



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY

---

# Sweden's High and Heavy Export Market

Master's thesis in the Master's Programmes  
Maritime Management and Supply Chain Management

SIRI ELISE HEGGHEIM  
ANNA MATTSSON GRANLUND

---

Department of Technology Management and Economics  
*Division of Service Management and Logistics*  
CHALMERS UNIVERSITY OF TECHNOLOGY  
Gothenburg, Sweden 2019  
Report No. E 2019:015



MASTER'S THESIS E 2019:015

# Sweden's High and Heavy Export Market

SIRI ELISE HEGGHEIM  
ANNA MATTSSON GRANLUND

Tutor, Chalmers: Gunnar Stefansson  
Tutor, Port of Gothenburg: Viktor Allgurén

Department of Technology Management and Economics  
*Division of Service Management and Logistics*  
CHALMERS UNIVERSITY OF TECHNOLOGY  
Gothenburg, Sweden, 2019

Sweden's High and Heavy Export Market

SIRI ELISE HEGGHEIM  
ANNA MATTSSON GRANLUND

© Siri Elise Heggheim and Anna Mattsson Granlund, 2019.

Master's Thesis E 2019: 015

Department of Technology Management and Economics  
Division of Service Management and Logistics  
Chalmers University of Technology  
SE-412 96 Gothenburg, Sweden  
Telephone: + 46 (0) 31-772 1000

Chalmers Reproservice  
Gothenburg, Sweden 2019

## **Acknowledgements**

This master thesis has been performed during spring 2019 within the programmes of Maritime Management and Supply Chain Management at Chalmers University of Technology. The thesis has been performed in collaboration with Port of Gothenburg.

We would like to give a special thanks to our supervisors at Port of Gothenburg, Viktor Allgurén and Claes Sundmark. Without their engagement and straightforwardness, the thesis would not have been the same. Thank you for your time.

We would also like to express our gratitude for all contributors who were involved in the interviews for the data collection of this thesis. Without their participation and passionate input, the data collection could not have been conducted in such a successful manner. You have provided us with knowledge and perspectives about the High and Heavy market beyond the literature which has been very interesting and educational for us.

Lastly, we would like to thank our supervisor Gunnar Stefansson at Chalmers who has supported us during the process of this thesis. He has allowed the thesis to be our own work but steered us in the right direction whenever we needed support or he thought we needed it.

*Chalmers University of Technology*  
*Gothenburg 2019-06-05*

Siri Elise Heggheim & Anna Mattsson Granlund

## **Abstract**

The free trade agreement that emerged after world war II had a significant positive impact on the Swedish export. It led to broader market possibilities and growth conditions for Sweden and since 1980, Sweden has consistently exported products of greater value than the imported. Today, approximately 70% of the Swedish export consists of commodities. A product category that is frequently exported through Swedish ports is High and Heavy cargo (H&H). H&H can be identified as high-value industrial products that are not suitable to be shipped in a container, due to weight or dimension restrictions. Containers or cars are mostly considered as the base load which ensures continuous transportation flows. However, it is the H&H cargo that generates high profits. Nevertheless, there is little information to be found regarding the export of H&H products, which makes the H&H market in Sweden interesting for further investigation.

Consequently, the Port of Gothenburg expressed an interest in how the H&H market functions; who the manufacturers are and through which channels they are exporting their products. Hence, the purpose of this thesis has been to provide the Port of Gothenburg with information about the Swedish H&H market, and emphasize elements that the H&H manufacturers find important in connection to their transportations now and towards the future.

To achieve the purpose of the thesis, it was first important to get an understanding of H&H cargo and what type of cargo the segment included. Due to the unexplored market, it was challenging to find relevant literature about the industry. Therefore, a pre-study was performed with study visits to two ports and open-structured interviews with different actors. This was followed by the empirical data collection that was collected through semi-structured interviews with the identified exporting H&H manufacturers. The empirical findings resulted in 28 H&H exporting manufacturers located throughout Sweden. The manufacturers had quite similar transportation flows to all continents. Whereas the main market was identified as Europe. When selecting their transportations, the manufacturers valued lead time, transportation cost and cargo safety respectively as the most important factors. All manufacturers had quite similar prospects for the future. However, their statements expressed a high level of uncertainty, due to the potential influence of external factors.

**Keywords:** Export, High and Heavy, Maritime transportation, Intermodal transportation.

# Table of Content

1. Introduction	1
1.1 Background	1
1.2 Motivation of Thesis	2
1.3 Purpose	2
1.4 Research Questions	2
1.5 Limitations	3
1.6 Outline of the Report	5
2. Methodology	7
2.1 Research Strategy	7
2.1.1 Research Process	7
2.2 Literature Search	8
2.3 Data Collection	9
2.3.1 Pre-study Data Collection	9
2.3.2 Primary Data Collection	10
2.4 Organizing of Empirical Data	12
2.5 Trustworthiness	12
2.6 Critique of the Study	13
2.7 Ethics	14
3. Relevant Literature	15
3.1 Sweden as an Exporting Nation	15
3.2 Definition of the H&H Segment	15
3.3 Transportation of H&H Cargo	16
3.3.1 Maritime Transportation	17
3.3.2 Vessel Types	17
3.4 Maritime Transport as a Part of Intermodal Transport	20
3.5 Environmentally Sustainable Freight Transportation	21
3.6 Theoretical Framework	21
4. Empirical Analysis	27
4.1 Current State of the Swedish H&H Export	27
4.1.1 Swedish H&H Exporters	27
4.1.2 Transportation Flow of the Swedish H&H Exporters	30
4.1.3 Main Swedish Ports used for H&H Export	34
4.1.4 Main Destination Continents for the Swedish H&H Export	37
4.1.5 Factors of Significance when Selecting Transportation	38

4.2 Future Prospects for the Swedish H&H Export	42
4.2.1 Supply and Demand Towards the Future	42
4.2.2 Future Transportation Flow	43
4.2.3 The Environmental Impact of H&H Transportations in the Future	45
5. Results	47
5.1 What Characterizes the Current Swedish H&H Export Market?	47
5.2 What are the main Influential Factors that the Exporting Manufacturers find Important when Making Transportation Choices?	49
5.3 How does the H&H Manufacturers Predict and Evaluate the Future?	50
6. Conclusions	53
7. Discussion	55
7.1 Why does the Current Transportation Flow look like it does Today and how will it Develop Towards the Future?	55
7.2 What is Actually Important when Selecting Transportation and why is it Important?	56
7.3 How will the Environmental Aspect Affect the Future?	56
7.4 Future Research	57

## **List of Abbreviations**

<b>CBM</b>	Cubic Meters
<b>BB</b>	Break Bulk
<b>H&amp;H</b>	High and Heavy
<b>LoLo</b>	Lift on/Lift off
<b>PCC</b>	Pure Car Carrier
<b>PCTC</b>	Pure Car Truck Carrier
<b>RoRo</b>	Roll on/Roll off



# 1. Introduction

*This chapter starts with a background about the subject of this master thesis ending with a motivation of scope and purpose. This is then followed by three research questions to complement the purpose. Further, limitations and outline of the study are discussed.*

---

## 1.1 Background

Up until the industrialization that flourished rapidly in Sweden between 1860 and 1960, 70% of the Swedish population worked within agriculture. However, when the industrialization arose, the employment within industry increased from 10% to approximately 33%. This mainly due to a number of large industrial companies which were founded during that time, as for example Sandvik (1862) and Atlas Copco (1873). After world war II, several countries signed a free trade agreement, which had a significant positive impact on the Swedish export. The increase of international trade, and particularly of export, led to broader market possibilities and better growth conditions for Sweden (Ekonomifakta, n.d.). Today, the export accounts for 47% of Sweden's gross domestic product (GDP) (Carlgren, 2019A).

In connection with the economic development and the increased export in Sweden, shipping gained a crucial role (Svensk Sjöfart, 2017). Ekström, Müller and Nilsson (2016) argues that through history, shipping has always been of great importance for Sweden and its trade relations. Shipping is an international industry by nature, and important for all types of Swedish commodity freight (Trafikanalys, 2017). In recent years, growth in the global economy, as well as the international commodity trade, has driven the demand for maritime transport (Trafikanalys, 2017). Today, approximately 90% of Sweden's trade is transported by sea (Svensk Sjöfart, n.d.A). Whereas 30% is shipped through the largest port in Scandinavia, the versatile Port of Gothenburg (Port of Gothenburg n.d.). Nevertheless, sea transport only trade between port to port and is thereof dependent on other transport modes to complete the transportation chain (Stopford, 2008).

A product category that frequently is exported through Swedish ports is industrial products, with weight or dimension restrictions that make them unsuitable for standardized containers. Such products must be shipped through the use of other types of handling equipment unless it has self-driven abilities and can roll onto the vessel. However, there is no distinct term for this type of cargo (C. Sundmark and V. Allguren, Personal communication, January 18, 2019). Hence, in this research, it will be defined as High and Heavy.

The Port of Gothenburg, which is considered the export gate for Swedish industry, have expressed an interest in the export of the Swedish H&H products. Allegedly, containers and cars are considered as the base load which ensures continuous traffic to the port. However, it is the "abnormal" cargo, as H&H products that generate high profits. Currently, the export

market of Swedish H&H products is unexplored (C. Sundmark and V. Allgurén, Personal communication, January 18, 2019). Hence, the Port of Gothenburg wants to investigate the H&H market to further develop their competence in order to increase their market share.

## 1.2 Motivation of Thesis

Sweden is the home depot of large manufacturers like AB Volvo and Scania. Hence, it came as a surprise that little information could be found about the export of such products. Neither is there any information about who the manufacturers are and through which channels they export their products. Commissioned by one of the largest maritime transport actors in Sweden, the Port of Gothenburg, this study will investigate Sweden's current H&H export market and its main manufacturers.

This research will bring light on the H&H market's current state and prospects for the future, with the intention to provide the Port of Gothenburg with the information they can use to develop their business.

## 1.3 Purpose

The purpose of this thesis is to provide the Port of Gothenburg with information about the Swedish H&H market and emphasize elements that the H&H manufacturers find important in connection to their transportations now and towards the future. Hence, this thesis presents an analysis of the Swedish H&H export market divided into two parts: current state and presumed prospects for the future.

## 1.4 Research Questions

To fulfil the purpose of the thesis, three main research questions have been developed.

The first part of the study aims to create an understanding of the current market; its transportation flows and the factors that manufacturers find important when making their transport decisions. Hence, the following research questions are defined:

### ***RQ1: What characterizes the current Swedish H&H export market?***

- *Who are the main H&H exporting manufacturers in Sweden?*
- *What distinguishes the main H&H exporters transportation flow?*
- *To what extent is the environment considered in the transportation flow?*
- *What are the main ports in Sweden that handle H&H export?*
- *What are the main destination continents for the Swedish H&H export?*

### ***RQ2: What are the main influential factors that the exporting manufacturers of H&H goods find important when making transportation choices?***

The second part of the purpose aims to create an understanding of how the manufacturers consider the future in connection to business growth and environmental transportations. Hence, the following research question is defined:

**RQ3: How does the H&H manufacturers predict and evaluate the future?**

- How will the supply and demand towards the Swedish manufacturing market develop?
- How will the transportation flow be altered towards the future?
- To what extent is the environmental impact of significance in the future?

## 1.5 Limitations

The thesis aims to establish an overview of the Swedish H&H export market and its potential prospects for the future. Due to the nature of global transportation, the study is concentrated on maritime transportation. However, other transport modes, if used, are not excluded as the study considers all transport from door to the destination port, see figure 1-1.

A transport agreement come in many forms and varieties and it is not necessarily the manufacturer that is responsible for transportation. However, since it was clear that the interviewed manufacturers held the wanted information regardless of the terms in their transport agreements, this thesis will not consider nor elaborate on which party that is responsible for the transportation. Hence, for the purpose of feasibility, the results are based on the manufacturer's perception. When referring to the other party, which could be different actors (forwarder, shipping company or agency) it will be defined as a transporter.

In the few cases where the interviewed manufacturer did not hold information about the transportation, those answers were not emphasized in the results. Further, it cannot be excluded that network and relationships may influence the market dynamics. However, such factors are excluded from the study.

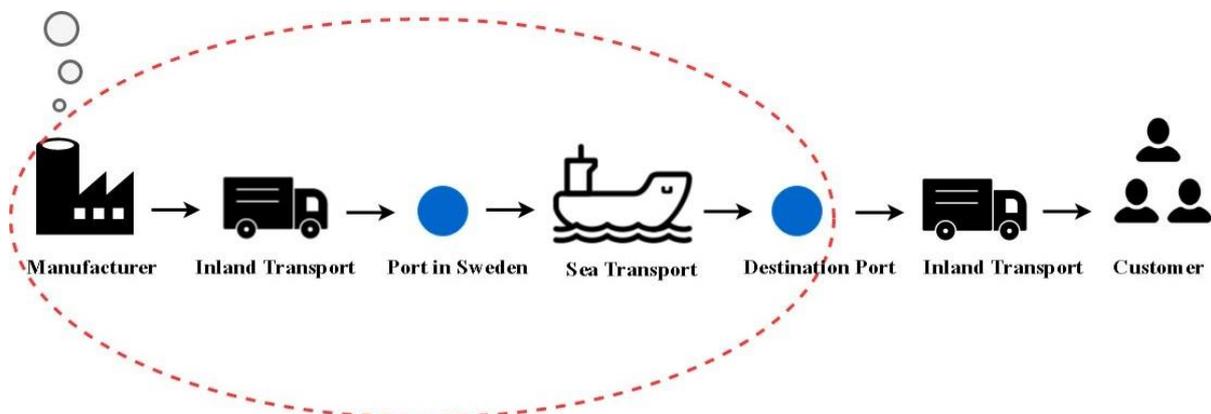


Figure 1-1: Scope of the transport flow handled in the study.

Due to the many different perceptions and definitions of the term H&H, a description of the term and what it defines in relation to this study is presented in the literature framework. The study is limited to H&H goods intended to be used in connection with different industries, as transport, forest, construction, industrial automation, and handling equipment, see table 1-1 for an example of each industry's product type.

Table 1-1: The investigated industries and examples of their product types.

<b>Industry</b> Product Type
<b>Transport</b> Buses Trucks
<b>Forest Equipment</b> Harvesters Forwarders
<b>Construction Equipment</b> Bulldozers Dumpers Excavators
<b>Industrial Automation</b> Generators Turbines Elevators Machines
<b>Handling Equipment</b> Forklifts Log-stackers Container handlers

## 1.6 Outline of the Report

The master thesis is divided into seven main chapters. Following, a short explanation of each chapter.

### Chapter 1 - Introduction

In the first chapter an introduction of the thesis is presented with a background of the study, leading up to the motivation of scope, purpose and research questions. Followed by the limitations of the study.

### Chapter 2 - Methodology

The second chapter presents the methodology of the study, including both the process and approach of the study as well as the research quality.

### Chapter 3 - Theoretical Framework

The third chapter presents the theoretical framework which intends to give the reader a better understanding and knowledge of central concepts in the study.

### Chapter 4 - Results

The fourth chapter presents the main findings of the study. It starts with the current state and ends with presumed prospects for the future.

### Chapter 5 - Empirical Analysis

The fifth chapter presents an analysis of the empirical results supported by literature. This chapter is presented through the research questions, to ensure that all questions are attended to.

### Chapter 6 - Conclusion

The sixth chapter presents the main findings from the study and connects to the research questions in order to make sure that the purpose is being fulfilled.

### Chapter 7 - Discussion

Chapter seven presents a discussion of the main findings from the study, both from the current state and the presumed prospects for the future. Further, recommendations for future research is presented.



## 2. Methodology

*This chapter describes how the master thesis was conducted. Firstly, it describes the research strategy of the study as well as the research process. This is followed by an explanation of the literature search as well as the methods and techniques used for the interviews and analysis. Second last, the structure of the empirical data is explained. Followed by a discussion about the trustworthiness, some critique of the study and ethics.*

---

### 2.1 Research Strategy

According to Bryman and Bell (2015), there are two types of research strategies, namely quantitative- and qualitative research. A qualitative research strategy often emphasizes on words instead of the collection of numerical data, as the quantitative research strategy entails. Furthermore, Bryman and Bell (2015), also argues for a third research strategy, namely mixed research methods. This method combines both a quantitative and qualitative research strategy within a single project.

This thesis focuses on the qualitative research strategy since the purpose is to present an overview of the Swedish H&H export market, its main manufacturers and their respective transportation flows. However, to present an overview of the Swedish H&H export market, quantitative research strategy elements have been used in research question 1, with the aim to understand the total volumes exported and the quantities exported to each destination, which is presented in numbers.

