual volumes at times have been 50% less than what was stated in the tender documentation. The customers state that they receive the numbers from their own sales department, which is the reason for the faulty numbers. The company also experiences variations in demand due to seasonality in periods like summer and Christmas.

Trade imbalances
RoRo3 experiences that there are some trade imbalances between the different routes but only to a limited extent. Sweden, Norway and the UK are described as markets where there is significantly more import than export. As there is no car production in Norway the ships often leave port with a low capacity utilisation. This is exemplified with the following statement from the interviewee: "*Clearly there is a lot more import than export, in Norway there is no car production at all. So, whatever you are shipping from Norway, you are always going not empty but basically empty*".

Lumpy capital
RoRo3 is not able to increase available capacity in small steps which makes it difficult to match supply and demand for every departure.

Type of Cargo
The way that the vessels are designed may affect the company's ability to fill it optimally. The interviewee exemplifies this by stating:

> *All depending on the configuration you might be unlucky. So let's say on deck, the lane is 1,8 meter wide or something, then you might be extremely unlucky because the car is 1,82 meter meaning that you are just crossing into the last lane, so along the deck you have 90% of a potential car you have space for, but that does not help you. Since you cannot fit it, so you are losing all that space. So how would you then argue? Are you 100% full on that deck? Because you used all the deck you can use, but if the cargo is two centimetres smaller, you would have been able to fit 80 more cars [...].*

Competitive situation
The competitive situation also affects the capacity utilisation. If an actor decides to enter a market in which RoRo3 is operating, the total volume that is shipped from that port is going to be split amongst more actors, reducing the capacity utilisation.

Weather
Harsh weather may result in late arrivals for ships in specific ports. The company does however plan to have slack in the system in areas where the weather is usually bad.

Ports
RoRo3 states that not being able to enter the port when planned is an issue that makes it impossible for them to load and unload the goods when planned. This is a result of ship operators operating big vessels which makes the loading and unloading operations take longer time. The company states that if all the ship operators would use smaller ships, they would be able to offer their customers a higher frequency and the port operations would be smoother, reducing the total cost. This is however often not achieved as ship operators try to increase their own profits and start operating bigger

ships, which incentivises other operators to do the same. Some ports do not have night shifts which hinders RoRo3's ability to load and unload goods during specific times.

Internal barriers

The company experiences that miscommunication over dimensions or bad coordination is an issue that may affect capacity utilisation negatively, especially for high-and heavy goods.

Legislation

When the company transports military cargo, there are restrictions regarding what goods can be loaded on the vessels.

4.3.3 Strategies

Increase demand

The company does not see marketing as a viable option as it would to increase the demand for their service. They state that they could increase the demand for the products they ship by marketing cars, but that would not be financially viable.

Standby cargo

The company sometimes leaves goods behind for the next departure as the vessels are full but does not plan for it in advance.

Cooperative arrangements

In situations where the company reaches its maximum capacity and cannot load all the goods, they may cooperate and load the remaining goods on the vessels of other actors that have the same port of destination.

Vessel allocation

If utilisation for a vessel is low on a specific route the company may swap the vessel for a smaller one within the RoRo3 network. This does however mean that there is a need for a bigger vessel somewhere else in the network. If utilisation is high and a larger vessel is needed the company may also swap vessels, but then the demand needs to be lower on the other trade, otherwise the company would only cannibalise its own profits. The company may also negotiate to exchange the vessel with a smaller one with another company. Swapping vessels may be hindered by constraints in the port such as draft requirements or port infrastructure such as ramps which may not fit the vessel that is to be exchanged.

Having a dense network where several ships sail between the same ports allows RoRo3 to remove a ship if utilisation falls below a certain point, as the remaining goods can be shipped with other vessels. The interviewee states that they can achieve a higher capacity utilisation on the main legs where more ships are deployed.

Frequency
The frequency of departure is used as a tool to cope with increased or decreased demand. If demand increases the company may add a new vessel to increase the capacity.

Routing
Trade imbalances can be handled by combining ports that have mostly imports with ports that have higher exports on the same routes. Designing the network so that the vessel first picks up cargo in a port which almost only has export. After this a port which has mainly imports will be visited, this allows RoRo3 to increase capacity utilisation on the trade.

As only some of the ports operate during the night, RoRo3 plans its routes so that the vessels arrive at the port during night-time. Arriving at more flexible ports during nighttime allows RoRo3 to operate their vessels around the clock.

In situations where there is available capacity on a ship going through another port with cargo available, RoRo3 is able to do an extra stop to pick up the cargo with the vessel.

Speed
RoRo3 does not alter the speed of the vessels to increase capacity if the demand increases. The reason for this is that the vessel performs the route more often than other vessels on the same route which may not be able to cover the whole route faster. This has a negative impact on the sailing schedule. A customer that is promised three sailings per week may only receive two, as the faster vessel may coincide on the same date as another vessel. The interviewee states that increasing the speed hinders them from operating like a bus, where the vessel visits specific ports at predefined times.

RoRo3 states that they have some time-slack in the system between certain ports in order to be able to increase speed and follow the schedule reliably. This is the case if the vessel needs to be able to unload the goods on a port with inflexible times or a convoy entering Russia which only leaves at specific times. As the ports of are often located close to each other, it is not always possible to increase the speed in order to follow the schedule.

Cargo
As the trade imbalances make it difficult for RoRo3 to find cars going out from certain markets, the company tries to find other commodities to fill the vessels on the leg with lower volumes. This allows them to increase their capacity utilisation on routes with large trade imbalances.

If the company reaches the max weight limit on a vessel there may be space left on the vessel which could have been used. In order to be able to fit more goods on the vessels, RoRo3 is trying to increase its cargo mix. By doing this, the risk of the company reaching maximum capacity for any of the restrictions such as weight or square meters is reduced.

Customer selection
Variation in demand is handled by trying to win contracts with several customers. According to the interviewee, this makes it less likely that the volume will drop simultaneously for all the customers at the same time which reduces the variation of demand. As stated by the interviewee: *"We try to avoid having only one factory at least, not necessarily one port, that is usually not in itself not a problem. It does not necessarily increase your utilisation, but it lowers the variability of how much you are loading. I mean, in an ideal situation you have ten factories delivering to one vessel, unless you get Corona, not all ten factories will drop at the same time".*

4.4 RoPax1

RoPax1 is a short sea shipper that provides liner services in the RoRo and RoPax segments. The Ropax vessels are designed to transport a combination of passenger traffic and freight goods and have an upper deck and often no internal ramp as opposed to the RoRo vessels. This requires a specific infrastructure on the port side in order to "load" the passengers on the boat. The company is active in Northern Europe and is one of the biggest actors in the region. Last year, RoPax1 transported 1,7 million cars, 2,1 million freight units and 7,6 million passengers used their services. RoPax1 has 19 ferry services in Scandinavia, Great Britain and the Baltic and operates around 36 ships. The ferry services have departures several times a day. The company is part of a bigger concern from which the company acquires its vessels. The concern owns 80% percent of its vessels and charters 20%.

The company's customers are mainly forwarders, but they are also in contact with BCOs. When it comes to the freight segment, the customers value service reliability over other factors such as cost. This includes departing from the port according to schedule and not cancelling departures. A low price is also seen as an important as well as frequent departures and security. The requirements depend on location and goods that are shipped. The customers loyalty varies depending on the corridor and number of alternatives. In some corridors the company is the only actor providing a service, resulting in a high loyalty from their customers. If several alternatives exist, such as another ship operator or an alternative transport mode, the customers are prone to change supplier if the service reliability is bad or the price is too high.

Most of the big actors with whom the company does business with signs a contract with RoPax1 once a year for a specific volume. The contract is often renewed every year. Some smaller actors buy the company's services on a spot basis, meaning that they compare different service providers for every shipment. Bookings from the spot-market are often placed between two weeks in advance up until the last hour.

RoPax1 is mainly focusing on increasing profits and revenue. Security is also seen as an important KPI that the company works with to improve. Capacity utilisation is also a priority but is mainly seen as a way to achieve increased revenue. The company measures available capacity using lane meters. The company measures their capacity utilisation for every departure and calculates weekly averages for the vessels.

4.4.1 Capacity planning

When deciding upon the available capacity, the company performs a market research for their routes and set the available capacity to match the demand. RoPax1 always wants to be able to take customer requests and barely has capacity shortages. The company states that they do not plan for overcapacity but there is some slack built into the system as the vehicles may often be arranged closer to the theoretical maximum capacity by reducing the space between the vessels.

When facing capacity shortages for a specific route, the company may exchange to larger vessels within their network in order to better match demand. Changing vessels may on the other hand prove to be costly as the port infrastructure is adapted to the current vessels. One example is the gate that used on the port to load passengers onto the Ro-pax vessels. These are adapted to the number of decks that the vessel has, which may vary between different vessels. As vessels are costly, they are often under operation which makes it hard for a company to find an available vessel that fit the company's requirements. Changing the vessel set-up for a specific route is therefore often done as a long-term measurement as when the company observes long-term changes in demand. The company may also acquire a new vessel if it believes that the demand is going to increase on a long-term horizon. As the vessels may be used for up to 40 years and the vessel takes 2-3 years to build, the company only purchases new vessels as a long-term strategy to increase the available capacity. The company charters 20% percent in order to have a little bit of flexibility and be able to reduce available capacity if demand drops. The company also charters in order to benchmark costs and compare the cost of operating its own vessels versus having another company operating them.

4.4.2 Factors affecting capacity utilisation

Variation in demand

The company experiences a daily variation of demand on some of the routes as there are peak times that are more attractive for the customers and non-peak times which often have a lower capacity utilisation. The company also experiences seasonal variations in demand, especially for the travel side where the demand is higher during the summer. Market trends and the global economy are factors that affect their travelling customers willingness to use their ferry services and therefore also affect the company's capacity utilisation.

Trade imbalances

The company also experiences an imbalance in the amount of goods that are sent in different directions in the services. This affects the load factor as more goods are sent in one direction. RoPax1 does not experience this as a big problem however, as most of the trailers that transport goods in one direction often take the same vessel back to its original destination.

Vessel design

The vessels often have two decks, an upper and a lower main deck. Some of the vessels are equipped with a hanging deck in the main deck which can be used to increase the available lane meters. Using the hanging deck will on the other hand restrict the loading of trailers on the main deck. This results in a dynamic capacity utilisation and a dynamic capacity which the company works with to optimise the loading. As the vehicles cannot be loaded without any space between them there will be a discrepancy between the theoretical lane meters and practical lane meters that are available. The way that the vehicles are loaded will therefore affect how close the company can come to achieve a 100% theoretical capacity utilisation

Competitive situation

How competitors operate on the same routes and price their services are also factors that highly affect the company's capacity utilisation, as it may reduce the demand for their services. Other transport modes or intermodal solutions may also affect the demand for RoPaxs' services which also reduces the company's capacity utilisation.

Ports

As mentioned above, the way that the loading operations are performed and the space between cars will also affect the company's ability to reach a high capacity utilisation.

4.4.3 Strategies

Increase demand

The most effective way to increase demand is to use pricing. During the day, the company experiences that there are peak times and non-peak times. In order to even out demand and increase the attractiveness of the non-peak times, the company increases the price for the peak times while reducing the price for the less attractive departures. RoPax1 states that the pricing tool has to be used with caution, as it may affect the customers view of the market or instigate a price war with competitors. Marketing is also used to increase the demand for their service.

Standby cargo

The company also works with customers which have goods that are not time sensitive and do not need to be transported as soon as they arrive at the terminal. This allows RoPax1 to transport the goods on departures that are not as attractive and have a lower load factor which increases the utilisation of the vessel. In return, the customers get lower prices for the flexibility that they provide to RoPax1. RoPax1 seldom moves goods to other departures if it has not been stated in the contract with the customer. Performing this will have a negative impact on their service for their customers. This might give the risk of losing the contract when it is going to be renewed.

Cooperative arrangements

RoPax1 cooperates with other actors in specific routes. If the respective companies have departures at different times, they can purchase capacity from each other in order to provide their customers a better service and more frequent departures.

Vessel allocation

If the company has two routes that go back and forth close to each other, the company may have a vessel that can be exchanged between the routes to provide flexibility in the available capacity for both routes. However, this only viable if the routes are located close to each other geographically. If utilisation is low on a route the vessel can be exchanged for a smaller one within the network.

Frequency

The timetable can be adjusted to counter seasonal variability of demand. During the summer the demand for RoPax vessels is increased. The company then implements a summer timetable which has more departures during the day to increase the frequency. This is done by increasing the speed of the vessels. The timetable may be adjusted a couple of times every year but cannot be changed often as the customers expect the vessels to leave the port at specific times.

Routing

RoPax1 does not change the routes or stop to make an extra port-call if the vessel has a low utilisation. The main reason is that the timetable which needs to be followed and stopping at another port to pick up extra goods is not feasible from a time perspective. The routes may be changed in the long run but are not adjusted on a short-term basis.

Ports

RoPax1 has contracts with many ports to rent a terminal for a longer time. They also own a couple of ports. In some of the ports they have their own stevedoring operations, and in some cases, they use a third party. RoPax1 prefers to have their own stevedoring operations as it allows them to create standardised work procedures on all their routes.

Overbooking

RoPax1 uses overbooking on rare occasions. The company uses it on occasions where customers repeatedly do not arrive at the port with the promised goods to be shipped.

4.5 Feeder1

Feeder1 is a short sea ship operator that works as a feeder operator in northern Europe. As a feeder operator, the company tranships the cargo to and from the larger hubs such as Rotterdam and Hamburg following a predefined schedule. Feeder1 visits 46 ports throughout its network and has around 150 port-calls a week. The company has the largest feeder network in Europe. Feeder1 works with containerised cargo and to provide their customers with a door to door service. This is done by transporting the goods by sea on the long leg and then truck or rail on the final leg. Feeder1 has 32 vessels, most of them are chartered in order to have flexibility in capacity.