#### 2.1.1 Research Process

The research process of this study and its phases are presented in figure 2-1. The initial phase started off with a planning report to plan how to approach the study. The planning report was made to answer questions like the purpose of the thesis, the scope, and limitations. Furthermore, a time plan was conducted to help the researchers to understand the study and was utilized to get a clear vision of the milestones relevant for this thesis. In the second phase, the pre-study was performed with qualitative unstructured interviews in order to get a better knowledge about the H&H industry in Sweden.



Figure 2-1: Study Process of the master thesis.

The third phase included the primary data collection with qualitative semi-structured interviews with the H&H manufacturers. However, to get in touch with the manufacturer's, an extensive work started. This process of identifying the manufacturers was different depending on the information the researchers had received from the pre-study. In some cases, the manufacturer and contact information to the manufacturer was given during the pre-study. In other cases, only the name of the manufacturer was given, and the researchers initiated contact with the company on their own. Where either the manufacturer or contact information was given during the pre-study, the researchers needed to make their own investigation of the current manufacturers within the H&H segments. This was conducted via web searches or similar. In the last and fourth phase of the study, the data was organized and sorted in order to be analyzed.

During these four phases, the literature was continuously studied in an iterative process which created the foundation of the literature framework. This was necessary to conduct the planning report, performing interviews for the pre-study as well as the primary data collection interviews.

## 2.2 Literature Search

Bryman and Bell (2015) state that the literature review is a crucial part of a study, that often consists of separate sections or chapters. The literature review provides the theoretical base on which the study is justified through the research questions and research design (Bryman and Bell, 2015). The literature research has been an iterative process, where the literature research and the planning report, pre-study, qualitative interviews were performed in parallel.

The literature search strived to obtain relevant information connected to the purpose of the study. It also aimed to provide the reader with knowledge about concepts later discussed in the study, which after new insights and discoveries, were complemented with additional research questions and research. The literature research consisted of scientific articles, conference papers, reports and books from databases as "lib" from the Chalmers library, Google scholar and websites. The keywords used for the literature search included "High and heavy transportations", "Roll on Roll off transportation", "Break Bulk transportation", "Maritime transportation", "Inland transportation", "Factors affecting the mode of transportation" and "Environmental Transportation". To secure the credibility of the literature search, several sources were considered for the same subject.

In addition to the literature search, the researchers have done their own elaboration of the factors that influence the selection of the transportation by conducting a literature study. Factors influencing the transportation flow was endless, hence, the researchers conducted their own theoretical framework with the most relevant factors. The secondary literature used were mainly based on Swedish studies since the products transported are exported from Sweden.

## 2.3 Data Collection

The interview technique in a qualitative research approach is usually very different compared to the interview technique in a quantitative study. The technique in a qualitative approach is less structured, and it shows greater interest in the interviewees perspective compared to the quantitative approach. As a result, qualitative interviews tend to be more flexible, being able to respond to the interviewee's direction and get rich detailed answers (Bryman and Bell, 2015). There are mainly two types of qualitative interview techniques; (1) *unstructured* interview and (2) *semi-structured* interview. In an unstructured interview, the interviewer often initiates the interview with a single question, where the interviewee is more freely to respond. This type of interview tends to be very similar to a conversation. A semi-structured interview is more structured with an interview guide consisting of a list of topics or questions to be covered. However, the questions do not have to be answered in a specific order (Bryman and Bell, 2015).

This study is divided into two sections regarding the data collection. Firstly, a pre-study has been conducted to get better knowledge about the H&H segment and its connection to the maritime industry. This involved interviews and two study visits. The second section consist of the primary data collection used in the study to answer the purpose and research questions.

### 2.3.1 Pre-study Data Collection

As little information was available about H&H cargo and how it is transported, it was necessary to get an increased knowledge and understanding of the subject. Hence, the pre-study was conducted with an unstructured interview technique to get information and knowledge about the industry from the relevant actors perspective. The interviews were initiated with one open question about the H&H industry in general. All interviews except one were conducted face-to-face. The one interview where a personal meeting was not possible, was conducted via telephone. In total eight interviews were conducted. They all lasted between half an hour up to three hours. All interviews were held in Swedish. The selection of the participants in the pre-study has been conducted with the snowball effect. Pursuant to Bryman and Bell (2015), the snowball effect could be explained as the researchers takes the initial contact with a small group of people that are relevant for the study and then uses these people to establish contact with others. This study started with multiple meetings with the Port of Gothenburg, which in turn recommended other participants to interview, which then, in turn, recommended further participants. The participants for the pre-study have been a variety of shipping companies, a manufacturer of H&H products, a forwarder, a shipping agency, ports and the academic, see table 2-1.

Table 2-1: Pre-study interview participants.

Title	Company	Title	Company
Account Manager	Schenker	Head of Sweden Sales	Wallenius Wilhelmsen
Manager Strategic Development and Sales	Logent	Purchasing Manager	AB Volvo
Site Manager	Logent	Operative Manager	Wallhamn
Managing Director	Scandinavian Shipping	Sales	Grimaldi
Sweden Sales & Account Management	Wallenius Wilhelmsen	Postdoctor	University of Gothenburg
Auto and H&H Sales Manager	Wallenius Wilhelmsen		

Lastly, the pre-study also included study-visits in two Swedish ports that handle the segment of H&H; one visit in the Port of Gothenburg at the Logent Terminal and a second one in the Port of Wallhamn at Tjörn. The study-visits were conducted to get better knowledge about the H&H segments and how the cargo can be handled to and from the ports.

### 2.3.2 Primary Data Collection

The primary data collection consisted of two types of semi-structured interviews, a long-edition and a short-edition interview. The interview template for both interviews are presented in Appendix 1 and 2. The first part of the interviews were concentrated on each of the participant's organization. This to get an increased understanding of the participant's products and characteristics. The second part focused on how the transportation network is designed, followed by a part focusing on how networks and relationships to the transport actors' function. The interview then continued a part focusing on export volumes and finished with questions regarding the future of the H&H segment. The difference between the short- and long-edition is the number of questions in the interview template. The long-edition is a more thorough interview, in order to obtain more complete answers about the H&H industry. The short-edition contain the same questions, but some questions were removed as those questions already had been answered sufficiently in the long edition interviews. However, some questions still needed to be answered by all participants, hence the short-edition was conducted.

The participants for the interviews was selected with carefulness to guaranty correct information of the subject. All participants have similar positions within sale or logistics.

Moreover, all participants have been verified through a few questions to secure that they work in the correct organization as well as having the correct role. All interviews are anonymous, hence only the company names are shown. See table 2-2 for the participants. In total, 23 interviews were held, where 9 of them were performed with the long-edition and 14 with the short-edition. The participants for the primary data collection consisted only of H&H manufacturers.

Table 2-2: The participants of the primary data collection.

Company	Company
ABB Machines	Lundberg Hymas
ABB Power Grids	Merlinum Forklift
AB Volvo	Quintus Technologies
Alimak	Rottne
AP&T	Sandvik Mining
Andritz	Scania
Dynapac Compaction Equipment	Siemens Industrial Turbomachinery
Eco Log	SveTruck
Epiroc	Ursviken Technologies
Gremo	Valmet Energy
Komatsu Forest	Valmet Paper
Konecranes	

All interviews except one were conducted via telephone due to geographic- and time constraints. The participants are quite spread all over Sweden. Only one interview was conducted face-to-face since the participant's geographical location was within reasonable travel distance. The interview process started off with a pilot-interview in order to verify the questions and make sure that the correct questions were asked, as well as formulated correctly. After the pilot-interview, the interviews began. All interviews were held in Swedish as it was the participants mother tongue. There was only one exception where the interview was held in English, as the participant requested it. Performing the interviews in the participants first language ensured deeper discussions. The long-edition interview lasted for approximately one hour, while the short-edition lasted for half an hour. Notes were taken of all interviews.

After each interview, the material from notes was summarized and sent back to the participant to verify the results. See section 2.7.2 Ethics, for more information about how this was handled.

## 2.4 Organizing of Empirical Data

The empirical data from the interviews were summarized and sent back to the participants, as aforementioned. The data was then categorized into two segments depending on the characteristics of the main cargo transported, namely the rolling unit segment and the Break Bulk (BB) unit segment. The data could have been sorted differently, but the chosen categorization of data was performed as distinct differences between those segments became visible during the interviews. Therefore, the authors wanted to highlight cargo types.

Each participant's interview, depending on the participant's characteristics, were then sorted into one of these two segments. After the categorization of the participants, the data were then transcribed and analyzed. The segmentation is also reflected in the analysis, to identify potential differences between segments. However, when connecting the data to the research questions in the results, the two segments were consolidated again under H&H. Rolling units and BB units were only mentioned when distinct differences were worth highlighting.

The data collected for research question two were organized based on an analysis of how the manufacturers expressed the factors. To highlight the factors that were more emphasized, the different factors were given points, based on a ranking table. Further, the factors were categorized in an ABC analysis, based on the total sums for each factor, derived from the ranking table. The ABC analysis expresses the significance of each individual factor, pointing out a clear categorization of the critical factors, very important factors and important factors. According to Hopp and Spearman (2011), class A items are few, but of great importance, while class C are the opposite, with many items but they are less important. The class B items are between class A and C. However, since some factors were mentioned more than others, but expressed as less important, the number of times each factor was mentioned is also illustrated. This, to avoid misleading results.

## 2.5 Trustworthiness

The trustworthiness of a research study is of great importance. Bryman and Bell (2015), argues for four different criteria that need to be fulfilled in qualitative research studies; (1) *credibility*, (2) *transferability*, (3) *dependability*, and (4) *confirmability*. Credibility can be defined as to which degree the researcher knows that the findings of the study are true and accurate. After all, this is very important since there are several accountings for social reality (Bryman and Bell, 2015). To increase the degree of credibility in this study, all participants of the interviews have been experienced and have great knowledge in their field. This has been ensured by asking all participants a few questions to secure that they are the appropriate participants before the conducting of all interviews. Furthermore, all the participants had similar positions within the area's logistics and sale. This increases the credibility as all

participants have the same basis to answer the questions but provide different perspectives. Lastly, after each interview the key points were summarized and sent back to the participant to confirm and validate the answers.

Bryman and Bell (2015), defines transferability as the universality of the study. Meaning how the researcher perceive the findings of the study to be applicable in other contexts, or in the same context but in another time. Other contexts refer to similar populations, situations, and phenomena. However, qualitative research is often characterized by depth rather than breadth and depends on contextual factors to explain the findings of the study in a certain context (Bryman and Bell, 2015). This study aims to present an overview of the Swedish H&H export market, its main manufacturers and their respective transportation flows. Hence, it could be stated that the study is based on contextual factors. However, the findings from the study could be suited for other contexts since they have some degree of universal value.

Dependability can be defined as the auditing process of the study, meaning that the researcher should ensure that complete records are kept during all the phases in the study in an accessible manner; the formulation of the problem studied, the selection of all participants, interview notes, fieldwork notes, etc. The dependability of the study has been ensured by the researcher's through a well-developed documentation process, performed daily through all phases of the study. In addition to consistently taking notes, all interviews and communication between the researchers and the participants were logged in a calendar.

Bryman and Bell (2015), defines confirmability as if the researcher has acted in good faith. Meaning that the study is conducted as objective as possible and no personal values or similar are influencing the study (Bryman and Bell, 2015). In order to ensure the confirmability of this study, all data and material gathered have been handled with care and stored in a proper way. Furthermore, the confirmability can also be ensured since none of the researchers have a personal connection to the subject of the study, and therefore prevented any unobjective factors to the study.

## 2.6 Critique of the Study

During the pre-study, it was found that network and relations are very important factors for H&H manufacturers in connection to their transportations. The market is quite small and the products all have unique characteristics that require special transport arrangements. Hence, the entry barrier for new transporters was perceived as quite high and most of the manufacturers expressed the importance of network and close relationships with the transporters. Nevertheless, network and relationships were excluded from this research to narrow down the scope. The topic was simply too large to be covered in this report. However, the exclusion of this factor will, of course, influence the results.

Some of the participants choose to not answer certain questions. When that happened, those blank answers were excluded from the research. Consequently, some questions have more answers than others, which potentially can distort the results. This study is based on a

qualitative approach, only presenting a grasp of the Swedish H&H manufacturers opinions and perceptions. Hence, the intention is to present an overall view that can be connected to the majority of manufacturers. It does not represent the entire population.

## 2.7 Ethics

Ethics of a research study is of great importance. Bell and Bryman (2007), argues for different aspects to be considered to uphold an ethical standard in research;

(1) *lack of informed consent*, (2) *harm to participants*, (3) *invasion of privacy*, (4) *confidentiality and anonymity*, (5) *deception and misrepresentation* and (6) *dignity*.

Before each interview, an information letter was provided to each participant to prevent lack of informed consent, see Appendix 1 and 2. The information letter included information such as the purpose of the study and how the participant's contribution will be used in the study. In addition, the interview questions were sent together with the information letter, so the participants could be prepared on what to come. To prevent any harm to the participant, the information letter also included information such as data the participant considered sensitive was not going to be included in the report. Since the master thesis is conducted in trust with the participants, all data from the interviews are handled with confidentiality in order to not endanger nor expose any participant.

The participants were informed that they could discontinue at any moment during the interview. They could also refuse to answer any question that felt uncomfortable in order to prevent the invasion of privacy. The confidentiality and anonymity of the study have been ensured through informing the participants that no names will be mentioned in the study, as well as the interview answers being non-traceable. anonymous.

The harm to the participants, invasion of privacy as well as the confidentiality and anonymity have also been prevented by conducting telephone interviews in the primary data collection. According to Bryman and Bell (2015), telephone interviews can be more effective in turns of making the participant feeling more comfortable by not having to see the interviewer face-to-face when asking sensitive questions for example.

After each interview, the most important information was summarized and sent back to the participants to prevent deception and misrepresentation of all interview answers. This way, the participants were able to ensure the accuracy of their answers and make sure that no unwanted data were represented in the study. By doing all this, the sense of the dignity of each participant has been increased. Through providing them with as much information as possible, the participants hopefully felt comfortable and prepared during the interview. Further, by presenting the questions in advance of the interview, the participants could be sure that no surprises would arise.

## 3. Relevant Literature

*This chapter presents the relevant literature for the study. The chapter starts with explaining the Swedish export market, continuing with a definition of the H&H segment, how the H&H products can be transported. Followed by some aspects about environmental transportation, and lastly factors that influence the selection of transport.*

---

### 3.1 Sweden as an Exporting Nation

Since the 1980's, the total value of Sweden's exported products and services have consistently been higher compared to the total value of imported products and services (SCB, 2019A). Today, approximately 70% of the export consist of commodities, while the remaining 30% is connected to services (SCB, 2019A). In 2018, Sweden exported commodities for 2 193 billion SEK, which is an increase of 7% compared to 2017. Hence, commodity export is very important for the nation as it contributes to the country's gross domestic product (GDP), as well as the growth of Swedish economy (Carlgren, 2019A; SCB, 2019A).

Approximately 40% of the Swedish commodity export consist of industry products like vehicles, machines, and products for the forest industry (Carlgren, 2019B). In 2018, industry products as machines and road vehicles were considered as one of the more important categories of exporting products that year (SCB, 2019A).

Approximately 74% of Sweden's export is shipped within the continent, which makes Europe Sweden's largest export market. On a country basis, Germany and Norway were the main buyers of 2018 (SCB, 2019A; Carlgren, 2019C). With Finland, Denmark, and the USA following respectively. Carlgren (2019D) argues that in 2018, world trade was slim. Ongoing trade conflicts, as the conflict between China and the USA, as well as Brexit, cause even further uncertainty about the future (Carlgren, 2019D). Nevertheless, Swedish commodity export still increased within all continents during 2018. Compared to 2017, Oceania increased with 15%, Europe 11%, America 7%, Asia 8% and Africa 1% (SCB, 2019B). Carlgren (2019C), particularly points out Asia as a growing market for Swedish companies.

### 3.2 Definition of the H&H Segment

This study investigates the segment of newly produced finished H&H products. There is no standardized definition of the H&H segment. H&H will henceforth be defined as goods with either weight or dimension restrictions that make them unsuitable for standardized containers. Thereof, the products must be shipped using other cargo handling equipment as mafi-wagons, flat-racks or similar, unless it is capable of being rolled into the transportation mode by its own nature (Wathne,2012).

This thesis has two sub-categories for H&H products; the products that can roll on to the transportation mode themselves are identified as rolling units. While the products that require assistance from handling equipment, as they cannot be rolled into the vessel by its own nature, are identified as BB, see figure 3-1.



Figure 3-1: Example of BB and H&H products (Wallenius Wilhelmsen, n.d.A).

The study focuses on products that are of high value, and also shipped with frequency. The products that can be rolled into the transportation mode can, for example, be heavy construction equipment such as quarry trucks, bulldozers but also trucks and tractors for agriculture, etc. (Wathne, 2012). While, the BB cargo, can, for example, be large generators or large machines for the industry, that must be lifted onto the transportation mode (Wathne, 2012). The BB cargo is generally not lifted for long distances. Therefore, lifting is most commonly limited to on and off the trailers. During the transportation, the BB cargo is generally inside in the lower decks of the vessel and is therefore sheltered from elements as sea water, while the rolling cargo is commonly placed on the upper decks (Wallenius Wilhelmsen, n.d.B).