As Feeder1 is a feeder operator, their customers are container shipping lines. As the larger shipping lines try to achieve cost reductions, a low price is seen as important for them. Being able to connect the cargo with the ocean vessel that takes the cargo to the final destination is also seen as important. As there are only around ten big carriers in the world, losing a customer has a considerable negative impact on the business. The company therefore tries to achieve close relationships with its customers. The customers are however not loyal, as they change supplier if they can find lower prices elsewhere. Feeder1 has contract with their customers which are between six months and three years. As their customers are able to in-source a charter vessel themselves, they are always measured against that alternative.

Capacity utilisation is seen as the most important KPI as it has a strong effect on the bottom line. The company measures its capacity utilisation in terms of TEU on every port call as well as the number of tons that have been unloaded and loaded.

4.5.1 Capacity planning

Not having excess capacity is of high importance to the company. The interviewee states that:

> *I don't want to have excess capacity. We are like a fish trade, when you are selling fish, and when you close your shop, what do you do with the fish you have not sold? You throw it away! When I leave a port with excess capacity and I am still able to load cargo on board, that is waste. I have paid the bunker, I have paid the port call, I have paid the truck loader, I have paid the charter for the vessel. If I do not use all the slots on board, that is waste. I cannot sell it later.*

Feeder1 prefers to be a little short on capacity than too high or else they will lose their revenues. The company charters most of its fleet so that they reduce capacity if volumes are dropping. The time period for charters can be between one week to one year.

4.5.2 Factors affecting capacity utilisation

Variation of demand

Uncertainty of demand is an issue which makes it difficult for the company to plan available capacity. There is a lacking commitment on the volume their customers want them to carry. The interviewee states this is because the ocean-going ship operators do not know the demand from their customers. The uncertainty makes it difficult for Feeder1 to plan available capacity and allocate the right vessels for the specific routes. The interviewee states that:

> *We have a lot of short charter because the commitment we get from our customers, there is a commitment that they want to use on this route, but we do not normally get a lot of commitment of how much volume there will be in that route. And our customers do not know if IKEA is going to buy how many containers from Shanghai next month because they do not know how much the people are pulling out of the warehouses or the shops. The same goes for deep-sea and for almost everyone, that the long-term planning of the volume, it might be there, but it is not trailing down to the feeder operator.*

Trade imbalances

Feeder1 states that there are large differences between different ports in terms of the balance between import and export. Copenhagen and Stockholm are examples of cities with more import than export. This creates a challenge for Feeder1 when trying to design its routes so that the vessels can be utilised to a large degree.

Weather

Harsh weather conditions may result in late port calls and making the company miss the scheduled time window. It may also inhibit the dock workers to load the goods onto the ship.

Ports

Feeder1 has an agreed time window with the terminals for when the loading operations can be done where the terminal guarantees a certain amount of container lifts. If the window or parts of it are missed, the loading operations may need to be stopped before all of the loading has been completed, reducing capacity utilisation.

Late arrivals, no-shows and cancellations

The company experiences that customers do not deliver the amount of cargo that they have promised which creates difficulties when trying to plan its operations and may result in overcapacity. The company also experiences that the goods coming from the oceangoing vessels are not always on time and ready for loading in the transit terminal which impedes loading cargo onto the vessels.

4.5.3 Strategies

Increase demand

The company uses the pricing mechanism as a way to attract more customers and get more contracts. It is however used with precaution as it may reduce the profitability.

Standby cargo

The company rolls some goods to later departures. Their ability to do this depends on the kind of goods that are shipped and the customers willingness to roll the goods. For example, medical cargo is of high value which makes it difficult to roll.

Cooperative arrangements

The company has vessel sharing agreements with other actors. This is done in order to consolidate volumes together and be able to provide their customers with the frequency they want, or to consolidate volumes and use bigger ships which reduces the slot cost.

Vessel allocation

If the utilisation is low on any of the routes, the company may look into the possibility of changing the vessel in the route with a smaller one within their own network. Daily decisions regarding vessel allocations are performed in order to be able to cater for the customers' requirements. Flexibility in vessel allocation can be achieved by having an extensive network.

Routing

In order to handle the export and import differences of cities and trade imbalances the ship operator tries to combine a port call of a larger city like Stockholm or Copenhagen with more imports with several smaller port-calls where the export is in general larger than the import. The company also works for having routing flexibility. They may also visit more ports in their route if their schedule and time permits it to increase the capacity utilisation. If volumes are falling, Feeder1 may also increase its capacity utilisation by terminating a vessel out of their system. This is done by removing a route from the system and including its port-calls into other routes. This makes it possible for the company to remove a vessel and redeliver it to the ship-owner.

The interviewee states their routing flexibility is a result of their wide network. This makes it possible for them to cater for differences in volumes or timings, as opposed to a big shipping line which only has 3-5 services. By having 45 vessels in their network Feeder1 are able to do changes without causing any disruptions.

Overbooking

Feeder1 uses overbooking to a large extent as no-shows are a problem for them. The interviewee states that *"I really prefer to be a little short than too high. Too high, then we do not earn money"*.

4.6 Container1

Container1 is a global company operating in 129 countries. The company has targeted liner shipping within container transportation and is a leading actor in the market. In total Container1 has 121 liner services and connections between 600 ports globally. For trades in Transatlantic, Middle East, Latin America and Intra-America the company is the leading ship operator. Container1 transports 12 million TEU yearly and has a pool of 239 vessels. Container1 has the most modern fleet for reefer containers. 50-60% of their fleet is owned by themselves and the other share is chartered. Container1 is in an alliance with three other ship operators.

Container1 works with forwarders and BCOs. Container1 does not collaborate with smaller private customers, instead they have to ship through forwarders. BCOs stands for 30% of their volumes and forwarders for 70%. According to the interviewee it is important for their customers to find a service for a low price. Their customers are loyal, and the shipping company is seen as a company offering a service with high quality. However, they also have customers who switch suppliers. Customers are prioritised on the vessels based on a nomination they have gained from the contract. Based on this they receive an allocation on the vessels. Their customers have contracts which are renewed yearly or every second year with a yearly volume defined which is distributed over 52 weeks. They also have customers who book space on a spot basis. Container1 can take bookings up to 24-48h before departure.

The most important KPI for company C is capacity utilisation and revenues per slot on the vessels, both from a short-term and long-term perspective. Capacity utilisation is measured in loaded tones divided by total allowed tones and loaded TEU divided by total TEU capacity. In their calculations empty containers are included and capacity utilisation is measured on every voyage.

4.6.1 Capacity planning

Each country performs a budget yearly, where they make an estimation on the amount of cargo that is going to be imported respectively exported. In their planning they also take into account if any new flows of cargo are being added, since they might have to add their own vessel to that specific route or have a third-party vessel. According to the interviewee Container1 does not plan for having excess capacity on their vessels. They always aim for 100% utilisation.

In total the company has around 239 vessels where they own 50-60% by themselves and the other share is chartered. When they purchase their own vessels, it involves long-term planning. To handle peaks on short-term horizons they either charter vessels or see over opportunities with their partners in the alliance. This is exemplified from the following statement: *"With chartering it is the short-term peaks[...]"* and *"To cover for peaks vessels can be chartered or discussions are made with alliance partners [...]"*.

Container1 also mentions that they are flexible with switching vessels between different routes within their network.

4.6.2 Factors affecting capacity utilisation

Variation in demand

In their transportation Container1 experience seasonal variation, for example during one period fish from Norway is being shipped. Increased shipping from Latin-America is also seen during some periods. However, the goods that are being exported from Sweden are in general even during the year.

Trade Imbalances

Container1 sees there is a great imbalance between Fareast and Europe but also between Europe and Latin-America. When goods are being shipped from Latin-America to Europe reefer containers are used. However, the export from Europe does not have high demand on reefer containers which creates an imbalance in their system. This is described by the interviewee:

> *There is a huge imbalance between Fareast and Europe and also Latin America when it comes to it. There is bit of difference, for example, in Latin America and Europe, the are the reefers needed in Latin America so they can be shipped to Sweden. Meanwhile in Sweden the export volumes of refers to Latin America are much lower.*

Type of cargo

Container1 transports different types of cargo. On their ships it is often the maximum weight that is the limiting factor for carrying goods and not the number of containers. It is common that they transport project cargo such as windmills and turbines. This affects their ability to fill their ships. This project cargo will affect them so that they cannot load and sort containers as they would have done in the normal case. This will lead to fewer containers loaded on the vessel.

Cooperative arrangements

Being in an alliance affects Container1's ability to make ad-hoc changes. The reason for this is that all of the 4 partners in the alliance have to agree when making decisions. With more actors involved this process will become slower, which is exemplified from the following: *"That is the problem when you are in an alliance, the more members the longer it takes".*

Weather condition

Poor weather conditions affect their ability to fill their vessels, since it may cause delays for the vessels during the loading operations. This may result in the vessel having to depart before the vessels are fully loaded.

Ports
In their planning they select ports which can handle ultra large vessels and have the equipment. This is adapted depending on which vessel they are operating with.

Service level
According to the interviewee they do not have buffers on their vessels in case important customers would like to ship goods. Instead every customer has been awarded an allocation on their yearly contract. This allows Container1 to only make promises which they can perform, otherwise it would have created delays and disturbances in the system.

Internal barriers
Within the company the trade management department wants to have the highest paying cargo, meanwhile the sales personnel want to have all their sold cargo on the vessels. Therefore, it may incentivise departments within the company to work against different targets which can have a negative impact on the utilisation.

Legislation
The interviewee mentioned dangerous goods are also being shipped on their vessels. Only a certain amount of these containers can be loaded on their vessels and they must have a certain distance between them. Therefore, this type of cargo affects their ability to load the vessels.

4.6.3 Strategies

Increase demand
If Container1 is experiencing low utilisation on their vessels, then they use pricing as a tool in their first attempt to find more cargo to their service. The interviewee mentioned the following: *"The first thing that is performed is to lower the freight price to see if it will attract more cargo".* However, it also mentioned that they use the pricing tool to some extent, after a certain point it will not be viable to lower their rates.

Standby cargo
Container1 aims to have standby cargo at the last port they visit in Europe before they are departing for a longer voyage. The reason for this is that they can then fill up their vessels with goods before departure. This is done with cargo that is not time-sensitive e.g. waste material or timber, which is supported by the following statement:

> *Before the long sail will be performed, we will always try to have cargo available where the customers accept that it does not have to be shipped this week. Instead it can be shipped next week or the week after. This cargo can always be used to load the vessel till last. This is rather coveted cargo which means that they do not have too much at all, but they still pay for the place on the boat simply and it can be such waste paper or something else that is not of*

high value or time-sensitive" has not reached the high value and is transit-sensitive simply then.

With this kind of cargo, they can have a time frame with two to three weeks where they can have the cargo in standby. However, the interviewee mentions that this is not something they are performing in Sweden, since most of their cargo is time-sensitive and has to be shipped on the first available departure. The cost of having the containers at standby at the ports is a high cost, therefore it is important to ship the standby cargo as soon as possible. Otherwise the cost will be higher than the revenues.

In a crisis situation they can move cargo between different days and have to prioritise which cargo is going to be sent. However, this kind of situation is something they try to avoid *"This is a situation you are trying to avoid"*.

Cooperative arrangements

Container1 is in a strategic alliance with four other actors. One reason is that by doing this they are able to operate large vessels as the vessel capacity is shared among the alliance members. The other reason is that it allows them to expand their network globally and cover many routes. This is described by the interviewee in the following way: *"It makes us globally and can cover all routes. The resources will also be shared, with vessels all over the world".* The interviewee also mentions that they have collaboration across different alliances as well. For example, they are purchasing slots from other alliances in order to provide a direct service to a port for customers.

Vessel allocation

According to the interviewee vessels can be exchanged between different routes within their network.

Frequency

Most of Container1's services have weekly departures. If they experience a situation where they have a peak in demand, they will not increase the frequency. The reason for this is that these lines are based on long-term planning. However, they can perform blank sailings when the demand is low to lower their frequency. When a sailing is blanked, the goods that would have been shipped on that vessel are loaded on other services that have the same port of destination.

Routing

Container1 makes larger changes in their routes in April where they have meetings with their alliance partners. The interviewee mentions that Container1 does not perform any ad-hoc changes where they add an additional port in their route to be able to fill more cargo. The reason for this is: *"It is not like that a new location will be added from nowhere. It does not happen. There is no cargo available to be shipped from there or to be unloaded".* By having their own liner traffic, they have control over their departures and arrivals, so therefore ad-hoc changes are not performed.

Speed
Slow steaming is not implemented on some specific vessels since it will affect their operations negatively. The reason for this is that if one vessel is using slow steaming and other vessels within the company are not, there is a risk that the slow steamed vessels will interfere with the schedule of the other vessels. This will result in a domino effect. Slow steaming is not used to withdraw excess capacity.

Ports
The terminals are not owned by Container1, instead they have close collaboration with the terminals. Container1s main idea is that they should be excellent in their core service to transport goods from A to B and not focus on terminal operations.

Overbooking
The interviewee mentions overbooking is used to a limited extent. Container1 does not have a target to reach for their overbookings. Instead they look up which customers they can perform overbooking on, the trade-off will be that the customer will receive a lower rate.

4.7 Container2

Container2 is one of the biggest actors in the container shipping industry. They operate in 120 countries and serves over 300 ports throughout its network. Container2 operates 750 container vessels globally, ranging from 3 500 TEU to 20 000 TEU. The size of the vessels depends on the demand for that specific trade. 70% of the vessels are owned and 30% are chartered. The majority of the large vessels are owned. Container2 is part of an alliance with another ship operator. The purpose of the collaboration is mainly to increase its network reach and reduce costs. Container2 has recently acquired another company and is now responsible for two brands, where the new one mainly covers transports to and from Africa and the middle east. The company has intra-continental short sea as well as inter-continental deep-sea operations. Container1 describes its services as a bus-route, where the vessels pick up and drop goods at several ports throughout its route. The company states that the ocean margins have been reduced significantly since 2008. In order to plug in to more revenue streams, Container2 is extending its supply chain operations and is now offering fourth-party logistics solutions such as customs haul brokerage, inventory warehousing and transportation to inland destinations. Container2 states that this also allows them to provide a more complete solution to their customers and provide a better service. Container2 is mainly focusing on revenues and market shares. Capacity utilisation is seen as very important as it highly affects the company's ability to make a profit. A capacity utilisation below 95% is seen as low and may have a negative effect on the company's profitability. Container2 measures available capacity in TEU and slots utilised is used to measure capacity utilisation. Their capacity utilisation under normal circumstances is around 97% globally.