### 3.3 Transportation of H&H Cargo

To understand how H&H cargo can be transported, a brief overview of the different options will be presented. 90% of the Swedish export is transported by sea (Svensk Sjöfart, n.d.B) and also identified as most relevant for H&H cargo. Hence, this section will be focused on maritime transport and how it can be used in connection with other transportation modes.

### 3.3.1 Maritime Transportation

Maritime transportation is a central component of international logistics systems. Through carrying and handling cargo across oceans, it creates a bridge between widely dispersed consignors and consignees. Although maritime transport is limited to the transport between two or more seaports, it is traditionally known to be the main transportation mode for global shipments of parts and finished goods (Song and Panayides, 2016). According to Song and Panayides (2016), 85% of international trade is carried out through maritime transport.

Song and Panayides (2016) argues that maritime transport is of particular value due to its high rate of operational efficiency and service effectiveness. Operational efficiency involves reduced lead-time and business costs while service effectiveness is connected to the transport mode's ability to be flexible, responsive and reliable in its service. However, Song and Panayides (2016) emphasize the importance of maritime transportation being integrated with the entire logistics flow. If not, additional costs, unnecessary delays, and accidents may arise.

### 3.3.2 Vessel Types

This section will elaborate on the different vessel types that can handle H&H cargo. The variety of conditions that govern operations make the shipping industry quite complex, but like other industries, provides a service (transport) to meet different customers specific needs (Stopford, 2008). Hence, the shipping industry is based on a simple supply and demand framework (Duru, 2018). Each segment is intended to carry different cargoes, provide different services and have a different economic structure. However, even though the market is segmented, they often compete for the same cargo. Cargo owners can easily move their business from one market to another, influencing the supply and demand (Stopford, 2008).

#### *RoRo Vessels*

One of the first unit load carriers developed was RoRo (Roll on/Roll off), see figure 3-2. RoRo vessels can be characterized as a horizontal transfer of cargo. Where the cargo is towed into the ship via a stern ramp (Lumsden, 2006; Wallenius Wilhelmsen, n.d.C). Unlike Lift-on/Lift-off (LOLO), whereas the cargo needs to be lifted by cranes in order to be loaded (Stopford, 2008; Wallenius Wilhelmsen, n.d.D). This makes RoRo shipping very efficient, as the cargo can either be rolled on or loaded on a rolling carrier as mafi-wagon into the vessel without requiring any special equipment (Lumsden, 2006; Medda and Trujillo, 2010). See figure 3-3 for mafi-wagon. RoRo vessels can transport anything from forest products, large agricultural machinery, construction equipment, generators, cars, containers to pallets and heavy lift cargoes (Stopford, 2008; Wallenius Wilhelmsen, n.d.C).

RoRo transport suffers great competition from the container industry. However, the design of RoRo vessels, especially Pure Car Carrier (PCC) and Pure Car Truck Carrier (PCTC), has proven to be very effective in the vehicle market. The RoRo segment is subject to the consumer market of vehicles and the location of car manufacturers forms the car-carrying routes (Stopford, 2008).



Figure 3-2: Example of RoRo ship (Wallenius Wilhelmsen, n.d.E).



Figure 3-3: Example of mafi-wagon (VantageFreight, n.d.).

### *Container Vessels*

Transporting cargo that is too big for a container is even possible on a container ship. Flat-rack equipment is a common tool used to transport oversized cargo that require loading from the top or side, as for example machinery (Gungor, 2018; DSV, n.d.). Flat-racks come in different shapes and sizes, but they do not have side walls, see figure 3-4. The normal types are, as regular dry containers, 20' or 40' ft. Some even come with fixed or collapsible walls

on the short side (Gungor, 2018). Without the side walls, cargo that is over width or over the height of the standardized containers can still efficiently be transported by containerships (Gungor, 2018).



Figure 3-4: Example of a flat-rack with H&H cargo (Gungor, 2018).

### *Bulk Vessels*

Bulk shipping has held an important part of the shipping industry all the way back to the eighteenth century, see figure 3-5. Bulk ships come in different shapes and sizes, but the principles are the same. The cargo is loaded into the hatches through a crane, and although it is not necessarily necessary, intermediate units as pallets or packaged lumber can be used to make it fit for different transportation modes. The concept of transporting goods in shiploads to cut transportation costs has been successfully used for centuries and still valid today (Stopford, 2008).



Figure 3-5: Example of bulk vessel (Oceanmax - Maritime LLP, 2016).

### 3.4 Maritime Transport as a Part of Intermodal Transport

Before describing the intermodal transport more specific, the different transport modes beyond maritime transportation will shortly be presented.

According to Lumsden (2012), road transportation offers high availability, delivery accuracy, and flexibility. In addition, road transportation is also able to handle different distances, everything from short local deliveries to international deliveries. Being a moderate fast and cheap transportation alternative, that can handle almost all types of goods, road transportation positions itself as a strong competitor in the transportation industry. Road transportation further has the advantage of being moderate fast and cheap mode handling all types of goods. Road transportation is neither dependent on any specific infrastructure other than the road network and has a low damage and loss rate of cargo (Lumsden, 2012).

Rail transportation offers moderate flexibility, delivery accuracy and availability compared to road transportation. It further offers longer lead time than road due to the focus on energy and has a high damage and loss rate of cargo (Lumsden, 2012; Eng-Larsson and Kohn, 2012; Roso, 2013). Furthermore, rail is more dependent on infrastructure compared to road, and often must rely on other transport modes since the rail network is not connected to many locations. Nevertheless, rail transport is considered as a cheap transportation alternative. Capable of carrying very large loads of goods and therefore suitable for larger flows (Lumsden, 2012).

Air transportation is the fastest transportation mode for long distances. However, it is the most expensive of them all with moderate flexibility and availability (Lumsden, 2012). Due to the characteristics of the H&H products, air transportation is presumed to be a rarely used option for exporting the goods.

Using more than one transport mode during one transport can be defined as intermodal transport. Intermodal transport is, therefore, able to combine the strengths of each transport mode. This enables the possibility of reaching more locations while offering flexibility (Song and Panayides, 2016; Flodén, 2007). For example, rail and sea have the availability to transport large loads of goods at a low cost, while road has the advantage of being flexible by being able to deliver at any location. A combination of the two networks could, therefore, offer great flexibility and reduce the transport cost (Flodén, 2007).

As previously mentioned, the maritime industry offers port to port service. Hence, at the port, the industry interface with the inland transport system. The inland transport system mainly consists of railway and roads, but also waterways using trucks, railways, and barges (Stopford, 2008). O'Leary-Kelly and Flores (2002) say that successful integration between maritime operations and a complete logistics system is the key to better results for all entities. The transport system must be designed to operate as a whole (Stopford,2008).

To obtain smooth cargo flows between transport modes, manual cargo handling must be minimized. According to Stopford (2008), this can be achieved through three factors: the units that the cargo is transported in must be standardized, the handling equipment must be designed to efficiently move cargo between transport modes and lastly, the transport vehicles must be designed to integrate with the standardized units and handling system (Stopford, 2008).

Depending on geographic location, the use of intermodal transport can decrease the distance between A and B significantly (Song and Panayides, 2016). Hence, the combination of different transport modes is also a promising factor that can reduce the environmental impact (Eng-Larsson and Kohn, 2012).

### 3.5 Environmentally Sustainable Freight Transportation

Macharis (2014) state that the focus on sustainable transportation has increased during the last decade, due to the reoccurring topic of reducing the environmental impact. According to SCB (2017), the transport sector is one of the largest greenhouse gas emitters. Hence, the transport sector has an important role, contributing to reductions of the environmental impact. This in terms of reducing greenhouse gas emissions and the dependence of fossil fuels. By 2050, the transport sector should have reduced its carbon dioxide emissions and fossil fuel use by 50% (Macharis, 2014). A commonly suggested action is the shift of transportation mode. For example, to slower and less polluting modes as maritime or rail transportation, from faster and more polluting modes as air or road (Eng-Larsson and Kohn, 2012).

Different studies suggest various actions to consider for reducing the environmental impact of freight transportation. In summary of these actions, Lammgård (2007), Björklund (2005) and Santén (2016) state that there are three general approaches for reducing the environmental impact of freight transportation. Following approaches are:

1. *“Reduce the environmental impact of each transport mode”*: Refers to fewer emissions/km, which is linked to technical advances of the vehicles for reducing the environmental impact.
2. *“Use environmentally friendlier transport modes”*: Refers to a modal shift of transport and the use of intermodal transportation for reducing the environmental impact.
3. *“Diminish the need for transport”*: Refers to decreasing the need for transport by traffic, tons/km or vehicle/km.

### 3.6 Theoretical Framework

The secondary literature that could be found about factors that influence transportation decisions was endless. Hence, the factors that were considered as most relevant for H&H

cargo were consolidated by the researchers to build a theoretical framework. The intention is to provide an understanding of the factors and how they can be connected.

### *Influential Factors when Selecting Transportation*

A critical decision process in logistics management is the choice of transportation mode (Meixell and Norbis, 2008). This is also mentioned by Liberatore and Miller (1995), which state that the decision-making process of transportation mode is extremely important for each company transport strategy. Managers of these companies often involve multiple factors that they take into account when making the decision (Meixell and Norbis, 2008). The literature search identified multiple factors influencing the transportation selection. However, the reoccurring factors will be presented. To simplify the factors, they are categorized into nine groups, see figure 3-6. It cannot be excluded that the importance of different factors for determining transportation has shifted during the years and will continue to shift towards the future (Murphy and Hall, 1995).

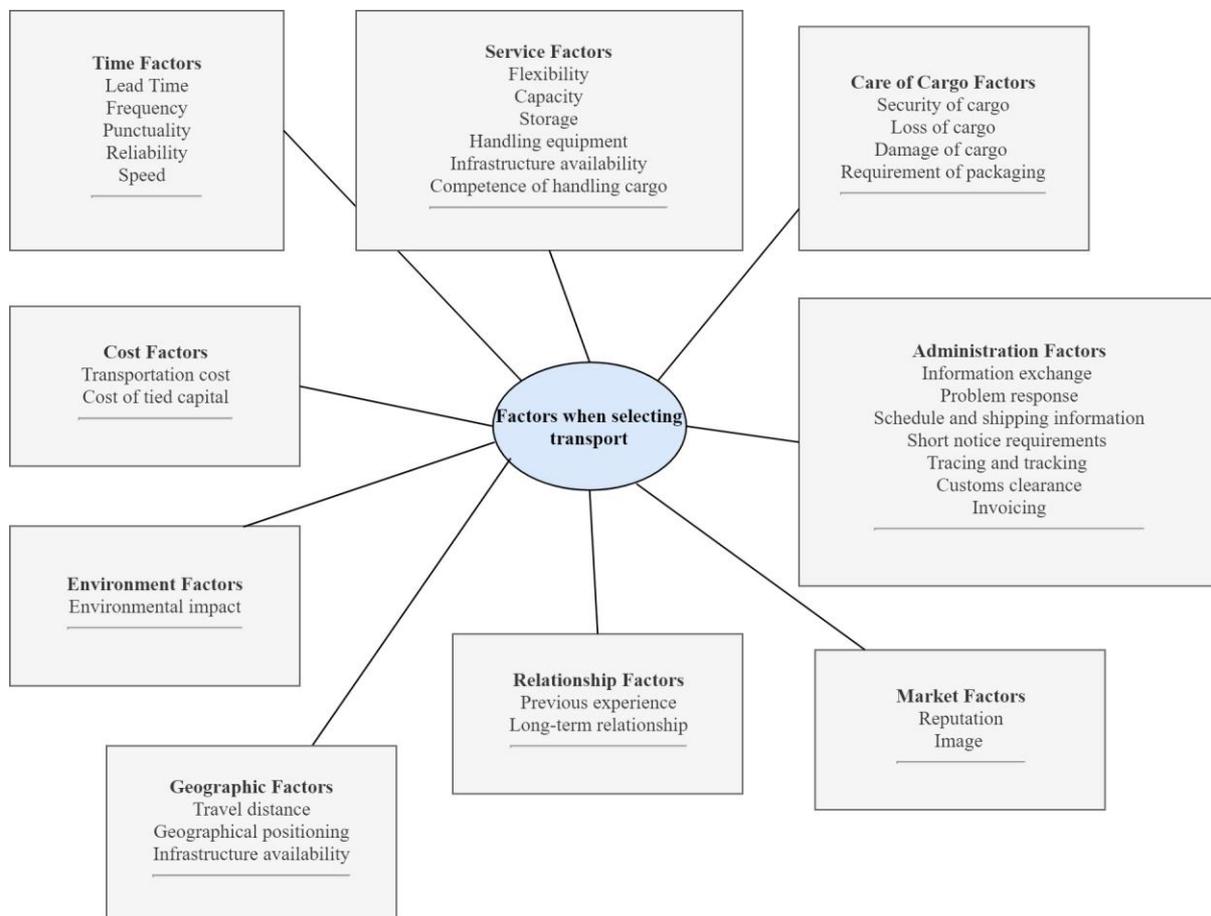


Figure 3-6: Own elaboration of factors that influence the selection of transportation mode.

### *Cost Factors*

Cost of transportation is seen as a predominant factor when selecting the mode of transport. Pursuant to Meixell and Norbis (2008), the transportation cost within manufacturing companies averages about 20% of total production cost. The cost of transportation can also be decisive in achieving the competitive advantage of a firm. Many studies have highlighted cost as the most important factor when selecting the mode of transport (Casaca and Marlow 2005; Cullinane and Toy, 2000; Meixell and Norbis, 2008; Flodén, Bärthel and Sorkina, 2017). However, in the more recent studies, the cost is not ranked as number one, rather it is ranked below service or quality factors (Flodén et al, 2017; Lammgård, 2007). Cost as a factor can also be ranked depending on the value of the cargo. For example, if the cargo is of low value, it is desirable to have low transportation cost compared to total production cost. Hence, cost becomes an important factor (Cullinane and Toy, 2000; Flodén et al, 2017; Casaca and Marlow, 2005).

### *Time Factors*

The competitiveness for the different transportation modes is affected by the frequency, regularity, and punctuality of departures, as the customers require scheduled, frequent and customized transport services (Ng, 2009; Casaca and Marlow, 2007). The speed and transit time are also dominant factors when selecting the transport mode (Meixell and Norbis, 2008). In the study of Cullinane and Toy (2000), speed is the second most important factor behind transit time reliability. However, Flodén et al, (2017) state that customers are not willing to pay more to reduce the transit time.

Reliability of delivered cargo can be defined as the ability to deliver the cargo on the appointed time (Lumsden, 2006). According to Cullinane and Toy (2000), reliability is ranked as one of the most important factors that influence the selection of transportation mode. During recent years, reliability has become more important, and in many cases, high reliability is of greater importance than short lead times (Lumsden, 2006). However, Flodén et al (2017), states that the importance of the reliability is different for different cargo. This could, for example, be explained by the value of the cargo. For example, rail is often used for low valued cargo and is not affected by reliability as much as high-value cargo. The frequency is however not as important as the other time factors. Frequency can be defined as how often departures of the transportation is offered (Flodén et al, 2017).

### *Service Factors*

Service include many different aspects. In this case, service include logistics services and delivery services that add value to the products or services (Lumsden, 2006). Cullinane and Toy (2000), discuss that service influence the selection of transport mode and the supplier selection. It is also ranked in the higher scope of influential factors (Cullinane and Toy, 2000)

The flexibility, capacity, problem responding, storing, handling equipment, infrastructure availability, competence of the handling cargo etc are sub-factors to service that influence the selection of transportation mode (Flodén et al, 2017; Casaca and Marlow, 2005; Cullinane and Toy, 2000; Brooks and Trifts, 2008; Reis, 2014).

Pursuant to Meixell and Norbis (2008), capacity can be defined as a form of flexibility since it allows to accommodate fluctuations in customer demand. However, all types of transportation modes have some type of capacity limitations in terms of weight, size, units, volume etc (Lumsden, 2006). Both Cullinane and Toy (2000) and Liberatore and Miller (1995), states that capacity is not a dominant factor when selecting transportation, but it does influence the selection. Furthermore, flexibility is also of great importance when selecting the mode of transportation (Cullinane and Toy (2000)). The flexibility and the skill of being able to respond fast on problems are determinant factors. For example, being able to handle urgent deliveries or special consignments (Liberatore and Miller, 1995; Casaca and Marlow, 2005). Cullinane and Toy (2000), further state that the availability of equipment and infrastructure is a dominant sub-factors of service when selecting the transportation. Lumsden (2006), stated that the factor of availability can be rather essential when transshipment occurs, and the right types of equipment are not available.

#### *Administration Factors*

The administrative tasks with transportation are vital in order to perform correctly and minimize problems and mistakes that may occur. Cullinane and Toy (2000), as well as Liberatore and Miller (1995), states that factors as tracing and tracking capabilities, handling of invoices or other factors connected to timeliness, accuracy and responsiveness are sub-factors that influence the selection of transportation. However, according to Cullinane and Toy (2000) and Flodén et al (2017), tracing and tracking are not of dominant influence, rather it is ranked quite low.

Liberatore and Miller (1995), states that customs clearance capabilities are administrative factors that influence the transportation selection process. The opportunity of using EDI is also a factor that affects the selection. In order to have integration and coordinate activities, a functioning information system is crucial (Liberatore and Miller, 1995). However, pursuant to Flodén et al (2017), information system services are ranked as low factors.

#### *Care of Cargo Factors*

Flodén et al (2017), mentions that the care of cargo is a determinant factor when selecting the mode of transport. However, it is not the most important since it is not considered as a problem in general. Several studies show that the ability to provide a service where the cargo is not being damaged is very influential (Cullinane and Toy, 2000; Liberatore and Miller, 1995; Flodén et al, 2017).

Kasilingam (1998), states that the ability to provide security for the cargo also determines how to transport the cargo. Depending on the characteristics of the cargo, one way of transportation provides better safety of the cargo than another and is therefore selected. Cullinane and Toy (2000), state that the loss of cargo is also seen as an influential sub-factor. However, it is not a dominant factor when selecting the transport. Another sub-factor of cargo care mentioned by Lammgård and Andersson (2014) is the security and theft of the cargo. Ekwall and Lantz (2013) state that cargo theft is a significant worldwide problem.

### *Cargo Characteristics Factors*

Cargo characteristics as type, size, weight, perishability, value, and the volume of the cargo have shown to be determinant factors when selecting transport (Cullinane and Toy, 2000). However, Cullinane and Toy (2000), state that the cargo characteristics factor is not as vital as the cost, service and lead time factor. Furthermore, Lumsden (2006) mentions that the different transportation modes have different restrictions, which influence the determination if a certain transport mode is more suitable than others.

Ng (2009) and Lumsden (2006) states that depending on the perishability and value of cargo, some transport modes are more preferable than others. Low-value cargo is most of the time transported with slow transportation modes, for example maritime, in order to keep the costs as low as possible. While high-value cargo is often transported with faster modes with higher costs in order to decrease the transportation lead time (Lumsden, 2006). Volume is also another sub-factor that influence the selection of transport. Transporting large volumes can, for example, fill a whole vessel (Cullinane and Toy, 2000).

### *Environment Factors*

The importance of reducing the environmental impact of transportation, and especially CO<sub>2</sub> emissions, have increased during the last years (Lammgård and Andersson, 2014). However, the importance of the environment as a factor when selecting transportation mode is low in several conducted studies (Flodén et al, 2017; Lammgård and Andersson, 2014; Postnord, 2014). For example, a study performed by Posten (2008) showed that 43% of Swedish companies are not willing to change if the lead time increases by 24 h. In addition, a study performed by Postnord (2014), showed that Scandinavian companies are not willing to change to a more environmentally friendly alternative if the price increases by 10%. However, Flodén et al (2017) state that the environmental impact is becoming more important. More recent studies indicate that environment is higher ranked than frequency and transit time. Furthermore, Lammgård (2007) states that the size of a company might be an important sub-factor, where larger manufacturing companies often rank the environment higher.

### *Market Factors*

The perception of the market and corporate image is also an influential factor when selecting the mode of transportation (Lammgård and Andersson, 2014; Casaca and Marlow, 2005; Meixell and Norbis, 2008). However, it is not as vital compared to cost, service, and quality, but it does have a significant role in the trademark (Casaca and Marlow, 2005). The corporate image can, for example, include reputation, the carrier's friendliness and knowledge exchange of documents (Casaca and Marlow, 2005; Meixell and Norbis, 2008). Furthermore, Meixell and Norbis (2008) state that regulations and market changes may influence the selection of transportation. For example, growing trends like environmental concern have influenced companies to be more environmentally friendly. Another example is the fuel prices that have induced to higher transportation rates, which in turn affects the selection of transportation (Meixell and Norbis, 2008).

### *Relationship Factors*

According to Casaca and Marlow (2005) and Cullinane and Toy (2000), relationships is a factor that influence the selection of transportation. Liberatore and Miller (1995), states that good customer service is one of the factors that develop and retain long term relationships.

### *Geographic Factors*

The geographical location and travel distance influence the selection process of transportation (Brooks and Trifts, 2008; Ng, 2009; Flodén et al, 2017; Cullinane and Toy, 2000; Arof, 2018). However, pursuant to Cullinane and Toy (2000), it is not a dominant factor, rather it is a low factor when selecting the transport mode. However, according to Brooks and Trifts (2008), short distances as < 700 km are dominated by road transports, while longer distances are dominated by maritime transport. Paixão and Marlow, (2002) also state that long coastlines with production and industrial centers located near the coast are providing maritime shipping an advantage.

## 4. Empirical Analysis

*This chapter elaborate on the findings of the study. The chapter is divided into two main parts: the current state of Swedish H&H export and prospects for the future.*

---

### 4.1 Current State of the Swedish H&H Export

Part one of the analysis will map out the current state of the Swedish H&H export. This includes the main manufacturers and an indication of volumes exported. Further, it will elaborate on transportation flows, destinations, and the factors the manufacturers consider important when selecting transportation.

#### 4.1.1 Swedish H&H Exporters

This study identified a total of 28 H&H exporting manufacturers in Sweden. However, it cannot be excluded there could be additional manufacturers that were not identified during this study. Table 4-1 indicate the manufacturers identified from “allabolag”, a website that presents all Swedish registered companies. From this website, the researchers have filtered out the manufacturers that can be placed under the category H&H. Some of the companies were even confirmed by stakeholders that participated during the pre-study and the primary data interviews.

Out of the 28 manufacturers, 16 of them are categorized under the segment of rolling units and 12 of them under BB units, see table 4-1. However, five of the identified manufacturers decided to abstain from the study. Hence, the results are based on the remaining 23 manufacturers. Nevertheless, all 28 manufacturers are presented in table 4-1, to give a rightful representation of the market.

Table 4-1: The main H&H exporters in Sweden identified in this study.

Rolling Units	BB Units
<b>Company</b>	<b>Company</b>
AB Volvo	ABB Machines
BAE Systems Hägglunds	ABB Power Grids
Dynapac Compaction Equipment	Alimak
Eco Log	Andritz
Epiroc	AP&T
Gremo	Quintus Technologies
Huddig	Sandvik Mining
Komatsu Forest	Siemens Industrial Turbomachinery
Konecranes	Ursviken Technologies
Ljungby Maskin	Valmet Energy
Lundberg Hymas	Valmet Paper
Merlinum Forklift	Valmet Pulp
Rottne	
Scania	
SveTruck	
Vimek	

Approximately 47 000 H&H units are exported from Sweden annually. However, all manufacturers do not count their export volumes in units due to different reasons, e.g. project cargo. Therefore, additional 16 000 tons, as well as 320 000 cubic meters (CBM), can be added to the annual export volume, see table 4-2. To be mentioned, seven of the interviewed manufacturers did not provide information about the annual exported volumes. Further, not all volumes given were possible to convert into an applicable measurement value. Hence, the numbers stated below is not fully correct, but gives a picture of the approximate exported volumes from Sweden.

Table 4-2: Total exporting volumes.

Exporting Volumes			
Entity	Rolling Units	BB Units	In total
Units	46 710	290	47 000
CBM	220 000	100 000	320 000
Tons		16 000	16 000

To get a better understanding of the transportation flows as well as the factors when selecting sea transportation, the location of the manufacturers production are illustrated, see figure 4-1. Figure 4-1 indicate that the manufacturers are located all over Sweden with the majority in the southern regions of Sweden, below Västerås. Some of the manufacturers have production units at several locations in Sweden, namely AB Volvo, Valmet, ABB, and Andritz.

The majority of the rolling units are located in the southern regions of Sweden below Västerås, more specific ten manufacturers. While six of them are located near and along the coast in northern Sweden above Västerås. The majority of the BB units are also located in the southern regions of Sweden, more specific nine manufacturers. While four of them are located near and along the coast in northern Sweden above Västerås.

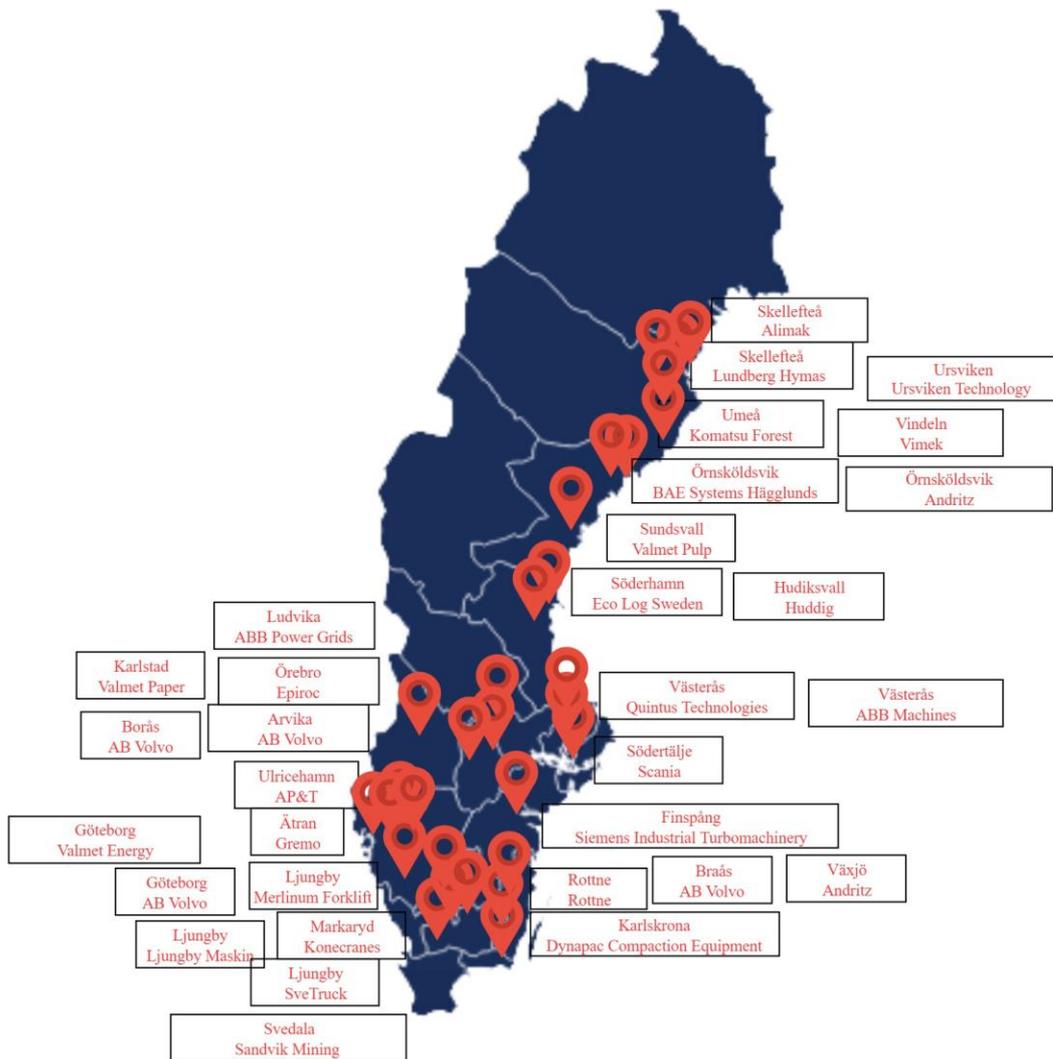


Figure 4-1: The locations of the manufacturers.

#### 4.1.2 Transportation Flow of the Swedish H&H Exporters

##### *Rolling Units*

All manufacturers from the rolling units emphasized that shipments with a destination outside of Europe are transported to a Swedish port and then shipped via sea transport to its destination. From manufacturing site to port, all manufacturers used road transport. Only one manufacturer expressed that they used both road and railway to transport the cargo to a Swedish port.

Shipments with destination Europe (including Russia), were handled with greater variety. 50% of the rolling unit manufacturers stated that they either use a combination of road transport and sea transport from manufacturing to the destination port, or road transport the entire distance for European destinations. 30% argues that they always combine sea and road

transport. While, the remaining 20% only used road transport but emphasized that they now only transport to Scandinavia and predict more sea transport towards the future.

None of the manufacturers transport their cargo outside of Swedish borders on road/rail with the intention to further ship the cargo with sea transport to other continents. However, some of the manufacturers highlighted that it has happened in special occasions, as stevedore strikes, or if they have a rushed delivery that cannot wait until the next departure from Swedish port.

All the manufacturers argued that the railway system in Sweden is not sufficiently developed nor flexible to be used for their inland transportation. The lack of infrastructure and railway connections throughout the country makes road transport the only option for most of the manufacturers. The one manufacturer who use the railway also emphasize the infrastructure issue, as an argument to why they have to compliment their inland transport with road transportation. Hence, all manufacturers find road transport as an essential part of their transport system. However, several of the manufacturers said that they gladly would have used the railway system, if it would have been a realistic choice.

All the rolling unit manufacturers agreed that sea transportation is essential for their business. Without it, it would not be feasible to deliver due to the long distances between them and their customers. One manufacturer emphasizes that due to the characteristics of the product, flying is not possible. Two manufacturers argue that although sea transportation is not always necessary, as for European customers, it is still the best choice for the sake of the environment.

### *BB Units*

BB unit manufacturers have the same approach as the manufacturers of the rolling units. When the destination is outside of Europe, they use either rail or road to a Swedish port and then ship the cargo to its destination. Further, three manufacturers said they always use sea transport, even for European destinations. The remaining manufacturers use both sea transport and rail/road transport to European destinations. Figure 4-2 indicates the most common way of transporting the cargo to Swedish ports for both the rolling- and BB units.

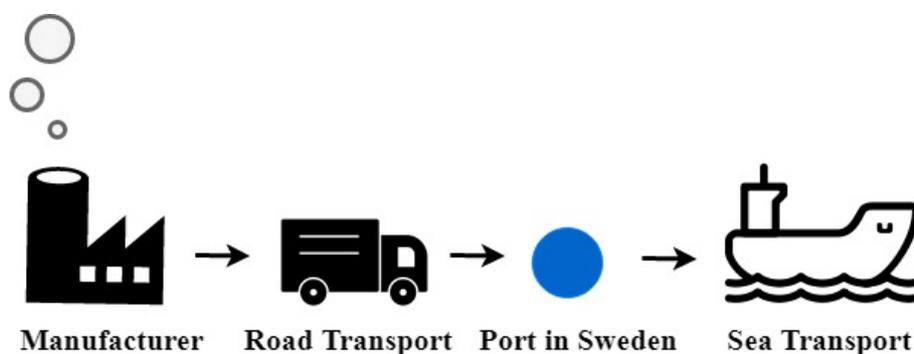


Figure 4-2: Illustration of the most common transportation flow for both the rolling and BB units.

The BB unit manufacturers argued that the transportation flow is highly influenced by vessel characteristics and destination port. Three manufacturers said that due to their products characteristics, such as weight or height, the transport to port can be quite complicated. Limitations in the Swedish infrastructure narrow their choice of port, and it is often the closest port at origin that becomes used. The manufacturers that argued that destination port determines the distribution flow does not have such limitations, it is rather that they have to adjust to the routes that are available. There is only one manufacturer that transport their cargo down to Europe and then ship overseas to other continents. This also because of the limited route options that can be found from Swedish ports.

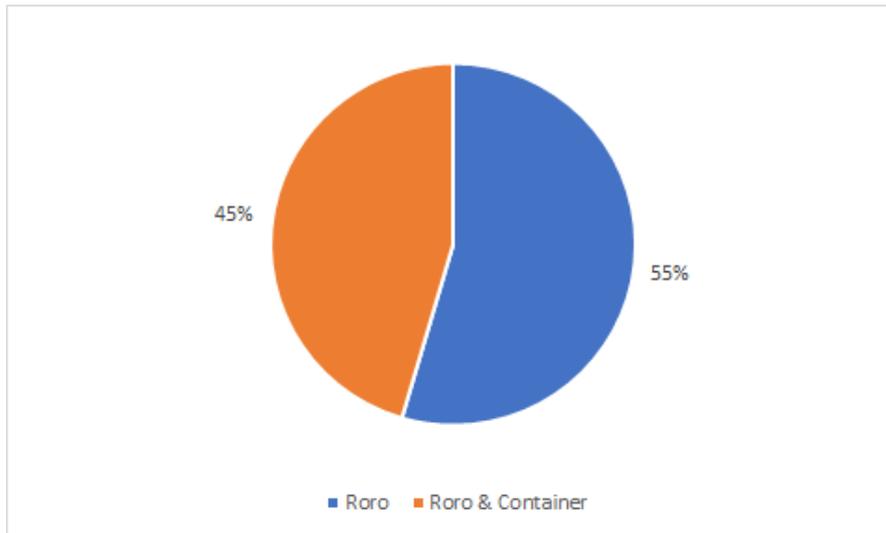
Due to product characteristics, it is not possible for most of the BB unit manufacturers to transport on railway. Hence, road transport is essential for the distribution of BB unit products. Most of the products are either too fragile or too heavy for the railway system. One manufacturer stated that use of the railway system involves too many risks, due to the increase of transshipments. In addition to road transport, the BB unit manufacturers emphasized the importance of sea transport and how it would not be possible to deliver to their global customers without it.