The company's customers are both BCOs and forwarders. In Scandinavia the share is 50% for both parts where the bigger actors often are in direct contact with Container2. The share also depends on the trade lane. The loyalty varies between customer groups. BCOs are loyal as they sign a contract for a certain volume once a year and often sign new contracts every year. The forwarders have a more transactional behaviour where they look for the cheapest prices on a daily basis. Container2 has a priority list for cargo, where government cargo is highest priority, followed by refrigerated cargo, key account clients and then a bucket system where the highest paying client gets a slot on the ship. Container2 can accept bookings until 3-5 days before departure but customers often place their bookings one-two weeks in advance. Container2 tries to have 60-70% of the space on the vessels allocated, meaning that there is a contract to ship a certain amount each week for a certain price. The rest is ad-hoc space for short-term cargo which gives the company a little bit of flexibility when charging its customers. If the oil prices increase, they are able to charge their ad-hoc customers a higher rate as an example.

4.7.1 Capacity planning

Container2 plans their available capacity so that they are not fully able to cope with all the peaks or dips in demand. This results in them having overcapacity when demand is low and under-capacity when demand is high. They do however increase or decrease capacity slightly when demand shifts. The company may for example change the vessel setup, i.e. ordering a bigger vessel in order to better match supply with demand. This is however not done if there is not a significant change in the market. Container2 states that deploying bigger vessels on routes to increase capacity may result in price deterioration and such decisions have to be taken with caution. Chartering vessels for longer periods of time is also used as a way to cope with long-term increases of demand. The company currently charters 30% of its fleet.

When demand is low on a short-term horizon the company may use a blank sailing. The vessel can either be left idle, used as a feeder vessel or be deployed on another service. When a sailing is blanked, the goods that would have been shipped on that vessel are loaded on other services that have the same port of destination. Short term increases in demand may also be handled by performing short-term charters.

4.7.2 Factors affecting CU

Variations in demand

The variations of demand are partly a result of the customers inability to estimate their production output properly which gives false information to the company. Another reason is seasonality, which affects the company mainly during the Christmas holidays and during the summer.

Trade imbalances

Container2 mentions there is an imbalance in Scandinavia with more exports than imports. There is also an imbalance in the United Kingdom, where the import is four times higher than the export in terms of containers being shipped. The market in Germany is balanced due to the automotive industry. However, the overall volumes in Europe indicated there is an imbalance which is described by the interviewee: *"So I think overall in Europe there is an imbalance probably with, I would say one and a half to two containers in for every one container out".* This imbalance forces Container2 to ship empty containers to Asia in order to have the containers available in Asia.

Weather

Weather is described as an issue which often also relates to the ports. If it is too windy, the port in Rotterdam closes down. Fog is a common problem in China as the ships cannot sail into the port under too foggy conditions. Not being able to enter the port disrupts the operations as goods cannot be loaded or unloaded.

Ports

Container2 experiences that the ports may constitute a problem under certain situations. Sometimes the ports are congested, making it difficult for them to carry out the loading and unloading operations. Time at port is often also a limiting factor as the company may have to do a cut and run, where they cut the operation and sail before all the loading has been done. The equipment at the ports is not seen as a limiting factor as the company only calls ports that have adequate equipment and the capacity to handle the big ships.

Some ports in areas which hinders Container2s ability to fill the vessel completely. One example is the port in Hamburg where the vessels need to sail in a river in order to reach the port. As the river is not that deep, the vessels can only have a certain draft. This makes it impossible to utilise the 18 000 TEU-ships to a high degree as it otherwise would get stuck in the mud. In some situations, there are bridges that force the ships to have a certain draft.

Late arrivals, no-shows, cancellations

The company experiences that many of the customers book space on the vessels and cancel before the departure. Customers may also book more space than they actually require and show up with less cargo on the day of departure. As Container2 does not charge its customers for a cancelled booking or showing up with less goods, there are no repercussions for the customers which instigates this behaviour. The shippers are however not obliged to take the goods on the ship if they are already full, which further increases this behaviour from the customers. This is seen as the biggest challenge to increase the capacity utilisation.

4.7.3 Strategies

Increase demand

The company uses pricing to attract more goods but only to a limited degree. The pricing mechanism is used for goods that are on the spot market. The interviewee states that:

> *If I reduce my prices for containers shipping from Asia to Europe, I cannot increase demand. Because the production is what it is. They will not produce more in the factory just because my prices are cheap. I can get cargo from other shipping lines, but they will most likely retaliate by reducing their prices.*

Standby cargo

Container2 has agreements with customers whose goods are not time sensitive to ship the goods on later departures.

Cooperative arrangements

Container2 is part of a strategic alliance with one other ship operator. The alliance allows Container2 to operate and fill bigger vessels which would otherwise not have been possible. It also allows them to offer more frequent departures to their customers. Their way of working with capacity utilisation has however not changed since they joined the alliance.

Vessel allocation

Container2 can allocate and swap vessels between the routes if the demand situation changes within the network.

Frequency

The frequency is rarely changed as a way to increase capacity utilisation. Sometimes sailings are blanked and ad-hoc vessels can be put into use but the frequency is never changed. Having blank sailings allows Container2 to better match supply with demand when the demand drops and utilise the vessels that are under operation to a higher degree. This is often used to cope with seasonal demand variations. Blanked vessels may be used on other services that may have an increase in demand

Routing

The overall network and routes for the services are revised once a year in April. Changes to the services, i.e. which ports they should call to is seldom performed besides in April. However, in situations where a sailing has been blanked and a specific port needs to be served, another service may need to add that port to its route. This is however often not done for capacity utilisation purposes. This can be done on a week’s notice.

In situations where one string is overbooked the company may move some of the goods to other strings that visit some of the same ports but are not utilised to the same degree. This is called an inducement call. In situations where demand is reduced for a specific route, the company may choose to move cargo too another string that visits the same port. Container2 states that this is an example of string optimisation, where cargo is moved between string to increase capacity utilisation. This may however create confusion for the customers.

Ports

Container2 owns many of the container terminals that it uses. In situations where they do not own them, they have a contract with a terminal operator to serve the ships.

Overbooking

In order to achieve a high capacity utilisation, the company sees the need to overbook their vessels. This is used as a tool to counter the cancellations and no-shows. The interviewee mentions that *"If we drive for 100% utilisation, we usually have to push for 120%".*

Two-way commitment

In order to reduce the number of no-shows and cancellations, the company states that there needs to be a two-way commitment where the shipping operators commit to taking the cargo on the ship if a booking is placed, and the customers arrive at the port with the promised cargo. A solution is mentioned where bookings are placed and paid for beforehand and the ship operator commits to send the goods. If the customer or the supplier do not deliver, they have to pay.

4.8 Container3

Container3 is a global ship operator who is operating in 155 countries. The company is a leading actor within container shipping and also offers services such as passenger ferries. The interviewed department was responsible for container shipping, where they have liner and feeder services. Container3 targets both local and international customers. On an annual basis they transport 21 million TEUs and have 500 port calls worldwide through 200 trade routes. Their fleet consists of 520 vessels. Container3 is in an alliance with one other leading actor in the market and has a market share of 22% in Sweden.

Container3 collaborates with forwarders and BCOs, where 70% of their cargo comes from BCOs and 30% of the cargo originates from forwarders. For their customers it is important that Container3 offers a service which is connected to the local area. Therefore, there will always be customer service available locally. Another important aspect for their customers is to have a ship operator that is flexible, this is achieved by Container3 by having local systems. According to the interviewee, their customers are in general loyal. Customers contracts can have the length between 1-24 months. Customers are prioritised for their departures, depending on their value in their portfolio. In the port of Gothenburg Container3 accepts late bookings up to 24h before departure.

The most important KPI for Container3 is volume, with the help of volume they measure the amount of TEU that is being shipped or their market share. Capacity utilisation is measured in different ways: by number of loaded TEU or the weight. This is followed up on a weekly basis and their current levels are 85% for their capacity utilisation.

4.8.1 Capacity planning

In Container3s capacity planning, all local offices give their expectations on expected volumes and continuously update their forecast to be able to optimize their network. For their longer routes' changes are planned on a yearly basis and implemented in April, ad-hoc changes cannot be performed to the bigger routes. If changes in capacity are needed, Container3 first tries to shift vessels between different routes within their network at first. Chartering vessels is used as a second alternative. In their operations Container3 does not plan to have overcapacity. An optimal level for them would be 101%.

4.8.2 Factors affecting CU

Variation in demand

The interviewee stated that they are affected by seasonal variation, for example the Chinese New Year.

Trade Imbalances

Container3 experiences trade imbalance in their system which affects their ability to achieve a high capacity utilisation.

Type of Cargo

Loading heavy cargo may result in the vessel reaching its maximum carrying capacity before the ship has been fully loaded with containers.

Weather condition

Changed weather conditions can affect their ability to achieve a high capacity utilisation on their vessels.

Ports

On specific ports, there are problems that affect the company's capacity utilisation. This is a result of the small buffers between arrivals and departures that the ports have, which limit their flexibility.

Service level
Container3 does not leave any additional space left on their vessels in the purpose of serving important customers that would come with cargo close to departure.

Internal barriers within the company
The interviewee mentions there are internal barriers within their company which puts hindrance on their efficiency. It is mentioned that there is a challenge in prioritising customers since it becomes a subjective judgment *"The prioritisation can be problematic and that can limit us [...]"*. Further, lead-times on information that is mediated within the company affects their ability.

Late arrivals, no-shows, cancellations and late arrivals
The interviewee mentions a problem which affects their ability to fill their vessels are cancellations on some of their bookings. Customers inform that they want to ship 20 containers but only arrive with 15 containers to the port. This late downfall affects their ability to fill the ships maximally. Combined with this they also experience customers who do not make the scheduled appearance which also has a negative impact on their operations.

Legislation
The interviewee stated that legislation affects their ability to fill ships with last minute-cargo going to China. Custom papers have to be handed in 48h before departure, therefore they cannot take cargo in the last minute to fill the ships.

4.8.3 Strategies

Increase demand
The following was mentioned from the interviewee*: "The price strategy can be revised in the middle east to increase the volumes".* Container3 uses the pricing tool to attract more cargo if there is a shortage of volumes. It is also mentioned that if Container3 has started a new liner service they can lower the price in the beginning to attract customers from competitors.

Standby cargo
In order to handle situations where customers do not arrive at the port with promised goods, the company has cargo that can be rescheduled from previous departures. If they do not have cargo available, empty containers can be used instead. As stated by the interviewee: *"It is good to have cargo which can be loaded. It is often empty containers".*

Cooperative arrangements
Their strategic alliance with another actor has been seen beneficial for their capacity utilisation. Being in a partnership has also made it possible for them to lower their unit cost.

Vessel allocation
Vessels within their network can be exchanged between different routes in order to match supply better with demand.

Frequency
If there is increased demand during a certain season, Container3 will not increase the frequency of their service. If there is a lowered demand, they will have blank sailings instead to reduce the available capacity: *"Then departures are cancelled [...]"*

Routing
In their long-term planning they look if changes can be made in their routing to increase the capacity utilisation on their ships. If they see a trend or an increased flow on a certain area, Container3 can add ports to their liner services. This is however only done in their long-term planning.

Speed
Container3 is already using slow steaming on their vessels. However, it is mentioned that slow steaming is not used to increase the utilisation on their ships, but rather to save bunker cost.

Ports
It is seen beneficial to own the terminals and the stevedores, since it will give ship operators better control of the operations. This will also make it easier to make prioritising in the ports.

Overbooking
In order to handle No-shows, Container3 uses overbooking in their planning to a limited extent.

5 Analysis

The structure of the analysis follows the order of the research questions where 5.1 addresses the desired level of capacity utilisation among ship operators. 5.2 covers the factors that affect companies' ability to achieve the desired capacity utilisation and 5.3 analyses what strategies can be used in order for ship operators to increase their capacity utilisation. In Appendix B a summary of 5.1, 5.2 and 5.3 has been presented.

5.1 Capacity planning

This section answers research question number one by analysing how ship operators plan their available capacity. First, different capacity utilisation strategies are explored and their applicability to different liner segments is studied. Thereafter, how capacity can be adjusted is investigated.

5.1.1 Planning of available capacity

Most of the studied companies perform long-term planning for their available capacity once or twice a year. During their planning, they look at the flows and see how they change and whether new ones are appearing. They also revise the expected total demand for their services on their routes and try to adjust their capacity to the changing needs. Table 5.1 below present the planned capacity utilisation and capacity utilisation strategy employed by the interviewed ship operators. A planned capacity utilisation of over 95% was defined as a cut peaks strategy, utilisation of below 85% was defined as never say no and 85-95% was defined as mixed. Table 5.2 presents the most important KPI for the customers of the interviewed ship operators.

Table 5.1 Planned capacity utilisation and capacity utilisation strategy employed by the interviewed companies.