#### *4.1.2.1 Vessel Type*

##### *Rolling Units*

Table 4-3 indicate the type of vessel used by the rolling unit manufacturers. All manufacturers used RoRo transportation but emphasized that the choice of vessel type is dependent on the cargo's destination. For example, some destination ports do not have RoRo traffic. For that reason, four manufacturers used container vessels in addition to RoRo vessels. The manufacturers that used more than one vessel type argued that container vessels were used when transporting to abnormal destinations or to destinations that do not have RoRo traffic. One of the manufacturers that only used RoRo vessels pointed out that they were looking into transportation with container vessels from a nearby Swedish port as they believed it would be cheaper than their current solution.

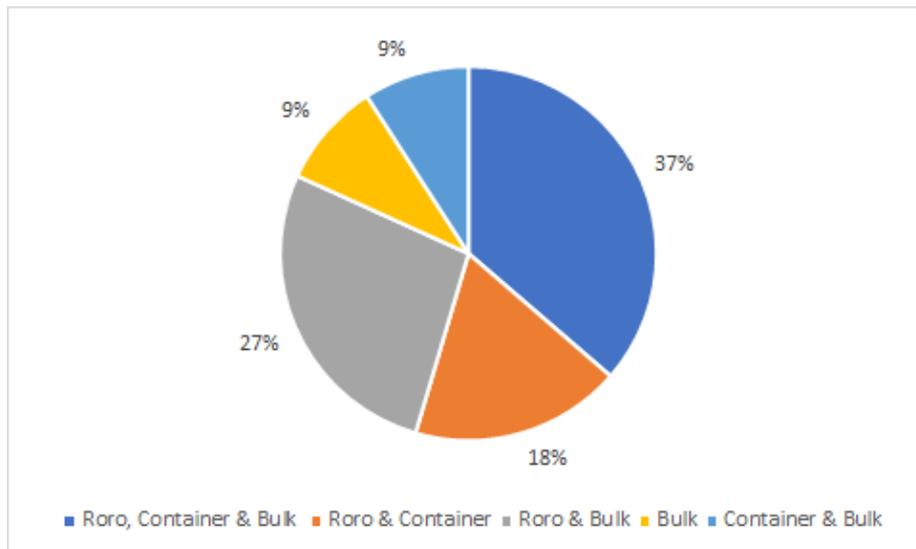
Table 4-3: Vessel type used for the rolling units.



*BB Units*

Table 4-4 present the vessel types used by the BB unit manufacturers. Only one manufacturer uses one, while all the others ship through a combination of two or more vessel types. Two of the manufacturers argued that the choice of the vessel depends on the characteristics of the cargo. One manufacturer stated that they prefer shipping with RoRo as their cargo must be placed under a deck for protective purposes.

Table 4-4: Vessel type used for the BB units.



#### 4.1.2.2 *The Environmental Impact of H&H Transportations*

##### *Rolling Units*

The majority of rolling unit manufacturers considers environmental aspects. However, how each manufacturer approaches the topic, as well as the degree it is focused on, vary. Some of the manufacturers argued that by being more flexible with their deliveries and consolidate the shipments, the fill rate can be optimized, and the environmental impact is reduced. Other initiatives were connected to placing environmental requirements on the transporters, performing audits, assessments and choosing local transporters to reduce distances.

Further initiatives as consistently using the most environmental transport mode available, as well as shipping from the closest port to avoid unnecessary inland transportation was also mentioned. Gävle Port was particularly mentioned by several manufacturers as a local port they wanted to exploit. However, today the port does not have the required facilities. Through replacing road transportation with either sea or rail transport, the manufacturers can reduce their environmental impact. However, rail transportation is not as competitive as other transportation modes according to one of the manufacturers.

It was pointed out by one of the manufacturers that new regulations, as IMO 2020, are in the near future. Hence, even though some of the more environmental transportation options can be more expensive, it might be beneficial in the long-term perspective.

##### *BB Units*

The majority of BB unit manufacturers consider the environment in their transportations. However, similar to the rolling unit manufacturers, the degree it is focused on and how it is performed vary between manufacturers. The methods used were quite similar to the rolling unit manufacturers; high fill rates, audits, use of local ports and transporters to reduce transport distances, choose more environmentally friendly transport modes (rail and sea) and place environmental requirements on the transporters. However, the BB unit manufacturers emphasized that product characteristics or time restrictions sometimes had to be prioritized before the environment. For example, when the railway infrastructure is not sufficient to carry the product safely and efficiently, or when the product must be delivered as soon as possible.

#### 4.1.3 Main Swedish Ports used for H&H Export

##### *Rolling Units*

Figure 4-3 present the rolling unit manufacturers choice of ports. All the rolling unit manufacturers use two or more ports. The Port of Gothenburg or the Port of Wallhamn, both located at the Swedish west coast, was mentioned from all the manufacturers of the rolling units. Some used one of them and some used both.

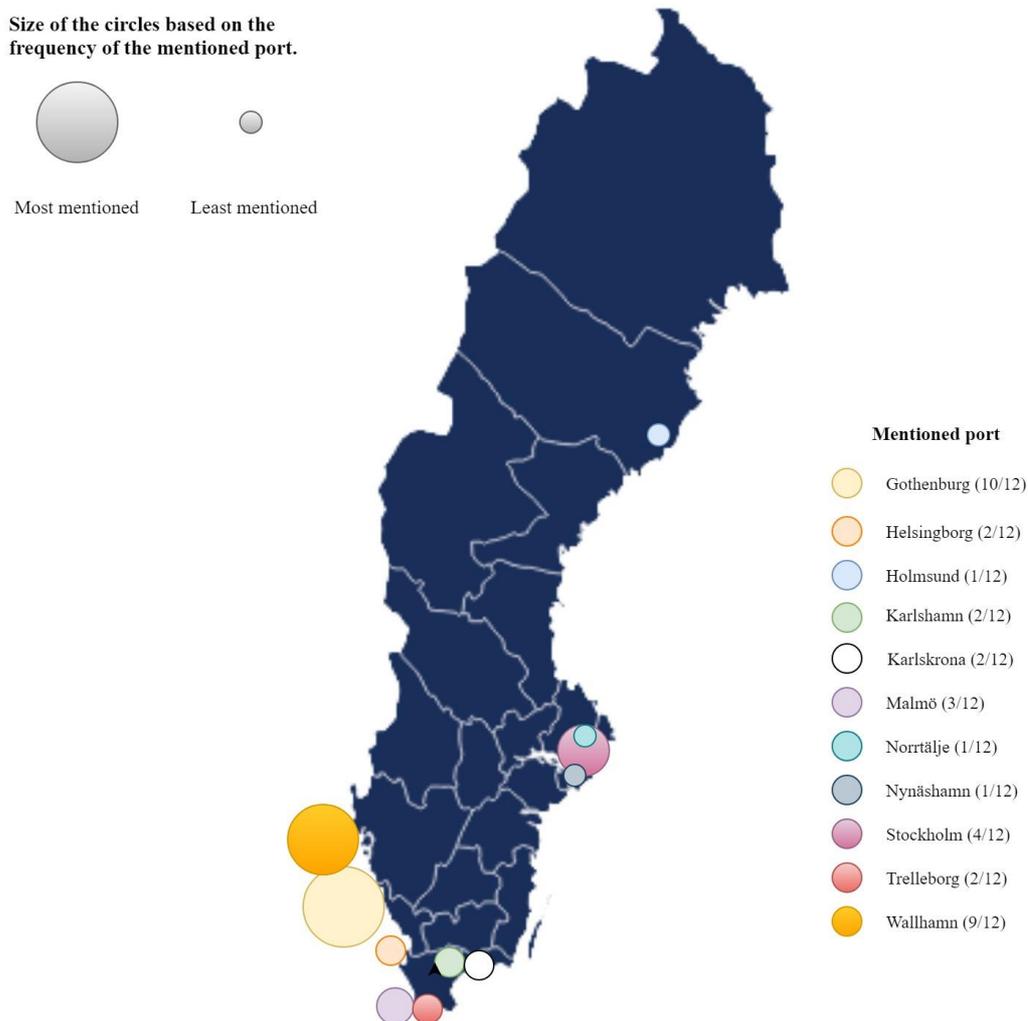


Figure 4-3: Swedish ports used for the export of rolling units based on the number of times it has been mentioned.

The rolling unit manufacturers emphasized that the service they receive from the port was important. A couple of manufacturers had a set of prerequisites that they demand from a port. If the requirements could not be fulfilled, they would not consider that port as an option. For example, two manufacturers said that they required that the product could be washed before loaded onto the ship. However, one of those two manufacturers clearly stated that the level of technology used to perform that service did not matter, as long as the job is done. Further, all the manufacturers pointed out that the ports knowledge about the product and how it should be handled was extremely important. The stevedores must be able to load/unload the cargo without causing damage to it. Further, two of the manufacturers say that they might require the port operators to assist with assembly and disassembly of the products due to shipment requirements.

All the manufacturers mentioned that they want “overall good service” and assistance for all the demands they might have. However, they all have different perceptions of what “good service” implies. While one manufacturer emphasized the importance of good communication flows, e.g. that they share updates on timetables, strikes and other influential factors, another manufacturer want to be able to drop off the keys and be able to trust that the port can handle it.

### *BB Units*

Figure 4-4 present the BB unit manufacturers choice of ports. The majority used more than one port. The Port of Gothenburg stands out as it was mentioned by all except one of the manufacturers. One manufacturer emphasized that the choice of port is often dependent on the destination. The possibilities are quite limited and usually, they only have one or two ports to choose from if they don't want to charter their own vessel.

However, it is not just the destination that limit the choice of ports. Most of the manufacturers emphasized that the port facilitations and service offered is essential. However, the degree that services are needed is very individual and often connected to product characteristics and shipment method. Services mentioned by the BB unit manufacturers are assistance with storage, repackaging, remarking, inspections, and safe and secure loading and unloading. The handling of the goods is emphasized by all of the manufacturers, as a crucial service. The manufacturers must be able to trust that the port and its stevedores can perform this service without hurting the cargo nor themselves.

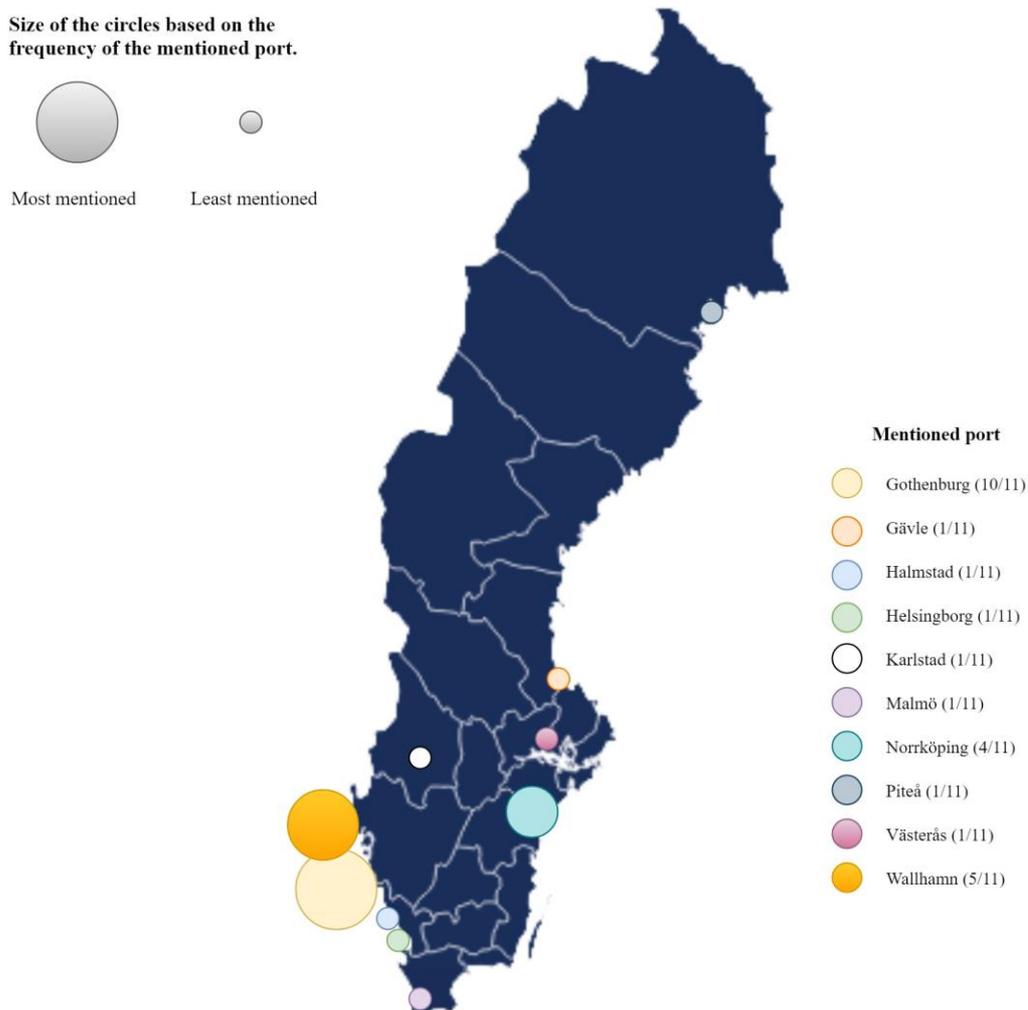


Figure 4-4: Swedish ports used for the export of BB units based on the number of times it has been mentioned.

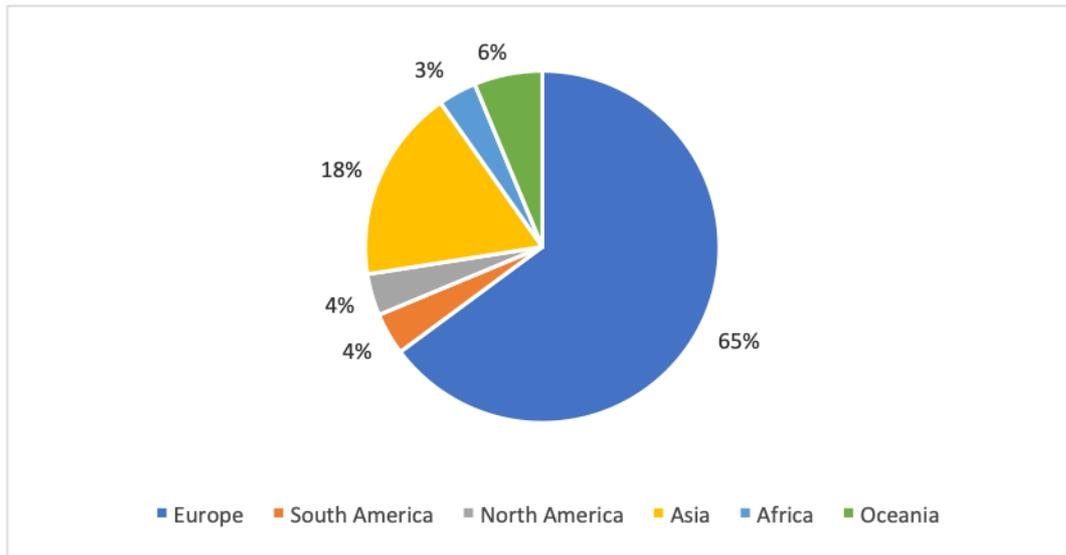
#### 4.1.4 Main Destination Continents for the Swedish H&H Export

Approximate calculations have been calculated based on the exported volumes to each continent received from the manufacturers. However, due to the different measurement methods used by the manufacturers, some manufacturers had to be excluded to make the calculations feasible. Hence, the tables below only present an approximate calculation to give readers an indication of the distribution of the exported products.

##### *Rolling Units*

Table 4-5 present an approximate percentage distribution of rolling unit shipments based on continents. As visible in the table, Europe is the main market with 65% and Asia follows with 18%. The remaining continents share a less significant part of the volume, all between 6-4%.