Ship operator	RoRo1	RoRo2	RoRo3	RoPax1	Feeder1	Container1	Container2	Container3
Planned capacity utilisation	80-85%	75-80%	85-98%	N/A	N/A	100%	95-100%	100%
Capacity utilisation strategy	Never say no	Never say no	Mixed	Never say no	Cut peaks	Cut peaks	Cut peaks	Cut peaks

Table 5.2 The most important KPIs for the customers

Ship operator	RoRo1	RoRo2	RoRo3	RoPax1	Feeder1	Container1	Container2	Container3
Customer requirements	Reliability	Frequency and flexibility	Flexibility and price	Reliability	Price	Price	N/A	Service and flexibility

The planned level of capacity utilisation differs between companies as well as segments. Ship operators in the RoRo and RoPax segment are more prone to employ excess capacity than companies in the container or feeder segments. This is described by Styhre (2010) as a never say no strategy. The strategy employed is likely a result of their customer requirements, as the ship operators need to adapt to them and provide the customers with the right service to stay competitive. As can be seen in table 5.2, the most important customer requirements within the segment are service reliability and flexibility. According to Styhre (2010), having excess capacity increases service reliability as goods can be shipped without delays which incentivise companies within the RoRo segment to use the never say no strategy. Customers within the RoRo segment also value flexibility to a large degree. According to Styhre (2010) this is more easily provided by ship operators while having excess capacity. Frequency is also highly valued amongst their customers. Having to provide their customers with frequent departures forces the RoRo and RoPax ship operators to sail at a lower capacity utilisation. This is supported by Styhre (2010), who states that having more frequent departures every week makes it difficult for ship operators to achieve a high capacity utilisation which forces them to utilise the ship less effectively. Companies in the RoRo segment also expressed the need to have close customer relationships in order not to lose contracts as this could be detrimental for their survival on a specific route since capacity utilisation could drop drastically. According to Davies (1983) operating at close to 100% capacity utilisation negatively affects customer relationships which further incentivises RoRo companies to use the never say no strategy. As the sunk costs of entering a new market are lower for companies in the RoRo segment than the deep-sea container segment. The risk of new entrants is higher in the RoRo segment than the container segment as the capital investments required are lower due to the smaller vessel sizes. This increases the necessity for RoRo ship operators to operate with excess capacity. As stated by Fusillo (2003), excess capacity may be used as a strategic motive to guard against the uncertainty of new actors entering the market. This further incentivises the RoRo companies to opt for a never say no strategy.

Container1 and Container2 are more focused on driving down prices for their customers compared to other liner segments, as this is seen as highly important for them. This is done by utilising the ship to a large degree which reduces the cost per unit transported. This is supported by Davies (1983) who states that increasing capacity utilisation is beneficial as the average total cost is reduced. As a result, container shipping lines use the cut peaks strategy which results in a high capacity utilisation. Styhre (2010) states that the strategy is suited for markets with low freight rates which incentivise container shipping lines to use this strategy. Styhre (2010) states that this strategy is achieved by increasing market share. This can be observed in the container shipping industry as there are fewer actors in the market with more market share each.

Feeder1 mentioned their customers are large deep-sea container ship operators who aim to drive down prices for their customers. Their services are also measured from a cost point of view against the alternative of insourcing the feeder services. As a result, price becomes the most important KPI for the feeder lines. The feeder line tries to drive down prices by using the cut peaks strategy and fully utilise the vessels. This is supported by Styhre (2010) which states that the cut peaks strategy is used in markets with low freight rates.

The excess capacity on the vessel does however not only depend on the segment but also differs between routes. RoRo3 states that the capacity needs to be adjusted to the specific route as there are factors that make it easier or harder for companies to cope with shortage of capacity. If the company has a high network density with several routes passing through or close to the same ports, goods can be loaded on other departures without causing delays. These factors make it easier for ship operators to handle shortage in capacity which allows them to plan for a higher capacity utilisation. According to Styhre (2010) RoRo vessels have a shorter turnaround time at port which facilitates the use of some of these measures such as picking up goods on vessels passing close to the port. Having competitors with excess capacity in the area may also prove advantageous under certain circumstances as they may carry goods that did not fit on their own vessels. Despite the ship operators long term planning for available capacity, every company tries to achieve high an utilisation as possible on every departure.

5.1.2 Increase and decrease capacity

The companies are able to adjust to changes in demand by adjusting available capacity. If demand is expected to increase on a long-term horizon, companies may opt to purchase a new vessel (Styhre & Lumsden, 2007). As stated by RoPax1, this is a long-term measurement as it takes 2-3 years to build a new vessel. Fussilo (2003) states that there are economic incentives to invest in larger vessels which makes it difficult to increase capacity in smaller steps when buying new vessels. Ordering oversized vessels result in excessive amount of capacity and result in price deterioration, as ship operators try to increase the capacity utilisation on the vessels by reducing their prices. If demand is expected to be reduced on a long-term horizon, companies may choose to terminate a vessel to reduce capacity. Table 5.3 below presents the share of owned vessels for the interviewed ship operators.

Table 5.3 Share of owned vessels in the fleet.

Ship operator	RoRo1	RoRo2	RoRo3	RoPax1	Feeder1	Container1	Container2	Container3
Share of owned vessles in the fleet	90%	100%	50%	80%	10-20%	50-60%	70%	N/A

Ship operators can choose to charter parts of the fleet or the whole fleet which makes it easier to increase or decrease available capacity. The reason is that chartered vessels are easier to remove from the fleet than owned vessels and do not require large investments, as opposed to acquiring a new vessel (Cariou, 2008). Therefore, chartering provides an increased flexibility of available capacity compared to a strategy where the companies own the vessels themselves. Chartering is also used by ship operators in order to increase capacity on a short-term perspective. It may be used in order to counter short peaks in demand due to seasonal variations as an example. Some vessels are highly specialised to carry specific cargo such as the PCTC vessels. These are difficult to find in the market which forces companies to own the vessels themselves.

In situations where demand is falling on one route in the network and another route sees an increase in demand, the company may swap vessels between the routes to adjust to the changing demand situation. As stated by RoRo1, having a large fleet of vessels makes it easier to redirect them between routes and adjust to changes in demand. RoRo3 states that having vessels of varying sizes also facilitates finding the right vessel for a route. Routes located close to each other increases the feasibility of swapping as the vessels do not have to sail far distances to be exchanged. However, swapping vessels is not always feasible as the vessel are not compatible with the port infrastructure. Vessels can have ramps adapted to specific ports which makes them unable to load goods on other ports. This affects the RoRo segment the most as their cargo varies in shape and size as opposed to containers which has affected the design of the vessels to vary widely as well. Ports may also be located in geographical areas that do not allow for a certain draft on the vessels which may restrict companies from swapping vessels.

RoRo3 states the size of the vessels has an effect on the companies' ability to increase or decrease available capacity. Operating smaller vessels increases costs due to a lack of economies of scale but increases capacity utilisation. RoRo3 states that if volumes fall, the company is able to reduce capacity with more ease as the capacity is more divisible. Smaller ships also allow companies to adjust the available capacity to the demand with more ease. This is supported by Styhre (2010) who states increasing capacity in smaller and frequent steps will lead to a higher capacity utilisation.

5.2 Factors affecting capacity utilisation

In this section, research question two will be answered. By addressing which factors are affecting companies and analysing how they inhibit them from achieving a high level of capacity utilisation. Table 5.4 presents a compilation of the factors that the ship operators are affected by.

Table 5.4 Compilation of factors affecting the interviewed ship operators.

	RoRo1	RoRo2	RoRo3	RoPax1	Feeder1	Container1	Container2	Container3
Variation in demand	X	X	X	X	X	X	X	X
Trade imbalance		X	X	X	X	X	X	X
Lumpy capital		X	X					
Vessel design			X					
Type of cargo			X			X		X
Cooperative arrangements						X		
Competitive situation			X	X				
Weather conditions	X		X		X	X	X	X
Ports	X	X	X	X	X	X	X	X
Service level	X							
Schedule characteristics	X	X						
Internal barriers			X			X		X
Late arrivals, no-shows and cancellations					X		X	
Legislation			X			X		X

5.2.1 Variation in demand

Several operators stated variation in demand affected their ability to achieve a higher capacity utilisation on their vessels. The ship operators are dependent on the manufacturing industry, as fluctuations in their production affects ship operators' ability to fill their vessels (Styhre, 2010; Styhre & Lumsden, 2007). Container2 states that before summer vacation there is a peak in demand. The scenario is the same before Chinese New Year and Christmas holidays. After these holidays the firms experience a regression in demand during a time period. Several ship operators also state that some products have seasonal variations in demand which increases the volumes that need to be transported for a certain period. Fluctuations in demand affect ship operators negatively since the supply is fixed from a short-term perspective (Fusillo, 2004). Therefore, this will create a challenge to cope with changes in demand and a mismatch between supply and demand will arise (Fusillo, 2004). As explained by Fusillo (2004) this mismatch reduces the utilisation on the vessels. Ship operators' ability to estimate their customers' production output therefore has a great impact on the utilisation levels on the vessels, as they are able to plan their available capacity accordingly. Besides having fixed capacity on a short-term perspective, ship operators also have a fixed schedule which they need to adhere to (Fussilo, 2004). This also creates difficulties when trying to cope with variations in demand as ship operators are not able to wait for more cargo for a specific departure to fill up the vessels when demand is low. This results in a lower capacity utilisation since the departures are fixed.

5.2.2 Trade imbalances

Every company except RoRo1 identified trade imbalances as one factor affecting their ability to achieve a high capacity utilisation on their vessels. RoRo1 is not affected by trade imbalances in the Gothenburg region, since they have achieved a good balance in their system. This may however be an issue for the ship operator on other routes.

RoRo2 mentioned within Sweden there is an imbalance with more goods going southbound compared to northbound within the country. The underlying reason for this is that the production and raw materials are placed in the northern parts of Sweden whereas the consumption is in southern Sweden which also has a larger population. This creates an imbalance in their system and repositioning of empty containers is required. This in turn leads to a lower capacity utilisation for their transports going northbound.

Several ship operators mention the import volumes are higher for Europe compared to the export volumes. According to Styhre (2010) and Ting and Tzen (2004) this is a result of the international trade patterns. This will in turn lead to a lower utilisation on the vessels going out from Europe as the vessels are dimensioned for the heavy leg of the route. These imbalances have also created issues for the ship operators to handle the empty positioning of containers in their system. For example, Container1 mentioned that they need to transport more reefer-containers to Latin America due to the low export volumes from Europe. This affects their capacity utilisation since they are forced to transport empty containers instead of containers loaded with cargo. This is supported by Ting and Tzen (2004) who state that transporting empty containers affects the capacity utilisation negatively, since empty containers have to be repositioned and therefore reduce the capacity utilisation on the vessels. As stated by Styhre (2010), the maximum capacity may be reached in different ways such as volume or weight. Empty container repositioning only restricts further loading on the vessel with more cargo if volume is the limiting factor.

5.2.3 Lumpy Capital

Capital lumpiness is an issue that is experienced by RoRo2 and RoRo3 and affects their utilisation. As stated by RoRo2, newly built vessels should last for at least 30 years and are built on a few occasions. As a result, they dimension their available capacity with 20-25% excess capacity to be able to cope with increased demand in the future. Fussilo (2003) states that increasing the available capacity at few occasions is a result of the costs that incur when acquiring new vessels. As the cost per capacity increment decreases with increased capacity, companies are prone to increase capacity in larger and less frequent steps. According to Davies (1983) the cost structure of the industry where high fixed costs and low variable costs incentivise companies to invest in larger ships to gain economies of scale (Davies, 1983). This is however not optimal from an utilisation point of view, as the larger vessels create an excessive amount of capacity which has a negative impact on the utilisation. Having larger and fewer vessels are also creating problems for companies trying to match demand with their available capacity.

5.2.4 Vessel design

The vessel design in conjunction with how the goods are loaded is an issue that affects the capacity utilisation for the RoPax1. As opposed to containers which are stacked on top of each other, the cars are loaded on to the decks with varying degrees of success. RoPax vessels often have a hanging deck on the main deck which increases the available lane meters but reduces the max height of the goods on the main deck. Loading trailers on the main deck inhibits the use of the hanging deck which reduces the available capacity on the ship. The way that the goods are loaded and the extent to which the main deck can be used therefore affects the amount of lane meters that can be transported on the vessel, which in turn affects capacity utilisation.

5.2.5 Type of cargo

Container1 and Container3 state that transporting heavy project cargo, i.e. windmills limit their ability to load more containers on their vessels. The heavy cargo causes the ship to reach its maximum capacity faster in terms of weight. As a result, more containers cannot be loaded even if there is space left on the vessel. The heavy cargo often also has varying dimensions which makes it harder to utilise the space on the ship optimally. This can reduce capacity utilisation on the ships. The incentive for transporting cargo which cause a lower utilisation is that it is generating more revenues.

RoRo3 states that the dimensions of the cargo being transported affect the utilisation on their vessels. The RoRo segment is affected by transporting different cargo with different dimensions as it is not standardised and homogeneous which makes it difficult for the ship operators to find a balance between available capacity and demand on the vessel level. A vehicle may have a varying width and height, compared to a container which is standardised to have the same dimensions. As the units that are being carried on the ships are not as standardised, there are often discrepancies on the decks between available capacity and the unit loads. This was exemplified by RoRo3, who stated that a car could be 1,82 meters wide whereas the lane only was 1,8 meters wide. This resulted in the last lane being unutilised to a large extent as the cars crossed over the lanes throughout the deck. As described by Santén et al. (2018), not utilising every deck to its maximum potential results in a low load factor on the ship level, which reduces the overall capacity utilisation.

5.2.6 Cooperative arrangements

All the ship operators except RoRo2 cooperate with other actors in order to achieve a higher utilisation. However, Container1 experienced that cooperative arrangements could also affect utilisation negatively. According to Container1, the drawback of being in an alliance with several ship operators is that all actors in the alliance have to approve changes. Examples mentioned are changes to the routes and schedules. The ship operator states that an increased number of actors in the alliance makes the decision making slower compared to only having an alliance with one actor. This is a result of negotiations which become more complex and everyone may have different agendas. This is supported by Cariou (2008), who states that the drawback of an alliance is that the coordination of different actors can be complex. As an example, a change that would increase utilisation for most of the parties involved could be stopped by an operator that does not benefit from that change. This would reduce utilisation for the remaining actors. This is supported by Panayides and Cullinane (2002) who state that different actors may drive their own individual objectives in the partnership. The fact that Container1 is the only ship operator with more than two alliance members may explain the reason why they are the only company experiencing the negative consequences of being part of a shipping alliance.