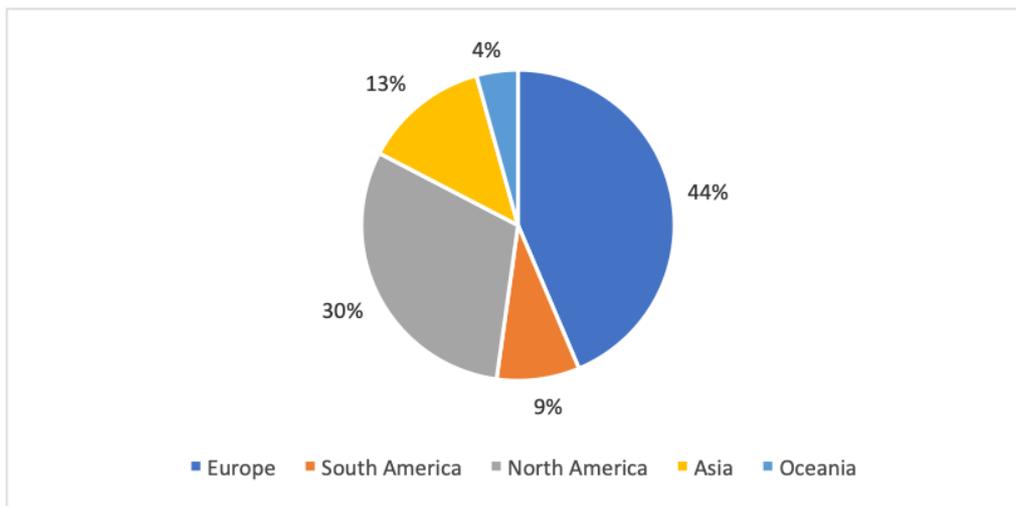
Table 4-5: Approximate volume to each continent of the rolling units.



*BB Units*

Table 4-6 present an approximate percentage distribution of BB unit shipments to the world continents. Africa is not a part of the table, as the volumes towards that destination were given in a value difficult to convert. Hence, Europe is the largest exporting market (44%) followed by North America (30%), Asia (13%) and Oceania (4%) respectively.

Table 4-6: Approximate volume to each continent of the BB units.



4.1.5 Factors of Significance when Selecting Transportation

To organize the data a categorization was made based on how the manufacturers have emphasized the different factors. Hence, a ranking table from 1-3 was developed, where 3 indicate that the factor is considered as a critical factor, 2 is considered as a very important factor and 1 is considered as an important factor for the selection of transportation, see table

4-7. Further, the points per factor were summed up and presented as a total value for each factor, per segment.

To ensure the visibility of the factors that were more emphasized by the manufacturers in the results, the factors are classified according to ABC analysis. In the analysis, the critical factors are classified as A, the most important factors are classified as B and the important factors are classified as C. Table 4-8 and 4-9 indicate the factors that the manufacturers find important for the rolling units and BB units respectively when making transportation choices. A definition of each factor is presented in appendix 3. However, some factors were mentioned more than others and therefore got more points even though there were expressed as less important. Hence, the tables also indicate the number of times each factor were mentioned, per segment.

Table 4-7: Importance factor when ranking the factors.

<b>Importance Factor Ranking</b>	
Critical Factors	3
Very Important Factors	2
Important Factors	1

Table 4-8: Importance of factors when selecting transportation in the rolling unit segment.

Rolling Units				
ABC	Number	Factors	$\Sigma$ Importance factor	$\Sigma$ Factors Mentioned
A	1	Lead Time	15	6
	2	Cargo Safety	13	5
	3	Correct Origin/Destination Port	13	5
B	4	Transportation Cost	12	6
	5	Frequency	11	4
	6	Punctuality	8	3
	7	Information Exchange	4	2
C	8	Consolidated Shipments/Shipment of Complete Product	3	1
	9	Vessel Characteristics	3	1
	10	Infrastructure	3	1
	11	No Transhipment	2	1
	12	Competence of Handling Cargo	2	1
	13	Industry Reputation	2	1
	14	Communication	1	1
	15	Invoicing	1	1
	16	Custom Clearance	1	1
	17	Service	0	0
	18	Relationship	0	0
	19	Equipment	0	0

The rolling unit manufacturers emphasized that lead time, cargo safety and that the cargo was shipped between the correct ports as the critical factors when making their transportation decisions. These factors were also the factors that were mentioned the most, which underpin the factors categorized as A.

Table 4-9: Importance of factors when selecting transportation in the BB unit segment.

BB Units				
ABC	Number	Factors	$\Sigma$ Importance factor	$\Sigma$ Factors Mentioned
A	1	Lead Time	14	6
	2	Transportation Cost	12	5
	3	Cargo Safety	9	3
	4	Consolidated Shipments/Shipment of Complete Product	9	3
B	5	Punctuality	6	2
	6	Service	6	2
	7	No Transshipment	5	2
	8	Frequency	5	2
C	9	Correct Origin/Destination Port	4	2
	10	Relationship	3	1
	11	Vessel Characteristics	3	1
	12	Equipment	2	1
	13	Competence of Handling Cargo	1	1
	14	Information Exchange	0	0
	15	Infrastructure	0	0
	16	Industry Reputation	0	0
	17	Communication	0	0
	18	Invoicing	0	0
	19	Custom Clearance	0	0

The BB unit manufacturers emphasized lead time as the most important factor, followed by transportation cost. Further, Cargo safety and consolidated shipments/shipment share third place as it was valued equally important. These factors were also the factors that were mentioned the most, which underpin the factors categorized as A.

*Consolidated results of rolling and BB units segment*

The results from both the rolling- and BB unit segment have also been consolidated to one table to give a summarized view from the H&H segment, see table 4-10. The H&H manufacturers emphasized lead time as the most important factor, followed by transportation cost and the cargo safety respectively. These factors were also the factors that were mentioned the most, which underpin the factors categorized as A. However, in the consolidated table, the number of times each factor has been mentioned obtains greater significance. For example, it can be seen that lead time and transportation cost were mentioned approximately the same number of times, but the summed factor of importance differs with five points.

Table 4-10: Importance of factors when selecting transportation.

Rolling Units + BB Units				
ABC	Number	Factors	$\Sigma$ Importance factor	$\Sigma$ Factors Mentioned
A	1	Lead Time	29	12
	2	Transportation Cost	24	11
	3	Cargo Safety	22	8
B	4	Correct Origin/Destination Port	17	7
	5	Frequency	16	6
	6	Punctuality	14	5
	7	Consolidated Shipments/Shipment of Complete Product	12	4
C	8	No Transhipment	7	3
	9	Vessel Characteristics	6	2
	10	Service	6	2
	11	Information Exchange	4	2
	12	Competence of Handling Cargo	3	2
	13	Relationship	3	1
	14	Infrastructure	3	1
	15	Industry Reputation	2	1
	16	Equipment	2	1
	17	Communication	1	1
	18	Invoicing	1	1
	19	Custom Clearance	1	1

## 4.2 Future Prospects for the Swedish H&H Export

The second part of the analysis elaborates on the Swedish H&H manufacturers prospects for the future; the manufacturers expectations regarding supply and demand, transportation flows and the environment connected to their transportations.

### 4.2.1 Supply and Demand Towards the Future

#### *Rolling Units*

None of the manufacturers of the rolling units believe that their export volumes will decrease, rather, the majority of them predict a positive future. Eight manufacturers believed that their export volumes will increase. Four out of these eight manufacturers believed that they will primarily expand to new markets, particularly developing regions, as Africa. While another manufacturer emphasized that they aimed to expand their business towards North America and Europe. Three manufacturers did not believe that they would expand to new markets. Rather the manufacturers will increase the volumes in their current markets, respectively Europe, North America and South America.

Some of the manufacturers believed that the market is stable. Meaning that the export volumes will neither increase nor decrease. However, it was pointed out by the manufacturers that their export market can be affected by the world economy. For example, if a recession arises. On the other hand, others argue that they will not be affected by a recession and will export the same volumes regardless of the world economy. Two manufacturers emphasized that world politics, as trade agreements, will affect their export volumes. One of the manufacturers has already been affected by world politics and the uncertainty that comes with it. In specific, the manufacturer was forced to insource their production back to Sweden, to secure future sales and simplify the transportation flow.

The manufacturers argued that there has been a trend to outsource the production during the last years. However, a few of them state that this is not relevant anymore. The parts of the production that is suitable for outsourcing have already been outsourced. Contrary, another manufacturer stated that they are thinking of outsourcing parts of their production to another European country, to decrease the transport distance to the customers.

#### *BB Units*

The majority of BB unit manufacturers had positive prospects of the future. Ten manufacturers believe that their export volumes will increase. While two manufacturers predict that the volumes will decrease. However, only one of them thought that the volumes would decrease due to rising competition, particularly from Asia. The other manufacturer simply predicted a decrease as they were planning to outsource parts of the production. All manufacturers, except this one, said that the production that still remained in Sweden was not possible to outsource, as it required the local competence.

The manufacturers that produce project cargo do not recognize any particular trend in their current flow. Hence, it is difficult for them to point out their future destinations. However, one of them argued that there is potential in Africa and Asia. The remaining BB unit manufacturers had different views on their future destinations. Some believed they would approach new markets, some thought they would continue to grow in the markets they already exist, and some emphasized the potential in developing countries. However, all the manufacturers emphasize that the future is impossible to predict and there is always uncertainty. For example, world politics can cause major changes to the expected trade.

## 4.2.2 Future Transportation Flow

#### *Rolling Units*

The rolling unit manufacturers had different perspectives on their future transportation flows. A few manufacturers stated that their transportation routes will likely change in the future. Two of them are located in the north of Sweden near the coast and argued that they want to use a port closer to their production to reduce the need for the inland transport. This would decrease cost, but also the environmental impact. Gävle Port was particularly mentioned but is unfortunately not a feasible option at the moment, as they don't offer the required services. However, such changes are neither performed without evaluating lead time vs price.

Two manufacturers located in the southern part of Sweden, below Västerås, also considered the possibility of switching local port in the future. One mentioned that a new roro terminal is being built in Norvik, which they planned to exploit when it is ready. Norvik Port will be closer to the production site, resulting in less inland transportation compared to the solution they have today, exporting through the Port of Gothenburg. However, the manufacturer also considered other options. They had a goal to decrease Co2 emissions by 50% by 2025, and consistently considered new transportation solutions to reach their target. The use of electric trains instead of road transport was also mentioned, but neither a realistic option at the moment due to the lack of quality.

Other manufacturers state that the change of port is more likely to be driven by the transporters (shipping companies in this case). If the transporters change route, they will have to follow. Hence, they were not necessarily searching for new transport options, but could not exclude that it would happen in the future. If the transport market, and particularly roro market, would change, this would naturally affect the transportation flow.

Several of the manufacturers argued that they would like to replace some of the sea transportation with railway. Railway is a more environmentally friendly, as well as cost effective option. However, all the manufacturers stated that the rail infrastructure is currently not sufficient. Neither is it competitive to sea transport, when it comes to flexibility and service quality. In general, railway have longer lead times and fixed departure times that cannot be adjusted in the last minute. However, two manufacturers particularly expressed an interest in the railway system from Europe to China and Russia. Hoping they would be able to exploit it towards the future.

Lastly, some of the rolling unit manufacturers also expressed that they do not want to change transport modes. Maritime transport is the best option for them. All other transport modes are either too complex or not a feasible option.

### *BB Units*

Almost none of the BB unit manufacturers stated that they are willing to change their transportation routes in the future. The manufacturers argued that they are pleased with the routes they are using today. Two of the manufacturers emphasized that they do have the possibility to change their transportation routes due to the characteristics of the cargo. Some of their products can be up to 400 tons, meaning that the inland transport needs roadside assistance, and in some cases the roads must be closed for other transport. Hence, they only have permission to transport the cargo to the closest port, which in their case is the port of Norrköping.

Two manufacturers stated that if railway would be possible to utilize to a greater extent than today, they would be open to change the transportation flow and choice of Swedish port. However, the BB unit manufacturers neither found the railway infrastructure to be sufficient enough to replace their current inland transport solution.

None of the BB unit manufacturers think they will use anything other than sea transportation for their future export. According to them, H&H cargo is not possible to transport in any other way. One even argued that they want to exploit the sea transportation as much as possible, in order to shorten the inland transport at both origin and destination. However, one manufacturer had used the railway from Europe to Asia when they experienced time constraints. They argued that this rail connection had a shorter lead time than sea transportation.

#### 4.2.3 The Environmental Impact of H&H Transportations in the Future

##### *Rolling Units*

The majority the rolling unit manufacturers have the intention to increase their environmental focus, in connection to transport, towards the future. The manufacturers stated that the environment is very important, and it will be even more important in the future. Some even stated that environmental focus will be essential for them in order to successfully do their business in the future. Several of the manufacturers mentioned upcoming regulations as IMO 2020, which will be very important towards future.

One of the manufacturers stated that it is very important to educate themselves as much as possible. For example, through visiting exhibitions that discuss the environmental issue or other similar events. Several manufacturers argued that they already consider the environment and is trying to reduce their impact consistently. For example, through reducing their inland transportation by shipping from ports closer to their production. As already mentioned, some manufacturers in the northern part of Sweden are currently investigating the possibility of shipping from Gävle port, as this is the closest local option.

Several manufacturers stated that it is very important for them that the transporters are using modern trucks or vessels, as well as sustainable fuels, to prevent pollution. However, some manufacturers are more driven than others. For example, one of the rolling unit manufacturers has started a project with an academic institution, as well as other manufacturing companies, with the aim of improving the accessibility and reduce the environmental impact between the port in Holmsund and Vaasa in Finland. The project involves designing a ferry that is considerably more environmentally friendly and has a shorter lead time than the current RoPax solution.

Three of the manufacturers stated that the use of rail would have been very efficient in order to replace the inland road transportation and potentially even the maritime transportation. The manufacturers considered the railway a more environmental and cost-efficient solution. However, in addition to the infrastructure problem, some of the manufacturers argued that they don't have the required volume to make it beneficial.

Despite the manufacturers willingness to change, three of the manufacturers argued that in order to make the future transports more sustainable, the governments must take action and put requirements on the manufacturers as well as the transporters. The demand for

transportation is increasing, and regulations is the only measure that can make sufficient change.

### *BB Units*

The BB unit manufacturers emphasized that environmental aspects were very important towards the future. However, admitted that their current work could be better. Nine of the manufacturers argued that they need to focus more on this area. One of the manufacturers mentioned that maritime transportation will be indispensable in a sustainable future economy, as it is the most environmental option to transport large volumes. Both in terms of energy efficiency, and the prevention of pollution.

A few of the BB unit manufacturers argued that the environmental aspect will be easier to work with if the governments put requirements on the manufacturers and transporters. Regulations is the only way to change the industry with a permanent effect. One of the manufacturers stated that *"Without no requirements, there will be no change"*.

Some of the BB manufacturers also mentioned that they use transporters in the local area to reduce unnecessary transport. Others mentioned that they would try to exploit geographically closer ports, the railway system and put their environment requirements on the transporters in the transport agreement to reduce their environmental impact.

## 5. Results

*This chapter aims to summarize the main findings of the study combined with the found literature. It starts with the current state and its two research questions and ends with the presumed prospects for the future connected to its research question.*

---

### 5.1 What Characterizes the Current Swedish H&H Export Market?

*Who are the main H&H Exporting Manufacturers in Sweden?*

Carlgren (2019A) argues that Swedish export is very important for the nation and its economy. 70% of the exported value is derived from commodity export, whereas 40% of that is derived from industry products, like vehicles, machines and products for the forest industry (SCB, 2019A; Carlgren, 2019B). In 2018, the most important group of exporting goods was industry products such as machines and road vehicles (SCB, 2019A). This study has identified 28 H&H exporting manufacturers, which mainly produce products within the categories handling equipment, trucks and buses, industrial machines, construction machines, forest equipment and other. The products either fall into the H&H category of rolling units or BB units. It was found that Swedish H&H export market export more than 47 000 units per year, see table 4-2. Hence, it can be presumed that H&H is an important and well-developed part of Sweden's export.

Figure 4-1 indicate where these manufacturers are located, which is mainly in the southern regions of Sweden, below Västerås. Only a few manufacturers are located on the east coast above Västerås.

*What Distinguishes the main H&H Exporters Transportation Flow?*

The majority of Swedish H&H exporters have the same transportation flow. This consist of intermodal transportation, with sea transportation to all destinations, supported by rail/road in order to reach the port area. The use of intermodal transport can reduce cost and travel distance, as well as increase flexibility (Song and Panayides, 2016). The use of intermodal transport has also been highlighted as a possibility to reduce environmental impact (Eng-Larsson and Kohn, 2012).