5.2.7 Competitive situation

RoPax1 and RoRo3 mentioned the competitive situation as a factor that has a negative impact on the capacity utilisation. The competitive situation in terms of the number of actors that are operating on a specific string is a factor that affects the utilisation of the vessels. This is a result of the demand situation to a large extent. The total demand for the services provided by liner companies is mostly unaffected by actions taken by the ship operators to promote their services and more affected by market conditions (Wu, 2012). As stated by RoRo3, more cars are not going to be manufactured and sold as a result of reduced prices on their transportation service. The RoPax segment is an exception to this rule as they are able to use marketing and pricing to increase the total demand for their services. As a result of this, the total volume that needs to be transported between specific ports is shared between the actors that operate on that string. Increased competition is therefore detrimental for a ship operator's capacity utilisation. In a situation where two actors are operating on a string and a third one enters; the capacity utilisation can be reduced by 33% assuming they achieve the same market share. In order to guard against the uncertainty and threat of new entrants, companies may decide to operate at a lower capacity utilisation in case a new actor decides to enter the market (Fussilo, 2003). In a situation where a competitor decides to enter the market, the ship operators are able to reduce their prices and allocate more volume to their existing fleet which deters new entrants from entering the market (Fusillo, 2003; Wu 2009).

Threat from substitutes also negatively affects the demand for the ship operator's services. This is the case for the RoPax segment as there are several alternatives to taking the ferry. RoPax1 exemplifies this by stating that the customer may take land borne solutions as opposed to the ferry. As stated by Feeder1, their customers are container ship operators and are therefore able to perform the services that they provide themselves. The way that competitors' price their services also affects capacity utilisation. Reduced prices from other actors reduces the demand for the ship operator's services as they get a smaller share of the total demand, which may also affect capacity utilisation.

5.2.8 Weather

Majority of the companies mention they are affected by harsh weather conditions as it may cause delays in their sailings schedule. Not arriving on the scheduled berth-time may result in a shorter time for loading and unloading operations. This may have a negative effect on utilisation as all the cargo may not be loaded before the berth time is over. As stated by Container2, having windy or foggy weather conditions may inhibit them from calling the port, which would entail cargo not being loaded on the vessels. This reduces utilisation on the vessel.

5.2.9 Ports

All studied companies mentioned ports hinder their ability to achieve a high capacity utilisation. Several ship operators experience the ports have a low flexibility. If the ship operators arrive with a delay to the port, their time window at the port will be reduced. The berth-time cannot be increased. This results in less time for loading cargo on the vessels, which reduces capacity utilisation. RoRo3 states that some of the ports are not opened during the night which inhibits ship operators to load and unload goods at specific times during the day. If the ship operators arrive at night, some ports cannot guarantee to have stevedoring employees available which makes it impossible for the ship operator to load the goods at certain times. Container2 and RoRo3 mention that congested ports cause slower unloading and loading operations. RoRo3 states that not being able to enter the port when planned inhibits them from loading goods on to the vessels, reducing utilisation. This is a result of ship operators capitalising on economies of scale and operating large ships which take longer time to process for the ports. This is supported by Midoro et al. (2005) who state that increased vessel sizes have increased the time at port. The location in which the port is situated may also affect utilisation. As stated by Container2, certain ports cannot handle a high draft, which means that large vessels cannot be loaded to a high utilisation.

5.2.10 Service level

Only one of the ship operator's experiences that the service level has a negative impact on their capacity utilisation. RoRo1 mentions operating at 100% capacity utilisation would not be sustainable for them. They state operating at high levels would increase the risk of rejecting cargo from customers, which in turn will have a negative impact on their service level. If cargo is rejected several times from the customers, some customers may opt to switch supplier, reducing the ship operator's market share. For this reason, ship operators want to leave unutilised capacity on their ships to serve important customers. This is aligned with Styhre (2009) who states that ship operators may not want to operate at 100% utilisation for this reason. Davies (1983) also states that operating on high levels can lead to ship operators having to reject cargo from some customers. If this happens several times, it will have a negative impact on their relationship and may lead to the customers changing to another supplier.

Container1 and Container3 do not leave capacity unutilised for important customers, instead their aim is to fill the vessels to 100%. This is contractionary to the explanation presented by Styhre (2009) and Davies (1983). The reason for this can be that these ship operators believe it is more sustainable for them to utilise their ships fully, without leaving capacity idle on their vessels on purpose as this generates more revenues. As Container1 and Container3 have a large market share, they may use their available capacity to a larger extent and reject cargo from customers since the customers are more dependent on them.

5.2.11 Schedule characteristics

RoRo1 and RoRo2 have several departures throughout the week. The weekend departures have a lower demand compared to the other departures. These departures on the weekend lowers their weekly figures for capacity utilisation as there is a lower demand for their services during the weekend. The ship operators need to have these departures in their schedule however as they need to offer the service to their customers several days throughout the week. Without having the high frequency customers may opt to transport cargo with other suppliers instead. Not providing a high frequency can cause loss of sales, since there will be no service available for the customers during the weekend. Styhre (2010) states that having a higher frequency may lead to a lower utilisation per voyage. However, the total amount of goods that are shipped during a year are increased. By transporting more goods annually, the revenues can be increased. However, increasing the frequency increases the total cost for the service (Styhre, 2010). Container2 states that most of their services have weekly departures. Deep-sea container ship operators transport goods that are less time sensitive than short-sea operators. As a result, their customers do not require them to provide departures with as high a frequency. This reduces the negative implication of schedule characteristics mentioned above.

5.2.12 Internal barriers

RoRo3, Container1 and Container3 mentioned internal barriers within their company may have a negative impact on their operations to achieve a high capacity utilisation. Miscommunication between different functions may as an example impact the loading operations on the vessels when handling high-and heavy cargo. If the right dimension of the cargo has not been forwarded onto another function the reserved space may be larger than required. This may result in unutilised space on the vessels. Container1 and Containter2 mention that different functions within the company have different goals and want to prioritise different cargo on the vessels. This will affect their levels of capacity utilisation, since one customer might have 10 containers and it is an important customer for salesman 1. Another salesman may have a customer with 50 containers ready for transportation but may not be able to load the goods as salesman 1 has already allocated the 10 containers to the vessel. The way that the prioritisation is done will therefore affect the levels of capacity utilisation. Styhre (2010) emphasised the need for different departments within the company to communicate with each other. Further, it is also important to achieve a holistic view over the company's situation (Styhre, 2010). Having miscommunication between different functions and having different agendas will therefore affect capacity utilisation negatively.

5.2.13 Late arrivals, no-shows and cancellations

Customers delivery behaviour is an issue that is seen as one of the biggest challenges that liner companies need to cope with. Late arrivals to the terminals inhibit companies from loading goods on the booked departure. The feeder services provide a connecting service for container shipping lines and are therefore highly impacted by no-shows and late arrivals. Service reliability is seen as an important KPI for them which makes it difficult to have countermeasures such as overbooking. No-shows and cancellations are also common, especially in the container industry. Customers book space on the vessels and do not arrive with the amount stated in the booking or cancel bookings right before departure. Container2 states that the customers are able to do this as they are not obliged to pay a fee and do not have any other repercussions for this kind of behaviour. None of the interviewed actors charged their customers for not arriving at the terminal with the predetermined amount of goods. The lack of commitment makes it difficult to plan available capacity to match the demand as it creates an uncertainty of demand, reducing the capacity utilisation. If the company doesn't have any standby cargo which they are able to fill the vessels with, the utilisation is reduced.

5.2.14 Legislation

Legislation regarding customer declaration for cargo being transported from Sweden to China has a negative impact on Container3's operations. Custom papers have to be handed in 48h before departure. This rule does not allow Container3 to fill up their vessels with cargo coming 48h before departure even if there is space left idle on the vessels. Instead, the cargo has to be scheduled for another departure, which results in a lower capacity utilisation. The time limit does not allow Container3 to take orders close to departure which may inhibit them from reaching higher levels of utilisation. Short sea RoRo and feeder companies are however able to accept bookings up to 30 minutes before departure. This legislation is therefore not applicable to them and does not affect them.

RoRo3 and Container1 mentioned certain cargo has to follow special rules, which limits their ability to load the cargo on the vessels efficiently. For example, transporting military cargo puts restrictions on what other cargo can be loaded on the vessels or larger space is reserved for this cargo. This hinders the ship operator's ability to allocate cargo efficiently. Dangerous goods need to have a certain distance between them and only a limited number of containers can be loaded. Keeping a safety distance between the containers results in space being left idle where other containers could have been loaded. This reduces utilisation, since fewer containers will be loaded on the vessel. However, this may not always be seen as a negative aspect. The dangerous cargo may be charged with a higher price. So, there can be a trade-off between revenues and capacity utilisation.

5.3 Strategies

This section answers research question number three by presenting strategies and tools that can be used by ship operators to increase capacity utilisation. The applicability of the strategies is evaluated by combining information acquired by the interviewed companies as well as the literature study. Identified differences in applicability between liner segments are presented. Table 5.5 is a compilation of the strategies that were mentioned to be used by the interviewed ship operators.

Table 5.5 Compilation of used strategies by the interviewed ship operators.

	RoRo1	RoRo2	RoRo3	RoPax1	Feeder1	Container1	Container2	Container3
Increase demand				X	X	X	X	X
Standby cargo	X	X	X	X	X	X	X	X
Cooperative arrangements	X		X	X	X	X	X	X
Vessel allocation	X		X	X	X	X	X	X
Frequency	X	X	X	X		X	X	X
Routing		X	X		X			
Speed								
Ports	X			X			X	X
Cargo		X	X					
Customer selection			X					
Overbooking		X		X	X	X	X	X
Two-way commitment								

5.3.1 Increase demand

This section presents how the ship operators use pricing and marketing in order to increase the capacity utilisation.

5.3.1.1 Pricing

Several of the interviewed ship operators state that there is an overcapacity in the market. This is supported by Wu (2009), who states that the economic benefits of economies of scale have resulted in overcapacity in the industry. The overcapacity has put the customers in an advantageous position as they are able to push down the prices when negotiating the contracts. Most of the interviewed ship operators state that customers are prone to change suppliers if the prices are not low enough, meaning that there is a high price elasticity of demand for most of the products. This makes it difficult for ship operators to adjust their prices as this affect the demand for their services negatively. The elasticity of demand does however vary depending on the segment, route, products that are being shipped and customers which alters ship operators' ability to adjust prices.

Pricing is seldom used amongst RoRo ship operators to increase the demand for their services. The interviewed companies argue that the total demand on a route or string is constant and unaffected by the prices that they provide to their customers. This is often the case as BCOs do not manufacture more goods to be shipped if the prices are lowered. As stated by several RoRo ship operators, there are often only 2-3 actors operating on specific strings between different ports. Reducing the prices would increase a ship operator's total share of the goods being transported on a specific string. However, it also creates incentives for competitors to reduce their prices which could create price wars, reducing the profitability for all the actors. Companies in the RoRo industry are therefore cautious when reducing their prices and do not use pricing as a mechanism to increase demand.

As stated by Styhre (2010) the number of competitors affects the degree to which price discrimination can be used for different customer groups. In situations where there are few competitors, RoRo companies may use price discrimination to increase the capacity utilisation and increase profitability. RoRo ship operators mainly transport cars and trailers, but also project cargo and containers. Project cargo are often goods which cannot be transported on other transportation modes due to their heavy weight or dimensions (Styhre, 2010). This reduces the elasticity of demand for these goods as there are no other transportation alternatives. However, containers and cars can be transported on containerships which increases the elasticity of demand and reduces the RoRo operator's ability to adjust the prices without negatively affecting the demand on their service. RoRo ship operators should charge prices above the long-run average costs for the project cargo, as this is not expected to reduce the demand to a large degree. This gives the companies more freedom to charge lower prices if necessary, for cargo with higher elasticity of demand such as containers which should increase the load factor.

The customers of the RoRo ship operators are mainly BCOs but they are also handling cargo on behalf of forwarders. The forwarders have a more transactional behaviour where they chose the cheapest option for every departure. This makes it difficult for ship operators to use price discrimination with forwarders. However, BCOs value flexibility, reliability and frequency to a larger extent which increases the flexibility of the ship operators when pricing their services.

The RoPax segment differs with regards to the total demand situation for the passenger segment as they can increase the total demand for their services by reducing their prices. As an example, if the price for the ferry ticket is reduced, more customers are prone to use their services. Pricing is therefore used to a larger extent than for the RoRo and container segment. It can be used as a way to handle seasonal demand variations, as lowering prices during the off-season.

The interviewed container shipping lines are part of alliances which reduces the competitiveness on the market and the negative effects of price reductions. As stated by Styhre (2010), strategic alliances reduce destructive competition and prices are not pushed to marginal costs to the same extent. This allows container shipping lines to use the pricing mechanism with greater freedom. This could be observed as the interviewed container shipping lines used the pricing mechanism to a larger extent than ship operators in the RoRo sector. As the service provided is homogeneous, the most important differentiator amongst the container shipping lines is price. The container shipping lines are therefore more prone to reduce prices as a way to increase their capacity utilisation and their revenues. The interviewed container ship operators are however also cautious with the pricing mechanism and do not want to deflate the prices excessively. The feeder segment has container shipping lines as customers which value low prices to a high degree. Pricing is therefore used as a way to attract more customers by the feeder operators. As the cargo transported by container and feeder ship operators is mainly containers it limits their ability to differentiate the prices between customer segments and use price differentiation to increase utilisation.

Pricing can be used to handle trade imbalances. This can be done by using price differentiation by reducing the prices for the low-volume sea leg while increasing the prices for the high-volume leg which increases the balance in the route. The negative effects of the schedule characteristics, where demand is lower for certain departures can also be handled by using price differentiation. The attractiveness of the departures with low demand can be increased by lowering their prices.

5.3.1.2 Marketing

Marketing is only used as a tool to increase demand by RoPax1. The reason for this lies in the type of services that are provided by the company. RoPax1 is the only interviewed actor that transports passengers on the vessels. Customers using the service have many alternatives to taking the vessel, such as taking the car over a bridge going to the same destination or taking the plane to for a summer vacation in another country. The total demand for their services is therefore affected by the knowledge that the customers have of their service. This is supported by Felstein (2010) who states it is important to work with awareness to remind customers about their offering. This is not the case for ship operators transporting containers or cars as there are often not many alternatives to transport the goods. As stated by RoRo3, there are often only two to three actors providing a service between specific ports. Customers working in the logistics sector often have knowledge about the alternatives that are available as they negotiate with them for the lowest prices and best services. Zeithhaml et al. (2009) states that demand can be increased by using marketing tools such as promotions during low seasons to even out the demand and counter seasonality of demand.

5.3.2 Standby cargo

All interviewed companies stated that standby cargo is used to increase the capacity utilisation on the ships. In general, standby cargo is cargo that is not time sensitive and can therefore be rescheduled for another departure which has a low capacity utilisation (Styhre, 2010). This allows companies to even out the demand for their services. If the Monday departure has a high utilisation whereas the Wednesday has a lower utilisation, standby cargo which has a departure for Monday may be allocated to the departure on Wednesday. Standby cargo is used by several ship operators to cope with the downfall caused by late arrivals, no-shows and cancellations. Changing departures for standby cargo makes it possible to handle variation in demand and simultaneously be able to increase the capacity utilisation on the vessels (Rogerson & Santén, 2017; Jonsson, 2008; Styhre, 2010). Standby cargo can be rescheduled to be shipped either for earlier or later departure to fill the vessels when the utilisation is low. Styhre (2010) states standby cargo have lower rates and are often not time sensitive. The customers have reduced rates for standby cargo since the arrival date is not fixed which gives ship operators a higher flexibility when planning the allocation of cargo. Besides using standby cargo to counter the downfall of cargo caused by late arrivals, no-shows' cancellations, it could also be used to counter negative effects of schedule characteristics. The characteristics of the schedules, where demand is lower for some departures can be countered by having standby cargo available which evens out the demand throughout the week. It is therefore important for ship operators to ensure to have standby-cargo available, as it allows them to reduce the empty space on their vessels.

5.3.3 Cooperative arrangements

All firms except RoRo2 are part of an alliance or a collaboration with other actors on the market. Being part of an alliance allows companies to adjust their available capacity more easily as it reduces the need of purchasing additional vessels to change the available capacity (Fusillo 2004; Cariou 2008). As stated by Fusilli (2003) investments in additional vessels can be done with alliance members which reduces the negative effects of capital lumpiness and allows companies to increase capacity in smaller steps. The firms mentioned that by being a part of a strategic alliance or collaboration they are able to allocate capacity on each other's vessel. This allows ship operators to consolidate goods and transport cargo on fewer vessels. This is done by having slot sharing agreements as described by (Panayides & Cullinane, 2002). Ship operators in an alliance are able to load more goods on the vessels without negatively affecting the service towards the customers as they are able to load goods on the vessels of the alliance members if necessary. The interviewed ship operators state that being part of a strategic alliance allows them to transport goods on one vessel instead of having two vessels operating back to back with a low utilisation. If two alliance members are operating on the same route, they can use one vessel instead of two to transport the same amount of goods. This allows ship operators to handle negative effects of schedule characteristics, where demand is lower for certain departures as capacity can be more easily adjusted throughout the week. As a result, capacity utilisation is increased on the vessels. The increased flexibility in capacity allows ship operators in an alliance to match capacity better with demand. This allows them to cope with variations of demand more easily. Cooperating with other actors in the industry increases the market concentration and reduces the number of competitors in the market. This reduces the competitiveness on the market and its negative effects on capacity utilisation.

5.3.4 Vessel allocation

RoRo1 has a fleet of vessels with various sizes, which allows them to shift vessels between different routes within their network. If there is a lower demand on one route resulting in a low capacity utilisation, the vessel can be exchanged for a smaller one under the presumption that a larger vessel is needed somewhere else within the network. Having vessels of varying sizes therefore allows ship operators to increase their capacity utilisation on one route and increase their ability to cope with increased demand on another route. Ship operators can as a result react to changing market conditions and variations in demand by swapping vessels. Styhre (2010) states that the increased flexibility that companies achieve by swapping vessels increases capacity utilisation. Having an extensive network of vessels is beneficial, since it gives ship operators a better flexibility to adjust their capacity on different routes. Being part of an alliance facilitates the use of this strategy, since it gives the ship operators access to a larger fleet of vessels. In situations of increased demand, swapping vessels allows companies to increase their available capacity without investing in new vessels which reduces the capital lumpiness. RoRo3 states if there are several vessels operating on the same route and the demand is lowered, one of the vessels can be terminated. This allows them to transport the same amount of goods on fewer vessels, which can increase the capacity utilisation.

5.3.5 Frequency

The ship operators within the RoRo and RoPax segment adjust their schedule to the demand situation to some extent. If there is an increase of demand before summer, they increase their frequency in order to match supply better with demand and be able to increase their sales and handle variations in demand. However, after seasonal peaks or if demand is lowered, their frequency is reduced by having a new schedule in order to increase their capacity utilisation. Having less departures allows ship operators to consolidate cargo to a larger extent, which results in a higher utilisation on their vessels. Maintaining the same schedule with the same vessel setup and frequency of departures throughout the year would result in a lower average utilisation as the total capacity is not adjusted to the demand situation. Reducing the frequency may however affect the service towards their customers negatively. Operating with a higher frequency and smaller vessels reduces the congestion in the ports as stated by RoRo3. This reduces the necessity to do cut and runs as the loading operations are done in time at the port. However, reducing the vessel sizes decreases the benefits achieved by economies of scale.

The interviewed container shipping lines have a fixed schedule that does not change in frequency throughout the year. If the companies experience lower demand, blank sailings will be used instead, reducing the number of departures. This allows ship operators to consolidate more goods and reduces their need to sail with vessels that have a low utilisation. Blank sailings are not changes that will be implemented permanently, instead blank sailings are used as a tool to increase their utilisation on a short-term basis.

5.3.6 Routing

When doing the long-term planning for their routes, the interviewed actors take trade patterns into account. If the companies experience an increase in demand in a specific port, it can be added to their route. This will help the ship operators to increase capacity utilisation from a long-term perspective. RoRo3 takes weather into account when designing their routes. By having slack in the schedule between ports where delays usually occur due to harsh weather conditions the company is able to avoid missing their berth-time at port. As some ports do not have a night shift, companies should plan their routes so that this does not affect their operations.

RoRo3 takes into account the amount of cargo that is imported and exported to and from the ports in their route. Capacity utilisation is increased throughout the route by designing it so that the vessel visits a port that mainly has export right after a port that mainly has import. This results in the ship operator sailing with a low capacity utilisation for a short distance as the vessel is loaded with more goods shortly after it has been emptied in the import port. Longer distances between ports are made from a port that mainly has export so that the vessels sail with a high capacity utilisation for a longer part of the journey. This is presented in Figure 5.1.

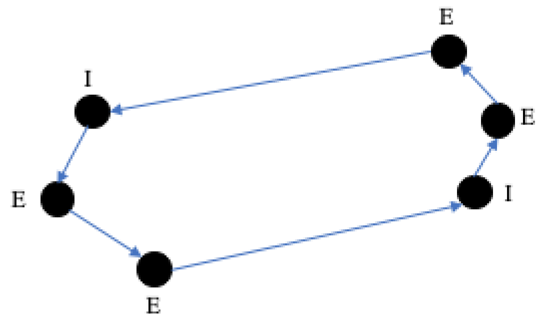

Figure 5.1 E = export and I = import. Ports which have high export volumes are visited right after a port which has high import volumes.

Feeder1 aims to combine several port calls which mainly export cargo to larger ports. By visiting several ports that are exporting cargo to one location, it is possible to consolidate cargo on the vessel for the longer part of the voyage, which increases the capacity utilisation. This is illustrated in Figure 5.2 below.

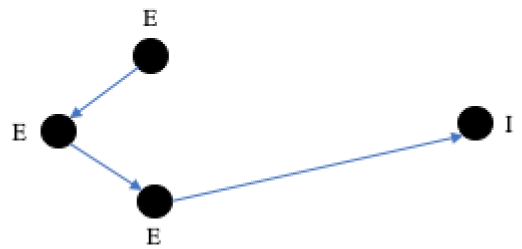

Figure 5.2 E=export and I=import. Illustrating that several ports which are exporting to one location are consolidated on the route.

RoRo3 and Feeder1 state that they visit additional ports in their route to be able to load more cargo if there is space left on the vessels. This change allows ship operators to increase the capacity utilisation by loading additional cargo which would not have been possible without the extra stop. However, the additional port will only be visited if there is a time gap in their schedule. Most ship operators do not do this as their service is a liner service where the schedule is fixed. Implementing ad-hoc changes would make it difficult to maintain the same schedule and they would no longer offer the service that has been promised to the customers. Other ship operators visit additional ports in order to pick up valuable cargo or serve customers on other ports when the service has been blanked. The reason for the change in route is not to increase utilisation in these situations, even though the changes result in capacity utilisation being increased. If demand is too high on a route, Container2 can move cargo to another string that visits the same port. This increases the utilisation on one string and reduces the load on the other route. If demand drops on a route, Container2 may choose to blank a vessel and move cargo to another route to increase utilisation.

5.3.7 Speed

Implementing slow steaming allows ship operators to absorb excess capacity from the market (Finnsgård et al., 2018; Malono et al., 2013; Dere & Deniz, 2019). However, none of the interviewed companies use this as a strategy to withdraw capacity from the market when they are experiencing low capacity utilisation on their vessels. This is supported by Raza et al. (2019), who state that slow steaming is not used within the RoRo segment. Instead, the interviewees mentioned slow steaming is used for the purpose to save bunker cost for deep sea shipping. Finnsgård et al. (2018) state that implementing slow steaming with the same number of vessels on a specific route forces ship operator to reduce the frequency of departure. This would affect the customers negatively which reduces the viability of reducing the speed to decrease capacity. However, slow steaming may be more favourable in a situation where there is large regression in demand and exceptional cost saving measures are required. RoRo3 states that altering the speed for a vessel on a specific route is not feasible as a short-term measurement to increase or decrease capacity on that string to affect utilisation. Changing the speed would change the frequency for that vessel whereas other vessels would have the same frequency. This would result in the vessels coinciding on the same port at the same date which would reduce the sailing frequency for the customers.

5.3.8 Ports

Several ship operators own the terminals and perform the stevedoring operations by themselves. This may be beneficial as it allows them to have a better control of the operations. As stated by RoRo3, having own terminals and stevedores allows companies to work in the same ways across ports, increasing the standardisation. Having better control of their operations and increased standardisation can increase efficiency in their loading and unloading operations, which in turn could increase their capacity utilisation. Midoro et al. (2006) support this as they state that owning the stevedores the schedule reliability can be increased. This is a result of the companies being responsible for the planning and can make the prioritisation at the terminal by themselves. Container3 states that being able to prioritise cargo and berth-time at docks allows companies to make adjustments and cope with situations when the vessels arrive late due to harsh weather conditions. RoPax1 states that owning terminal and stevedoring operations allows them to have a coherent view on which KPIs are important for the firm. This way the different units within the firm can work to achieve a better capacity utilisation by working towards the same target. However, if the terminal and stevedores are owned by another company, the goals might not be aligned between stevedores and the ship operators and lead to efficient operations.

5.3.9 Cargo

As stated by Santén (2016), vessels are able to reach maximum capacity on different dimensions such as weight or volume on the ship level. Loading heavy cargo with low volume results in reaching maximum capacity from a weight standpoint while the space on the vessel is still highly unutilised. RoRo ship operators are therefore able to increase their capacity utilisation by increasing their cargo mix, as this reduces the probability of reaching the maximum capacity of one restriction such as weight or volume long before the other. RoRo3 states transporting cargo that fits better with the dimensions of the vessels also increases utilisation. An example is carrying cars which have approximately the same height as the deck on the vessel as volume is better utilised. RoRo2 and RoRo3 state that finding cargo going on the low-volume sea leg is also a strategy adopted by them. This reduces the trade imbalances and allows ship operators to increase their overall capacity utilisation.

5.3.10 Customer selection

Container1 and Container2 state that it is beneficial to have a large part of the space on the vessel being allocated as it reduces uncertainty of demand. This is done by having long-term contracts where there is a fixed price for a certain amount to be shipped every week. Even though the weekly volume may deviate to some extent, the ship operators are able to plan their available capacity more easily. The loyalty amongst customer groups varies. Ship operators experience that BCOs are more loyal than forwarders and are more prone to sign long term contracts. Having a larger part of the volume allocated to BCOs with whom the companies have long term contracts reduces the uncertainty of demand and variation of demand. However, a smaller part of the volume can be allocated to forwarders as this allows the company to absorb peaks in demand. Table 5.6 presents the share of the volume that is transported for BCOs. The remaining volumes are allocated to forward except for Feeder1, which only ships goods for ship operators within the container segment.

Table 5.6 Share of volumes transported for BCOs.

Ship operator	RoRo1	RoRo2	RoRo3	RoPax1	Feeder1	Container1	Container2	Container3
Share of volumes from BCOs	30-40%	65-70%	N/A	N/A	0%	30%	50%	70%

RoRo3 aims to have a customer portfolio that consists of several customers within different segments. This will reduce the risk that the different customers will have fluctuations with their peaks and troughs coinciding simultaneously. This allows the ship operators to cope with variation in demand better which results in an increased capacity utilisation. Customers have different preferences with regards to the departures that they prefer throughout the week. Having a large customer portfolio therefore increase the probability of being able to allocate cargo to different departures throughout the week.