When discussing the first leg of the transportation flow, the majority of the H&H manufacturers elaborated on their opinion of the railway system. They argued that due to the lack of railway infrastructure throughout the country, railway is rarely a feasible option. Swedtrain (n.d.) states that more and more Swedish companies have expressed an interest in the railway system, but that the current infrastructure put the breaks on this development. Hence, For the first leg of the transportation flow, the H&H manufacturers to a large extent considered road transport as the only option. Road transportation offers higher availability, flexibility and delivery accuracy, compared to rail transportation. Further, road transport can also handle different travel lengths, all from short local deliveries to international deliveries

(Lumsden, 2012). However, as already mentioned, the manufactures mostly used road transport to one of the ports in and then shipped the cargo through sea transport to its destination port. According to Song and Panayides (2016), maritime transport generally offers high operational efficiency and service effectiveness. However, O’Leary-Kelly and Flores (2002) emphasize the importance of maritime transport being integrated with the rest of the transport chain, to avoid unnecessary costs, delays or accidents.

In shipping, Stopford (2008) argues that different vessel types often compete with each other for the same cargo. This was highly visible for the BB units, as the majority of the BB unit manufacturers used either two or more vessel types to transport their cargo, see table 4-4. However, for the rolling units, only two vessels typed was used, RoRo vessels and container vessels. Stopford (2008) argues that when the cargo can roll on to the vessel without the use of additional equipment, RoRo shipping is very efficient. In this study, 55% of the rolling unit manufacturers only used RoRo vessels to transport their cargo. The remaining 45% used either RoRo vessels or container vessels. Stopford (2008) says that even though the RoRo transportation has proven to be very efficient, it still suffers great competition from the container industry.

#### *To what Extent is the Environment Considered in the Transportation?*

The majority of H&H manufacturers consider the environment in their current transportation flow. However, to a different extent and through different approaches. A common method was to transfer the problem over to the transporter, placing environmental requirements on them before any agreement could be done. This way, their environmental impact is reduced without much effort from the manufacturers. However, still, a sufficient effort to promote change.

The manufacturers argued that through exploiting the more environmental transportation modes, sea and rail, the environmental impact can be reduced. Eng-Larsson and Kohn (2012) state that sea and rail transportation is less polluting than road transport. However, the Swedish rail infrastructure is not sufficient and therefore not utilized to the degree the manufacturers would like to.

Furthermore, the manufacturers are working to diminish the inland transportation. For example, using ports closer to their production sites and optimize the fill rate of their transportations. Some manufacturers argued that they want to exploit their local port Gävle, to reduce the distance of inland transport. Through reducing the need for transport, the environmental impact is also reduced (Lammgård, 2007; Björklund, 2005; Santén, 2016).

#### *What are the main Ports that Handle H&H Transport?*

Figure 4-3 and 4-4 indicate that the two most frequently used ports for H&H products are the Port of Gothenburg and the Port of Wallhamn. The Port of Gothenburg is the largest port in Sweden and can receive berths from multiple vessel types as RoRo, bulk and container vessels (Port of Gothenburg, n.d.). The Port of Wallhamn, on the other hand, is focused on

RoRo traffic (Svensk Sjöfart, n.d.C). However, the choice of port is highly influenced by two factors; product characteristics and the destination of the cargo.

#### *What are the main Destination Continents for the Swedish H&H Export?*

According to Carlgren (2019C), almost three quarters of the Swedish commodity export is shipped to Europe. In this study, 65% of the rolling unit volumes and 44% of the BB unit volumes had Europe as their final destination. Carlgren (2019C) also state that in 2018, Sweden exported primarily to Germany, Norway, Finland, Denmark, and the USA respectively. However, Asia was considered a growing export market for Sweden (Carlgren, 2019C). In this study, Asia was the second largest export market for rolling units (18%), and the third largest for BB units (13%).

## 5.2 What are the main Influential Factors that the Exporting Manufacturers find Important when Making Transportation Choices?

The factors highlighted by the H&H manufacturers in connection to making transportation decisions indicate high correspondence with the nine influential factors presented in the theoretical framework, see figure 3-6. The manufacturers emphasized elements in all of the categories; time factors, cost factors, service factors, market factors, administration factors, care of cargo factors, geographical factors and relationship factors. The only factor not mentioned by the manufacturers is the environmental factor. Flodén et al (2017), Lamngård and Andersson (2014) and Postnord (2014) states that the importance of the environment is identified as less prioritized in several studies.

Out of all factors, the H&H manufacturers valued lead time, transportation cost and cargo safety respectively, see table 4-10. Meixell and Norbis, (2008) confirm the importance of lead time, arguing it is one of the dominant factors that influence transport decisions. Cullinane and Toy (2000) as well as Lumsden (2006) also argue that time factors is often a dominating factor. However, they emphasize that is more connected to reliability. In this study, the reliability factor was expressed by the manufacturers through punctuality. It was an important factor, but not a dominant factor. Flodén et al (2017), states that the importance of reliability could be affected by the value of the cargo, whereas low-value cargo is not as affected by the reliability as high-value cargo. This somewhat correlate with the results found in this study as all H&H products are considered as high value.

When dividing the H&H into two the two sub-groups, distinct differences became visible. Both the rolling units and BB units value lead time as the most dominant factor, see table 4-8 and 4-9. However, the following factors vary based on segment. The rolling unit manufacturers, in presented order, value lead time, cargo safety and correct origin/destination port as their main influential factors. The BB unit manufacturers on the other hand value, lead time, transportation cost, cargo safety and consolidated shipments/shipments of complete products. Correct origin/destination port and consolidated shipments/shipments of complete products are not mentioned in figure 3-6, but highly ranked by the H&H manufacturers.

According to Flodén et al (2017) and Lamngård (2007), cost is ranked as a less dominant factor, placed below service or quality factors. The H&H manufacturers neither expressed the price as the top dominant factor. However, it is ranked high in the total results. Cullinane and Toy, (2000), Flodén et al (2017) and Casaca and Marlow (2005) argue that the importance of cost varies depending on the value of the cargo. When the cargo is of low value, the cost has been a very important factor when selecting transport, and visa versa. All of the H&H products are of high value. However, although it was not the most dominant factor, price yet resulted into being an important influential factor for the H&H manufacturers.

The H&H manufacturers ranked cargo safety as a top three factor that influence their transport selection. Cullinane and Toy (2000) Liberatore and Miller (1995) and Flodén et al (2017), state that care of the cargo and its safety is a determining factor, but it is not the most important factor. In this study, the H&H manufacturers emphasized that cargo safety is extremely important due to the complexity and high value of their products.

### 5.3 How does the H&H Manufacturers Predict and Evaluate the Future?

#### *How will the Demand and Supply Towards the Swedish Manufacturing Market Develop?*

In general, H&H manufacturers have positive prospects for the future. Most of them argued that the major changes have already occurred and that elements as outsourcing will not be relevant for the future. The production that is still based in Sweden is there because of the local competence, and that is why it will not change. When discussing future export volumes, the majority of the manufacturers predict that the exported volumes either stay as is or increase. Some manufacturers expect an increase in the developing countries around the world, as different parts of Africa, while others believe that there is a lot of unexplored potential in the regions they already trade, particularly Europe, North America, and South America. According to SCB (2019B) commodity export within all these regions increased during 2018. Compared to 2017, Europe increased by 11%, America 7%, and Africa 1%.

Some of the BB manufacturers only produce to different projects. Those manufacturers had difficulties with predicting future destinations, but still had a positive view on future volumes. However, a few of the manufacturers emphasized that the world economy and political factors, of course, have a large impact. According to Carlgren (2019D), world trade was slim under the year of 2018, and the ongoing trade conflicts, as the conflict between China and USA, as well as Brexit, cause even further uncertainty about the future.

#### *How will the Transportation Flow be Altered Towards the Future?*

When asking the H&H manufacturers of their future transportation flow, they had quite different opinions. While none of the BB manufacturers emphasized that they thought the route would change, several of the rolling unit manufacturers argued that they hoped the

transportation route would be more efficient towards the future. A port closer to the production would reduce transportation cost of inland transport and reduce emissions. Some manufacturers argued that it is not they who necessarily want to change the routes, it is rather a consequence of the transporters changing theirs.

When discussing inland transport with both the rolling unit and BB unit manufacturers, the majority of them spoke positively about transportation through railway. However, as previously mentioned, the current infrastructure, unfortunately, put a hold on this development. Several of the manufacturers also argue that the current quality is neither comparable with the quality received when using sea transportation. Nonetheless, the national plan presented in 2018 of the Swedish government intends to improve the railway system. With a well-invested budget, the plan is concentrated on the development of new infrastructure throughout the country. It also involves renovation and modernization of the current infrastructure (Regeringen, 2018).

The use of the railway between Europe and China is rapidly increasing (Jensen, 2019). Some of the manufacturers emphasized high interest in this railway and one manufacturer argued that this route even reduces lead time. Jensen (2019) argues that during the last decade, the lead time on this track has been reduced significantly. Hence, it is now capable of competing in both speed and cost (Jensen, 2019).

#### *To what Extent is the Environmental Impact of Significance in the Future?*

Macharis (2014), argue that the focus on sustainable transportation has increased during the last decade due to the reoccurring topic about reducing the environmental impact. This is emphasized by the majority of the Swedish H&H exporters, which have the environmental aspect for their transportations in mind for the future. The manufacturers state that the environment will be an important element of future business.

Lammgård (2007), Björklund (2005) and Santén (2016), mentions three general approaches for reducing the environmental impact of freight transportation, see section 3.5. All three of the approaches are mentioned by the H&H manufacturers. One additional approach mentioned by the manufacturers is the power of governments. The manufacturers state that the government needs to take action and put requirements on the manufacturers and transporters. Otherwise, the ongoing work and future work with sustainability will be difficult to sustain.

The H&H manufacturers state that the change to a more environmentally transport mode, for example to rail transportation from road is a very efficient way of reducing the environmental impact. Both for long international distances and inland transportation to a port. However, the Swedish rail infrastructure is not sufficient, making railway a less realistic option. Some manufacturers neither produce the volumes necessary to justify a switch to railway transport.

Diminishing the need for transport is also important to the manufacturers and especially for the manufacturers located in the northern part of Sweden. Today, there is no port in northern Sweden that can handle H&H products, and inland transportation to the closest serviceable port is long. Hence, some manufacturers mentioned that the port Gävle would be a great alternative for the future, if the required facilities became available. Decreasing the need for transport by vehicle/km is one of the ways environmental impact can be reduced (Lammgård,2007; Björklund ,2005; Santén, 2016). Some manufacturers even argued that they could set environmental requirements on the transporters. For example, through demanding that their transporters always use the newest technology, as well as alternative fuels. Setting requirements on the transporters is a useful method to reduce the environmental impact according to Lammgård (2007), Björklund (2005) and Santén (2016).

## 6. Conclusions

*The purpose of this study was to provide the Port of Gothenburg with information about the Swedish H&H market and emphasize the elements that the H&H manufacturers find important in connection to their transportations now and towards the future.*

---

### *Characteristics of the Current Swedish H&H Export Market*

A total of 28 H&H manufacturers were identified in this study. All suitable to be placed in either of the subsegments; rolling units or BB units. All of the manufacturers were located in the south of Sweden, below Västerås, with only a few exceptions. The main transportation flow for H&H manufacturers consists of two legs in an intermodal transport chain. Where road transportation brings the cargo to a Swedish port and from there it is shipped through sea transportation to its destination port. The BB unit manufacturers generally mixed between two or more vessel types; RoRo, container, and bulk. Whereas the rolling unit manufacturers used RoRo vessels only, or a mix of RoRo and container vessels.

Nearly all the H&H manufacturers consider the environment in their current transportation flow. However, to different extents and through different methods. The method identified as most common was putting environmental requirements on the transporters. Some manufacturers argued that they tried to use more environmental transportation modes, rail and sea transport. However, the lack of infrastructure restrained them from using the railway system as much as they would like too. Further, methods as shipping through the closest port, high fill rate, and flexible time schedules were also mentioned as measures to reduce environmental impact.

The main ports used for H&H cargo were all located in Sweden. The most frequently mentioned ones for both segments were Port of Gothenburg and the Port of Wallhamn. From the Swedish ports, the H&H manufacturers exported to all the world continents. However, Europe was identified as the main destination for both segments, with 65% of the rolling unit volumes and 44% of the BB unit volumes.

When making their transportation choices, the H&H manufacturers emphasized three factors as most important, lead time, transportation cost and cargo safety respectively. However, when dividing them into the subgroups, rolling unit manufacturers valued lead time, cargo safety and correct origin/destination port as the more important factors. Whereas the BB unit manufacturers prioritized lead time, transportation cost, cargo safety and that the shipments were consolidated/shipped as a complete product.

### *H&H Manufacturers Evaluation and Predictions About the Future*

When asking the H&H manufacturers about the future, they all had positive prospects. The majority of them argued that the major changes have already occurred. Hence, the future seems stable and there is no reason to suspect any larger changes as reorganization or outsourcing. The majority believed that the exported volume would either stay as is or increase. Some predicted developing areas as Africa as potential markets for the future, while others assumed they would grow even larger in the areas they already traded. Europe, North America, and South America were particularly mentioned. However, some manufacturers emphasized that political conflicts cause uncertainty, making it very difficult to predict future trade.

All H&H manufacturers had very different prospects regarding their future transportation flow. None of the BB unit manufacturers predicted any distinct changes in their transportation routes. However, the rolling unit manufacturers emphasized that they hoped more efficient and environmentally friendly solutions would appear towards the future. The railway was identified as a highly considered transportation mode for several of the manufacturers. However, the development of the infrastructure must occur before this becomes feasible. Several participants even discussed railway for international shipments, particularly the route from Europe to China.

The H&H manufacturers all considered the environment as an important element for future transportation. They argued that the topic is increasingly becoming more and more relevant and that it will be critical for the business future success. Some of the measures that the manufacturers consider have already been mentioned. However, the manufacturers argued that if the environmental aspect shall be properly dealt with, it has to be organized and implemented through a governmental body.

## 7. Discussion

*The following chapter aims to address some topics for discussion that the authors found interesting. The topics are questions that arose during the process of the thesis, both during the interviews with the manufacturers and during the analysis. Some parts will refer to the Port of Gothenburg, as the thesis is initiated based on their request.*

---

### 7.1 Why does the Current Transportation Flow look like it does Today and how will it Develop Towards the Future?

The fact that the majority of H&H manufacturers had the same transportation flow, raises the question if there is a lack of opportunities or a lack of effort. The first leg of the transport flow which mainly consisted of road transport to the closest port seems to be the only option today. However, it could and should be replaced with rail towards the future based on the findings in this study. The manufacturers have expressed an interest in the railway for environmental purposes and the Government has dedicated large sums to reinforce the railway system. Hence, towards the future, it should be feasible for at least some of the manufacturers to exploit the railway system. However, this depends on how the railway system will be developed, as well as the actual willingness of the manufacturers, if and when it becomes a realistic option. The manufacturers emphasized that cargo safety is crucial when making their transport decisions. However, the use of the railway, regardless if it is domestic or international, might increase the level of risk connected to theft, and the number of loads/unloads. It will also influence transport flexibility, as road transport is not dedicated to time schedules in the same extent as rail transport. The Port of Gothenburg has great potential to receive cargo through railway with their rail connections all the way into the port area (Port of Gothenburg, n.d). However, rail infrastructure must first become available close to the manufacturers.

When evaluating the map in figure 4-1, it becomes visible that some of the H&H manufacturers are located in certain geographical clusters. If the results were presented and sorted based on geographical location, the conclusions might differ from what is found in this research. However, there were no major differences in the responses that indicated that geographical location was of critical significance. Hence, the results were rather processed through a categorization of product type. However, it must be emphasized the manufacturers that wanted to exploit Gävle port towards the future was located geographically close to that port. Using a closer port will reduce inland transportation which can result in lower costs and less environmental impact. Whether or not Gävle port has the facilities to receive this type of cargo is not investigated more than what the manufacturers expressed, but such a development would increase the competition towards the Port of Gothenburg. However, although several of the manufacturers mentioned the same ambitions for Gävle port, it did not seem as there was any clear communication between them. Implementation of such a flow

would most likely require resources and collaboration from multiple of the manufacturers, which today seems to be non-existent.

## 7.2 What is Actually Important when Selecting Transportation and why is it Important?

All H&H manufacturers described their cargo as specialized cargo that required a special type of handling. Hence, as the Port of Gothenburg described, it is not the regular base load. H&H cargo is “abnormal” cargo of high value, with special care requirements. Due to these special requirements that arise in the connection to transport, it can be assumed that ports and transporters often are required to provide additional services compared to what the regular base load requires. Nearly all of the H&H manufacturers used more than one port, whereas the port of Gothenburg was mentioned by close to all manufacturers. Hence, their facilities and service offerings seem to be in place. However, the question for them is rather how they can 1. Get all the cargo from the manufacturers that already use their port for part of the shipments, and 2. Obtain the little cargo that they have not gotten a hold of. The manufacturers stated that they had to use multiple ports, as the ports rarely ship to the same location or they wanted to avoid transshipment. If the port of Gothenburg expanded their trade routes and expand their offer of direct routes, the prospects for a higher market share and increased competitiveness would hopefully increase. However, further dialogue with the manufacturers on the coveted routes is necessary, as that was not sufficiently investigated in this research.