5.3.11 Overbooking

As presented in section 5.2.13 several ship operators face the problem of late arrivals, no-shows and cancellations. RoRo1 and Container2 state that customers are currently not penalised for this, which creates incentives for them to continue with this behaviour which reduces capacity utilisation. Container2 and RoRo2 states if customers behaviours are characterised by late arrivals, no-shows or cancellations they overbook the vessels. This is supported by Biyalogorsky et al. (1999) who state that this strategy is used when a customer does not make use of their booked capacity. As an example, for a departure that is fully booked the ship operator may expect 20% of the cargo not to arrive on time. In this situation, the ship operator may overbook the vessel by 20% to achieve the desired utilisation. Performing overbooking is a viable tool to handle the effects of no-shows and cancellation which will increase the utilisation (Qvartz, 2017; Smith et al., 1992). Qvartz (2017) points out that no-shows and cancellation are common problems in the sea trade. Therefore, it may be beneficial to use overbooking on most of the departures. In general ship operators are not punished for rolling cargo to other departures and can choose what cargo to load on the vessels. As a result, the highest paying cargo can be selected if there would be a situation when more than 100% cargo is available at the port. This way the capacity utilisation increases as well as the revenues. Overbooking can also be used as a tool to absorb short-term variations in demand. However, this will have a negative impact on the service and should therefore be used with caution. Overbooking is therefore used more by ship operators opting for a cut peaks strategy and less by ship operators opting for a never say no strategy as the customer relationships and service is negatively affected.

5.3.12 Two-way commitment

Container2 stated that increasing the commitment between the customers and ship operators would make it easier for ship operators to increase their capacity utilisation. At the current stage, the customers do not have to pay for a cancellation fee or any punishment fees for late arrivals, no-shows or cancellations. At the same time the ship operators do not guarantee to transport their cargo for a specific departure. As the ship operators know their customers cancel departures, they are more prone to overbook. The customers know the ship operators uses overbooking, therefore they are more likely to book more space on the vessels than needed and then cancel departures or not arrive with the stated quantity. Figure 5.3 presents the current situation whereas Figure 5.4 illustrates the improvement opportunity.

Figure 5.3 Illustration of incentives to overbook capacity and space on the vessels by ship operators and customers.

Container2 states that in order to overcome this situation, customers and ship operators should create a system where they commit to their promises. Container2 states that customers could perform the payment for the shipment before the transportation has been made. Containter2 states if the ship operators' does not transport the cargo, they would be obliged to pay a punishment fee which would create an incentive for them to follow up on their promise. This would create a situation in which both actors have an economic incentive to deliver on their promise. Container2 states that implementing this would therefore make it easier for ship operators to forecast the amount of cargo that arrives at the port as there would not be the same amount of downfall due to late arrivals, no-shows and cancellations. This would in turn result in an increased capacity utilisation as the number of late arrivals, no-shows and cancellation would be reduced. The strategy of increasing commitment between actors may not be used simultaneously with overbooking, since overbooking reduces the commitment from the ship operators to the customers and incentivise them to use no-shows and cancellations.

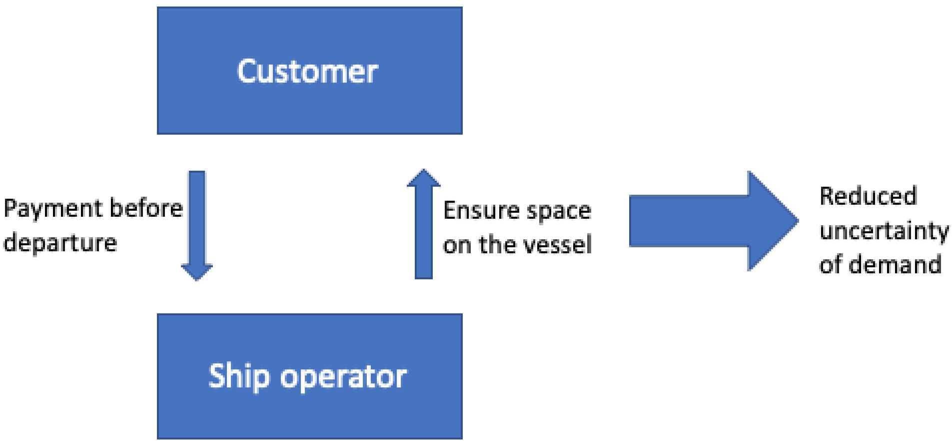

Figure 5.4 Solution in which a payment before departure is performed by the customer and in return the ship operator guarantees space on the vessels.

6. Discussion

This section presents the discussion, where the relationship between the three research questions is presented. Facilitators for the different strategies are discussed and presented. Challenges with implementation of different strategies is also discussed. The sections end with suggestion for future research.

6.1 Relationship between research questions

As could be seen in the analysis there are different ways in which the strategies can be used to increase capacity utilisation. In some situations the strategies can directly increase utilisation. Ad-hoc changes to the routes such as extra stops to pick up more goods is an example as this directly increases utilisation without positively affecting any of the factors under study. In other situations, the strategies increase utilisation by countering or reducing the negative impacts of the factors that negatively affect utilisation. Table 6.1 presents a compilation of the relationship between the analysed strategies and the factors, which can be used as a guideline by ship operators to increase utilisation. None of the previous studies made within the area of capacity utilisation has investigated the direct relationship between strategies to increase utilisation and factors that inhibit ship operators from achieving their desired capacity (Wu, 2009; Cullinane & Khanna, 2000; Ting & Tzeng, 2004). As can be seen in Table 6.1, cooperative arrangements' impacts more factors than any of the other analysed strategies.

Table 6.1 Ways in which the factors can be countered by the different strategies.

Factor	Strategies
Variation in demand	Increased demand, Cooperative arrangements, Frequency, Routing, Speed, Customer selection, Overbooking
Trade imbalance	Increased demand, Routing, Cargo
Lumpy capital	Cooperative arrangements, Vessel allocation
Vessel design	
Type of cargo	Cargo
Cooperative arrangements	
Competitive situation	
Weather conditions	Routing, Ports
Ports	Frequency, Ports
Service level	Cooperative arrangements
Schedule characteristics	Increased demand, Standby cargo, Cooperative arrangements, Frequency, Customer selection
Internal barriers within the company	
Late arrivals, no-shows and cancellations	Overbooking, Two-way commitment
Legislation	

Some of the factors are not improved by the discussed strategies but are important to have knowledge about as they affect utilisation negatively. They may be handled with other countermeasures outside of the scope of the project or measures which are not specifically defined as strategies in the project. An example is the competitive situation, which can be handled by having excess capacity to deter against new entrants from entering the market. Excess capacity is not defined as a strategy, as it reduces capacity utilisation, but it reduces the negative implications of the competitive situation which is a factor in this study. The factors may also impact the analysed strategies. An example is legislation, which affects the applicability of pricing policies. As stated by Container2, there are strict laws regarding the information that may be exchanged between actors in the industry and prices can not be discussed. This increases the probability of prices being reduced towards marginal pricing which reduces the applicability of differential pricing, which could be used to increase utilisation. The discussion above which explains the relationship between strategies, factors and the desired level of capacity utilisation is summarized in Figure 6.1 below.

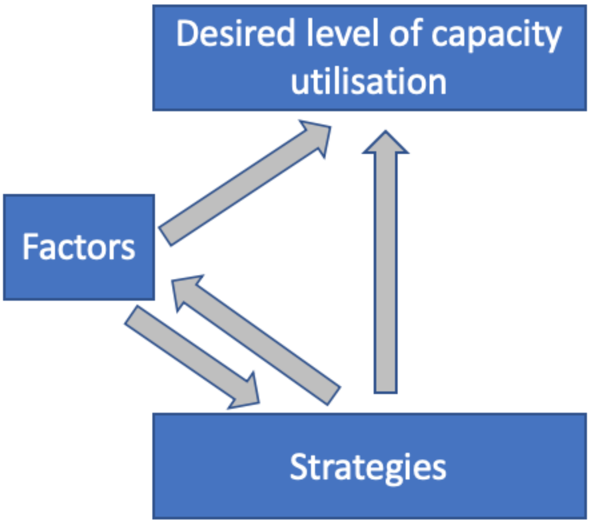

Figure 6.1 Illustration of the relationship between the research questions.

There is previous literature within the area of capacity utilization where factors and strategies to increase utilisation have been analysed to observe its effects on utilisation (Wu, 2009; Davies, 1983; Fussilo, 2003; Haralambides, 2004). However, there is no study that has a holistic perspective on utilisation and identifies the ways in which utilisation can be affected or improved by actions taken by ship operators to achieve a desired level of utilisation for several liner segments within deep sea and short sea.

6.2 Facilitators

The strategies that have been identified to increase utilisation can be achieved with varying degrees of success, as there are measures that can be taken by the ship operators to facilitate the adoption of these strategies. Three measures have been identified to improve the feasibility of the strategies or increase their positive effects. Horizontal integration is an example discussed by Cruijssen (2007). Acquiring another ship operator through mergers and acquisitions provides companies an increased vessel fleet and a more extensive network, which is supported by Panayides and Cullinane (2002). The studies do however not state how this may impact capacity utilisation. In this study it was found that this facilitates the use of the strategy vessel allocation as there are more vessels that may be exchanged between different routes to match supply better with demand. Merging with another actor also provides the ship operator with more customers and an increased cargo mix. The cargo can as a result be allocated to the adequate vessel to increase capacity utilization. Acquiring another ship operator provides the company more contacts with other ship operators and therefore increases their ability to cooperate with other actors in the industry to increase utilization. Acquisition of other ship operators also reduces the competition on the market which makes it easier to use pricing policies that can be beneficial from an utilisation point of view.

Ship operators should also try to achieve a high network density. Having shorter distances between the routes reduces the distance that ships have to travel when they are swapped between different routes which reduces empty running and increases the applicability of the strategy vessel allocation. Having a higher network density increases the number of routes passing through the same ports, which is supported by Panayides and Cullinane (2002). This makes it easier for ship operators to reduce capacity by introducing blank sailings as the gods may be loaded on other departures. A high network density could be achieved by integrating horizontally or through strategic alliances with other actors in the industry. Focusing on a specific geographical area instead of expanding to other locations is also preferable from an utilisation point of view.

This study has also found that close customer relationships should also be strived for as they provide ship operators with a better insight into their customers operations and allows for better communication. Better information from the customer regarding the necessity for specific cargo to be shipped on a specific date can be achieved which makes it easier to use standby cargo. Ship operators could as an example gain insight into the customers ERP (enterprise resource planning) systems to make better decisions regarding the goods that should be left behind. Closer relationships can also be useful when trying to increase the commitment from the customers and reduce the number of late arrivals, no-shows and cancellations.

6.3 Implementation

Qvartz (2017) identified that there is a lack of commitment between the ship operators and customers, which creates the problem of no-shows and cancellations. The same issue has been found in this study. To counter this the strategy of two-way commitment is proposed as a solution. However, the strategy of two-way commitment has not yet been implemented in the industry by any of the actors as it requires ship operators to charge their customers before departure, which results in a service that is seen as worse by the customers. If a ship operator with a small market share would start implementing the strategy, it is likely that their customers would change supplier when there are several other ship operators who do not require a payment before departure and do not have a punishment fee. This may result in losing their customers and increase the risk of being outperformed by other ship operators. Smaller ship operators are likely not going to affect larger actors in the industry and would not be able to bring a change to the shipping industry. To make this strategy viable it is necessary that a larger ship operator such as Container2 and Container3 starts with implementing the two-way commitment strategy. This would be more viable, as smaller actors would be more prone to follow them. As the larger ship operators have a larger market share and more power in the market it is likely that their customers are more dependent on them compared to smaller ship operators. As an example, between Sweden and China, Container2 and Containter3 are the only ship operators providing a direct liner service, in this case it may be beneficial to implement the two-way commitment as the customers are more dependent on the ship operators as they cannot change to another supplier for the same service. As Container2 and Container3 are large actors they are likely able to cope with the eventual customer loss at the beginning of the transitions towards a larger commitment between both parties.

There are several strategies proposed to counter the different factors affecting capacity utilization. However, some of the strategies are more difficult to implement as they also affect other ship operators within their alliance. Several studies have found that there are difficulties that arise as a result of being a part of a collaboration with other actors in the industry (Cariou, 2008; Panayides & Cullinane, 2002). This study identifies how collaborations affect the strategies which has not been found in previous studies. As an example, most ship operators mentioned that they revise their routes once a year, and in their long-term planning for routes ports can be added or removed. Being in an alliance makes this change harder, since all ship operators in the alliance have to approve the changes. One ship operator may not be able to implement a change according to their proposals to the alliance, instead they need to compromise with their alliance members. The same situation could arise when changing the frequency of their departure, which cannot be changed without the approval of the other alliance members if they are sharing a vessel on a route. Therefore, the decision making of these strategies can be more complex and time-consuming when more decision makers are involved.

Vessel allocation is one of the proposed strategies to increase capacity utilization by swapping vessels between different routes in order to match supply better with demand. Being part of an alliance can be beneficial as ship operators can achieve an extensive and dense network of vessels. However, this may cause rigidity in the system as swapping vessels between different routes becomes more complex, as the swapping involves other ship operators. Not being part of an alliance would allow the ship operators to perform these on their own with more ease.

6.4 Future research

This study was based upon eight different case studies in order to identify improvement opportunities for ship operators. However, the impact of the proposed strategies on capacity utilisation has not been quantified. Therefore, further research within the proposed areas is needed to see the impact of each strategy. Further research within two way-commitment is also needed, since this strategy has not been implemented by ship operators before.

7. Conclusions

The desired level of capacity utilisation is affected by several factors such as customer requirements and such as service reliability and frequency of departure. Having excess capacity allows ship operators to provide a better service as cargo can be delivered with a higher level of reliability. A high frequency also often results in a lower capacity utilisation as goods are spread out amongst more departures. Market factors such as risk of new entrants also affects the desired level of utilisation as there is a need to employ excess capacity to deter new entrants from entering the market. Cost effectiveness is positively affected by an increased utilisation which incentivises companies to strive for a high level of utilisation. As cost effectiveness is the most important order winner and competitive factor amongst container and feeder ship operators, a cut peaks strategy is seen as beneficial. Close customer relationships are of high importance for RoRo and RoPax ship operators which they achieve by providing their customers with a high service reliability, high frequency of departure and high flexibility. This makes a never say no strategy more suitable.

The capacity utilisation is a result of a variety of factors that impact the performance of ship operators. The performance of the company from an utilisation point of view is partly a result of actions taken by the ship operators, since most of the inhibiting factors are external contingencies and situations that impact the ship operators negatively. The most prevalent ones are external factors such as: variations in demand, trade imbalances, ports and weather conditions. The studied liner segments are affected by the factors to varying degrees as their customers and the characteristics of their respective industries vary. The most prevalent differences are late arrivals, no-shows and cancellation, which mostly affect container and feeder ship operators, as well as schedule characteristics which RoRo and RoPax ship operators are mostly affected by.

The study has identified 12 different strategies to increase utilisation. These can be of a strategic, tactical or operational nature as they require different time horizons for implementation and take longer or shorter time to have an impact on the utilisation. Some of the strategies work better if they are used concurrently such as vessel allocation and cooperative arrangements. However, others cannot be used simultaneously such as two-way commitment and overbooking. The applicability and usefulness of the strategies also vary between liner segments as the contexts in which the segments operate differ. The strategies can increase capacity utilisation by countering the factors that have an impact on utilisation or directly increasing utilisation. The strategies that have been studied reduce the negative implications of the factors, whereas two way commitment is the only strategy that eliminates the negative implication of a factor (late arrivals, no-shows and cancellations). This study indicates that cooperative arrangements is the most important strategy for increasing capacity utilisation, as it provides a solution to several of the factors under investigation.

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Appendices

Appendix A

Bold questions are added questions after the fourth interview.

General questions

- Can you give us a short presentation about yourself and your role in the company?
- What type of customers do you have?
    - Forwarding agents?
    - Shippers?
    - What is the share of the different customers?
- What do your customers think is most important for you to provide?
    - Price?
    - service?
    - Reliability?
- Where are your customers located?
- What is the share of loyal customers vs customers that may change supplier or use several suppliers?
    - Do you prioritise any of your customers shipments? In that case, how?
- Are your customers prone to change supplier if your increase the prices?
        - Are there any differences between customer groups?
- What routes do you traffic?
    - Do you ship goods oversea or shortsea?
    - How often do you change the routes?
        - *What has been the reason for these changes?*
    - How fast can you change routes if necessary?
- How much goods do you transport per year?
    - Do you see that there is an imbalance in the amount of goods that is sent in different directions?
- How much does the demand from your customers vary?
    - Weekly?
    - Monthly?
    - Yearly?
- How do your customers book space on your vessels?
    - How does your customers behaviour look like when booking capacity?
        - How late do your customers usually book capacity?
        - How close to departure do you accept new bookings?
        - Are there customers that book fixed capacity for every departure?
            - How common is this?

- How is your fleet structured?
  - How many ships do you have?
  - What type of ships are they?
  - How many of them do you own and how many are leased?

Capacity utilisation general information

- What KPIs are important for you?
  - Profits? Market share?
- How is capacity utilisation prioritised compared to other targets?
- Is working with CU important for you?
  - Why? (Economic or sustainability reasons?)
- How do you measure capacity utilisation? Do you have a standard?
  - Number of loaded TEU / maximum capacity? Draught utilisation? Lane meters?
  - Do you take into consideration empty containers when calculating capacity utilisation?
    - If you do, how do you take them into account?
- Do you follow up on your levels of capacity utilisation in a structured way?
  - If you do, how do you do it?
- What are your current levels of capacity utilisation?
- What is an optimal level of capacity utilisation for you?
  - Why this level?
- Are there any differences between short sea shipping and oversea shipping when it comes to your way of working with capacity utilisation and your current levels?
    - Different segments (RoRo vs LoLo)

What affects capacity utilisation?

- What are the reasons for why you cannot fill your ships maximally?
  - From an economic point of view, do you experience that it is good to fill the vessel to its maximum capacity?
  - Is your ability to provide a good service to your customers hindered by a high capacity utilisation?
  - **How does bad weather affect your operations?**
  - Are the ports a limiting factor when trying to load the ships to their maximum capacity?
    - Ex due to not having enough cranes or trucks
    - Is the time at port a limiting factor when trying to fill the vessels to their maximum capacity?
  - **Do you own the terminal and stevedores?**
    - **What is the share that you own vs lease?**
    - **What do you prefer?**
  - Does the way that you work in the company affect CU? In what way?

- Do you experience that there are differences in the amount of goods that are sent in different directions?
    - Does this affect your ability to fill your vessels optimally?
- **Is there any legislation that hinders you from loading the vessels maximally?**

Strategies to increase capacity utilisation

- How do you work to increase your capacity utilisation?
    - How does it differ in terms of a ship or a fleet of vessels?
    - How do you plan your available capacity on a long-term horizon?
        - **Do you plan for overcapacity in the system?**
            - **What is the reason for that?**
                - **Ex, to be able to handle seasonal variations?**
    - How do you increase capacity?
        - Do you exchange smaller vessels for bigger ones or buy new ones? when and why? alliance members? High fixed costs!
    - How do you work to increase demand when the vessels are at low capacity utilisation?
        - Do you use pricing as a mechanism to attract more goods?
    - How flexible are you with changing your fleet of vessels?
        - How do you do go about when you do it?
        - Can you lease vessels when demand increases, and capacity isn't enough?
        - *Can you terminate a contract if the demand decreases?*
        - Can you shift vessels between different routes?
    - Do you ever change the routes to increase CU?
        - How? Can you give examples?
        - Do you increase the number of ports you visit when demand is decreased?
    - What reasons do you have for changing the frequency of departures?
        - Why would you increase the frequency?
            - Do you increase the frequency to increase the capacity if the demand increases?
        - Why would you decrease it?
            - To increase capacity utilisation.
    - Do you increase the speed of the vessels to increase the amount of goods that are shipped or to increase the number of departures?
    - Do you use slow steaming when the demand is decreased?
    - Do you use overbooking or standby cargo in case there are no-shows?
    - Can you move the goods between different departures to increase the capacity utilisation?
        - Is the customer willing to change days of dispatch?
    - Do you always want to be able to accept requests from your customers when they want to ship goods?
        - If no, can you provide us with some examples?

- Are you a part of a partnership or collaboration with another actor in the market? What is the purpose of that collaboration?
    - How do you work together?
    - Has your way of working with capacity utilisation or handle problems related to capacity utilisation changed since you entered the partnership?

Finishing question

- What is the biggest/hardest challenge that you experience when trying to increase your capacity utilisation?

Appendix B

- **RQ1 What is the desired level of capacity utilisation for ship operators?**

The desired level of capacity is affected by factors such as customer requirements and such as service reliability and frequency of departure. Having excess capacity allows ship operators to provide a better service as cargo can be delivered with a higher level of reliability. A high frequency also often results in a lower capacity utilisation as goods are spread out amongst more departures. Market factors such as risk of new entrants also affects the desired level of utilisation as there is a need to employ excess capacity to deter new entrants from entering the market. Cost effectiveness is positively affected by an increased utilisation which incentivises companies to strive for a high level of capacity utilisation.

Based on previous literature, three different strategies have been used to categorize the studied liner segments depending on their adequate levels of utilisation. These are the cut peaks strategy, the never say no strategy and the mixed strategy. In the never say no strategy ship operators plan their available capacity so that they sail with 100% utilisation whereas the cut peaks strategy plans for excess capacity. The mixed strategy is a balance between both. Table B.1 presents the employed strategy for the analysed segments.

Table B.1 presenting the capacity utilisation for each segment.

Liner segment	**Capacity utilisation strategy**	**Motivation**
RoRo and RoPax	Never say no and Mixed	High frequency and service reliability, close customer relationships and low entry barriers
Container	Cut peaks	Cost effectiveness and low freight rates
Feeder	Cut peaks	Cost effectiveness and low freight rates

- **RQ2 What factors affect capacity utilisation?**

Several factors have been identified to affect capacity utilisation negatively. The list below presents the factors and how they affect utilisation:

- **Variation in demand:** Fixed supply on a short-term horizon and varying demand creates imbalance between available and required capacity.
- **Trade imbalances:** Planning available capacity for the high volume sea leg reduces utilisation on the low volume sea leg. Repositioning of containers reduces utilisation.
- **Lumpy capital:** Cost structure creates incentives for ship operators to increase capacity at excessively large steps, reducing utilisation for a limited time.
- **Vessel design:** Bad compatibility between vessel design and cargo results in unutilised space in the vessel. The way that cargo is loaded may affect the use of space on the vessel.

- **Type of cargo:** Cargo with unstandardised dimensions and/or heavy weight makes it harder to utilise space on the vessel. Discrepancies between dimensions of unit loads and deck space reduces utilisation on the ship level.
- **Cooperative arrangements:** Rigidity in approval of changes reduces the ability of ship operators to perform short-term measurements to increase utilization. Different interests may result in changes that do not benefit the ship operator from an utilization point of view.
- **Competitive situation:** Increased competition reduces the demand for each ship operator's service. Guarding against the uncertainty of new entrants creates incentives for ship operators to operate with excess capacity, reducing utilisation.
- **Weather:** Harsh weather conditions may cause delays in the schedule reducing the berth time or not being able to make a port call.
- **Ports:** The ports have a low flexibility as the berth-time cannot be increased when delays occur and some ports are unmanned during the night shifts which inhibits ship operators to load cargo at specific times. Congested ports may cause slower loading and unloading operations.
- **Service level:** Having unutilised capacity on the vessels in order to serve important customers reduces utilisation.
- **Schedule characteristics:** Providing a service with several departures throughout the week results in having less attractive departures with lower utilisation. This reduces the weekly average capacity utilisation.
- **Internal barriers:** Miscommunication between different departments regarding the dimension of project cargo may result in unutilised space on the vessel. Conflicts between employees on priorisationing customers' cargo can lead to less cargo being loaded on the vessel.
- **Late arrivals, no-shows and cancellations:** Customers book space on the vessels and do not arrive with the amount of cargo stated in the booking, or cancel bookings right before departure.
- **Legislation:** On deep sea departures, ship operators cannot accept bookings from customers close to departure due restrictions. Regulations regarding space between certain goods reduces the utilisation on the decks.

- **RQ3 How can ship operators achieve a high capacity utilisation?**

The study has identified 12 strategies that companies can employ to increase their capacity utilisation. These can be of a strategic, tactical or operational nature and their applicability varies between liner segments.

- **Increase demand:** Ship operators can use the pricing mechanism as a way to increase demand for their services, this can however create price wars which reduces the applicability of the strategy. Pricing can be used to counter trade imbalances by reducing the freight rates for the low volume sea leg. Price differentiation may also be used amongst customer groups in order to increase utilisation. This strategy may be used if cargo being transported have different price elasticities of demand. The price elasticity may be high or low depending on the segment, route, cargo or transportation alternatives. Marketing may also be used by RoPax ship operators as the total demand for their services may be increased by marketing their products.

- **Standby cargo:** Cargo that is not time sensitive can be rescheduled to other departures, evening out the demand and countering schedule characteristics. It may also be used to handle the downfall from late arrivals and no-shows.
- **Cooperative arrangements:** Being in a strategic alliance increases the flexibility in available capacity as cargo may be loaded on the alliance members vessels and reduces the negative impact of lumpy capital as investments are made with alliance members. A high service may also be provided to customers without having excessive capacity available. Schedule characteristics may also be countered by transporting cargo on the alliance members vessels. The increased flexibility in capacity that comes as a result of slot sharing agreements allows alliance members to handle variations of demand.
- **Vessel allocation:** Variations in demand may be handled by swapping vessels between routes. It also reduces the capital lumpiness as the increased flexibility in capacity reduces the need to invest in new capacity.
- **Frequency:** The schedule may be changed to accomodate for seasonal variations in demand. blank sailings may also be introduced if there is short-term reduction of demand by consolidating cargo on the remaining departures.
- **Routing:** Trade imbalances may be handled by adjusting the routes to the ports trade patterns. Extra stops could also be made to increase utilisation for specific departures. If one route has to high demand, cargo can be shifted to another string which visits the same ports to increase the overall utilisation in the network. Capacity utilisation may also be optimized amongst the routes by blanking a vessel with low utilization and transporting cargo on another string.
- **Speed:** Sailing at a lower speed may be used by ship operators to remove capacity from a specific trade. However, this is not done as it directly affects the frequency of departure negatively.
- **Ports:** Owning terminals and stevedores is beneficial since the ship operators have more control and can standardise the loading and unloading operations which increases the utilisation. This also allows the ship operators and stevedores to align their goals to achieve a higher utilisation on the vessels. Further, by owning the terminals the ship operators are responsible of the planning and prioritisation at the port and can therefore more easily cope with delays due to harsh weather conditions
- **Cargo:** A mix of cargo allows ship operators to have a balance between the weight and volume restriction on the vessels and not reach maximum capacity early for one of the parameters. Having cargo which is better adapted to the vessel requirements also increases the utilisation. Trade imbalances can be handled by finding various kinds of cargo which can be transported on the low-volume sea leg.

- **Customer selection:** Ship operators experience that BCOs are more loyal customers compared to forwarders. It is therefore beneficial to allocate larger parts of volumes to BCOs as the demand becomes more predictable. A smaller part of the volumes can be allocated to forwarders in order to handle peaks in demand. This allows ship operators to handle variation in demand. Having a customer portfolio consisting of customers in different segments reduces the risk that they will have fluctuations coinciding at the same time, which reduces variations of demand.
- **Overbooking:** The maritime industry is characterized with no-shows and cancellation. Using overbooking ship operators can counter the downfall of cargo.
- **Two-way commitment:** This strategy allows ship operators to counter the problem of no-shows and cancellations. The customers have to perform a payment for the service before departure and in return the ship operators have to transport their cargo on a specific departure and not roll on the cargo to another departure. If the ship operators do not follow their commitment they have to pay a punishment fee. This allows ship operators to better predict the demand for their services and adjust their available capacity accordingly.

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