## 7.3 How will the Environmental Aspect Affect the Future?

Most of the manufacturers considered the environment in their current transportation flows. Some of them even had environmental requirements for their transporters. However, none of them mentioned the environment as a factor when selecting transport.

Almost all manufacturers considered the environment to be very important and had ambitions to work with sustainable transportation towards the future. This raises the question if the environment factor will be more important towards the future when making transport decisions. It can be discussed if the statements about the environmental aspect and its importance is all bark, or if it will become an important factor, equal or more important, than lead time, price and cargo safety towards the future.

The transportation actors, including ports, should anyhow have the environmental aspect in mind and be prepared. IMO 2020 will for example set requires to the shipping companies, whereupon from 1<sup>st</sup> January 2020, the limit of sulfur in fuel oils onboard ships that are operating outside emission control areas must be reduced by 0,5% mass by mass (IMO, 2019). Ports could also prepare by trying to create an open dialogue with the different transporters regarding the different transportation modes arriving at the ports and how they will develop in the future. One strategy for a higher market share and contributing to a better environment could be if the ports offered the manufacturers help to restructure their

transportation routes. For example, by rail, or if all trucks will be powered by electric, the ports might have to upgrade with charging stations. However, this would also require a dialogue and cooperation with the local authority.

## 7.4 Future Research

Due to time and resource constraints, this research is limited to the boundaries that shape the research scope. However, during the research period, multiple other interesting aspects connected to the Swedish H&H export appeared and those will be elaborated in this section.

This research is only limited to Swedish export. However, when discussing the topic with different actors in the pre-study, it was identified that Sweden also has a significant import market of the same products. Further research could concentrate on the Swedish H&H import market and if there is any form of coordination or connection to the export market.

Further, this study has excluded all factors regarding relations and network between transporters and manufacturers because it was too comprehensive. However, research on how relationships and network influence market characteristics and transportation decisions in the Swedish H&H market would be an important development of this study.

The factors that turned out to be the most important when selecting transportation was only verified by the manufacturers. Thereof, the factors were not verified by the transport actors in order to examine if the transport actors were apprized with the most important factors. Hence, research verifying the factors by the transport actors would be interesting to investigate. Thereby, confirm if the communication between the actors could be even better in order to strengthen the H&H export market.

This research was performed based on a request from the Port of Gothenburg. Their desire was to be presented with factors and elements about the Swedish H&H export market that could be useful for them in connection to current and future business. This research has hopefully provided them with insight into what the market currently looks like as well as elements that could be exploited towards the future. However, future research should concentrate on how these elements could be exploited through the resources and competence that the Port of Gothenburg holds. This would provide the Port of Gothenburg with more detailed guidelines on how to successfully develop within the H&H market.



## References

- Arof, A. (2018). Decision Making Model for Ro-Ro Short Sea Shipping Operations in Archipelagic Southeast Asia. *The Asian Journal of Shipping and Logistics*. 34(1):33-42.
- Bell, E., & Bryman, Alan. (2007). The Ethics of Management Research: An Exploratory Content Analysis. *Journal of Management*. Vol. 18 Issue 1, p63, 15 p.
- Björklund, M. (2005). *Purchasing Practices of Environmentally Preferable Transport Services*. (Doctoral dissertation, Lund Institute of Technology, 2005).
- Brooks, R.M., & Trifts, V. (2008). Short sea shipping in North America: understanding the requirements of Atlantic Canadian shippers. *Maritime Policy & Management*. Vol. 35 Issue 2, p.145-158.
- Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford: Oxford University Press.
- Carlgren, F. (2019A). *Export och import över tid*. Retrieved April 19, 2019, from <https://www.ekonomifakta.se/Fakta/Ekonomi/Utrikeshandel/Export-och-import-over-tid/>
- Carlgren, F. (2019B). *Sveriges export- och importprodukter*. Retrieved April 19, 2019, from <https://www.ekonomifakta.se/fakta/ekonomi/utrikeshandel/sveriges-export--och-importprodukter/>
- Carlgren, F. (2019C). *Sveriges Handelspartner*. Retrieved April 19, 2019, from <https://www.ekonomifakta.se/fakta/ekonomi/utrikeshandel/sveriges-handelspartners/>
- Carlgren, F. (2019D). *Prognoser om Ekonomin*. Retrieved April 15, 2019, from <https://www.ekonomifakta.se/Fakta/Ekonomi/Tillvaxt/Prognoser-om-ekonomin/>
- Casaca, P.A., & Marlow P.B. (2005). The competitiveness of short sea shipping in multimodal logistics supply chains: service attributes. *Maritime Policy & Management*. Vol. 32 Issue 4, p363-382. 20p.
- Casaca, A.C.P., & Marlow, P.B. (2007). The Impact of the Trans-European Transport Networks on the Development of Short Sea Shipping. *Maritime Economics & Logistics* 9 (4), 302–323.
- Cullinane, K., & Toy, N. (2000). Identifying influential attributes in freight route/mode choice decisions: a content analysis. In *Transportation Research. Part E* 2000 36(1):41-53.
- DSV. (n.d.). *Flat rack container*. Retrieved May 15, 2019, from <http://www.se.dsv.com/sjofrakt/Transportenheter/Flat-rack-container>

Duru, O. (2018). *Shipping Business Unwrapped: Illusion, Bias and Fallacy in the Shipping Business*. Boca Raton, FL : Routledge.

Ekonomifakta (n.d.). *Det har blivit bättre - Sverige under 150 år*. Retrieved April 19, 2019, from

<https://eduna.se/downloadable/download/link/id/MC42NDg1NTcwMCAxNTU1MzE1NjYwMTEwOTgxNzI3OTM5/>

Ekström, S. Müller, L., & Nilsson, T. (2016). *Sjövägen till Sverige: från 1500-talet till våra dagar*. Sverige: Roos & Tegner.

Ekwall, D., & Lantz, B. (2013). Seasonality of cargo theft at transport chain locations. *International Journal of Physical Distribution & Logistics Management*. 43(9):728-746.

Eng-Larsson, F., & Kohn, C. (2012). Modal shift for greener logistics – the shipper’s perspective. *International Journal of Physical Distribution and Logistics Management*. 42(1):36-59.

Flodén, J. (2007). *Modelling intermodal freight transport - the potential of combined transport in Sweden* (Doctoral dissertation, School of Business, Economics and Law Gothenburg University, 2007). Retrieved from

[https://gupea.ub.gu.se/bitstream/2077/17141/3/gupea\\_2077\\_17141\\_3.pdf](https://gupea.ub.gu.se/bitstream/2077/17141/3/gupea_2077_17141_3.pdf)

Flodén, J. Bärthel, F., & Sorkina, E. (2017). Transport buyers choice of transport service – A literature review of empirical results. *Intermodal freight transport management, Research in Transportation Business & Management*. 23:35-45.

Hopp, W.J. & Spearman, M.L. (2011). *Factory Physics*. Waveland Press.

IMO. (2019). *Sulphur 2020 – cutting sulphur oxide emissions*. Retrieved May 7 2019, from <http://www.imo.org/en/mediacentre/hottopics/pages/sulphur-2020.aspx>

Jensen, P.T. (n.d.). *Rail transport has become more competitive in speed and cost*. Retrieved April 23 2019, from

<https://tschudilogistics.com/rail-transport-china-cis-europe/>

Kasilingam, G.R. (1998). *Logistics and Transportation*. USA: Springer US.

Lammgård, C. (2007). *Environmental Perspectives on Marketing of Freight Transports* (Doctoral dissertation, School of Business, Economics and Law, Gothenburg University, 2007). Retrieved from

[https://www.gu.se/digitalAssets/1345/1345179\\_environmental\\_perspectives\\_on\\_marketing\\_of\\_freight\\_transports.pdf](https://www.gu.se/digitalAssets/1345/1345179_environmental_perspectives_on_marketing_of_freight_transports.pdf)

- Lammgård, C., & Andersson, D. (2014). Environmental considerations and trade-offs in purchasing of transportation services. *The Marketing of Transportation Services, Research in Transportation Business & Management*. 10:45-52.
- Liberatore, M.J., & Miller, T. (1995). A decision support approach for transport carrier and mode selection. *Journal of Business Logistics*, vol. 16, no. 2, pp. 85.
- Lumsden, K. (2006). *Logistikens Grunder*. Lund: Studentlitteratur.
- Lumsden, K. (2012). *Logistikens grunder*. Lund: Studentlitteratur.
- Macharis, C. (2014). *Sustainable logistics*. Bingley: Emerald Group Publishing Limited.
- Medda, F., & Trujillo, L. (2010). Short-sea shipping: an analysis of its determinants. *Maritime Policy & Management* 37 (3), 285–303.
- Meixell, M.J., & Norbis, M. (2008). A review of the transportation mode choice and carrier selection literature. *The International Journal of Logistics Management*. vol. 19, no. 2, pp. 183- 211.
- Gungor, B. (2018). *BREAK BULK, OVER-SIZED CARGO SHIPMENTS ON FLAT-RACK CONTAINERS*. Retrieved May 14 2019, from <https://www.morethanshipping.com/break-bulk-over-sized-cargo-shipments-on-flat-rack-containers/>
- Murphy, P., & Hall, P. (1995). The Relative Importance of Cost and Service in Freight Transportation Choice Before and After Deregulation. *Transportation Journal, American Society Of Transportation & Logistics*. 35, 1, pp. 30-38.
- Ng, A.K.Y. (2009). Competitiveness of short sea shipping and the role of port: the case of North Europe. *Maritime Policy and Management*. 36(4):337-352.
- Oceanmax - Maritime LLP. (2016). *About us*. Retrieved May 14 2019, from <http://www.oceanmax.in/index.html>
- Paixão, A.C., & Marlow, P.B. (2002). Strengths and weaknesses of short sea shipping. *Marine Policy* 26 (3), 167-178.
- Port of Gothenburg. (2017). *Expand your business*. Gothenburg: Port of Gothenburg.
- Port of Gothenburg. (n.d.). *SKANDINAVIENS STÖRSTA HAMN*. Retrieved March 20 2019, from <https://www.goteborgshamn.se/om-hammen/omgoteborgshamn/>

- Posten. (2008). *Nordisk Logistikbarometer 2008*. Sverige: Posten Logistik.
- Postnord. (2014). *Nordisk Logistikbarometer 2013-2014*. Sverige; Postnord Logistik.
- Reis, V. (2014). Analysis of mode choice variables in short-distance intermodal freight transport using an agent-based model. *Transportation Research Part A*. 61:100-120.
- Regeringen. (2018). *Regeringens plan för infrastrukturen – så bygger vi Sverige starkt och hållbart*. Retrieved April 18 2019, from <https://www.regeringen.se/pressmeddelanden/2018/06/regeringens-plan-for-infrastrukturen---sa-bygger-vi-sverige-starkt-och-hallbart/>
- Roso, V. (2013). Sustainable intermodal transport via dry ports – importance of directional development. *World Review of Intermodal Transportation Research*. 4(2-3):140-156.
- Santén, V. (2016). *Towards environmentally sustainable freight transport*. (Doctoral dissertation, Chalmers University of Technology, 2016). Retrieved from <http://publications.lib.chalmers.se/records/fulltext/243257/243257.pdf>
- SCB. (2017). *Greenhouse gas emissions unchanged in 2017*. Retrieved April 23 2019, from <https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/environmental-accounts-and-sustainable-development/system-of-environmental-and-economic-accounts/pong/statistical-news/environmental-accounts--emissions-to-air-q4-2017-and-preliminary-statistics-for-2017/>
- SCB. (2019A). *Sveriges export*. Retrieved April 24 2019, from <https://www.scb.se/hitta-statistik/sverige-i-siffror/samhallets-ekonomi/sveriges-export/>
- SCB. (2019B). *Utrikeshandel, export och import av varor*. Retrieved April 24 2019, from [https://www.scb.se/contentassets/492c4f66836c4adf8e009089668ed37a/ha0201\\_2018m12\\_sm\\_ha22sm1901.pdf](https://www.scb.se/contentassets/492c4f66836c4adf8e009089668ed37a/ha0201_2018m12_sm_ha22sm1901.pdf)
- Song, D.W. & Panayides, P.M. (2016). *Maritime Logistics – A Guide to Contemporary Shipping and Port Management*. Kogan Page Publishers.
- Stopford, M. (1997). *Maritime Economics*. London: Routledge.
- Svensk Sjöfart. (2017). *Remissyttrande*. Göteborg; Näringsdepartementet. <https://www.regeringen.se/4ae1cc/contentassets/c8e97e99cac449e99dcc2e5c6f707ebf/svensk-sjofart.pdf>
- Svensk Sjöfart. (n.d.A) *SVENSK SJÖFART I KORTHET*. Retrieved May 8 2019, from <http://www.sweship.se/svensk-sjofart-i-korthet/>

Svensk Sjöfart. (n.d.B). *TILLVÄXT & KONKURRENSKRAFT*. Retrieved May 8 2019, from <http://www.sweship.se/fokusomraden/tillvaxt-konkurrens/>

Svensk Sjöfart. (n.d.C). *Kraftfull expansion för Wallhamn AB*. Retrieved April 25 2019, from <http://svensksjofart1.e-tabloid.se/page.php?id=1142>

Swedtrain.(n.d.). *Behov av infrastruktur*. Retrieved May 5 2019, from <https://www.swedtrain.org/jarnvagsbranschen/jarnvagsindustri-framtidsindustri/behov-av-infrastruktur/>

Trafikanalys. (2017). *Svensk sjöfarts internationella konkurrenssituation 2017*. Stockholm: Trafikanalys.

VantageFreight. (n.d.). *Refurbished Rail Wagons Bremerhaven DE to Maitland NSW AUS*. Retrieved May 15 2019, from [https://www.vantagefreight.com.au/portfolio\\_page/refurbished-rail-wagons-bremerhaven-de-maitland-nsw-aus/](https://www.vantagefreight.com.au/portfolio_page/refurbished-rail-wagons-bremerhaven-de-maitland-nsw-aus/)

Wallenius Wilhelmsen. (n.d.A). *The HERO – a vessel for all your needs*. Retrieved March 19 2019, from <https://www.2wglobal.com/news-and-insights/infographics/the-hero-a-vessel-for-all-your-needs/>

Wallenius Wilhelmsen. (n.d.B). *What is the meaning of Breakbulk?*. Retrieved March 19, 2019, from <https://www.2wglobal.com/online-tools/frequently-asked-questions/what-is-the-meaning-of-breakbulk/>

Wallenius Wilhelmsen. (n.d.C) *What is the meaning of RoRo?*. Retrieved March 19, 2019, from <https://www.2wglobal.com/online-tools/frequently-asked-questions/what-is-the-meaning-of-ro-ro/>

Wallenius Wilhelmsen. (n.d.D). *Handling Equipment*. Retrieved March 19, 2019, from <https://www.2wglobal.com/services/portfolio/ocean-transportation/equipment/>

Wallenius Wilhelmsen. (n.d.E). *Ocean Fleet*. Retrieved May 14, 2019, from <https://www.2wglobal.com/global-network/fleet/fleet-overview/>

Wathne, E. (2012). *Cargo Stowage Planning in RoRo Shipping*. (Master thesis, Norwegian University of Science and Technology, 2012). Retrieved from [https://brage.bibsys.no/xmlui/bitstream/handle/11250/238211/566111\\_FULLTEXT01.pdf?sequence=3&isAllowed=y](https://brage.bibsys.no/xmlui/bitstream/handle/11250/238211/566111_FULLTEXT01.pdf?sequence=3&isAllowed=y)

# Appendix 1

## Long-edition interview

### Informationsbrev

*Marknadsanalys av Sveriges export av High and Heavy produkter.*

#### Presentation

Vi är två tjejer som läser sista året vid Chalmers Tekniska Högskola. Siri läser programmet Maritime Management och Anna läser Supply Chain Management. Vi skriver nu vårt exjobb om Sveriges export av High and Heavy (H&H) och Break Bulk (BB) produkter via sjötransport med fokus på RORO.

Avsikten med undersökningen är att samla in data för att besvara vårt syfte. Syftet med examensarbetet är att skapa en överblick av H&H och BB marknaden i Sverige och belysa de faktorer som är viktiga i samband med transporten av sådana produkter. Arbetet kommer utgå ifrån följande frågeställningar:

RQ1: What characterizes the current Swedish H&H export market?

RQ2: What are the main influential factors that the exporting manufacturers of H&H goods find important when making transportation choices?

RQ3: How does the H&H manufacturers predict and evaluate the future?

Genom att analysera de svaren från undersökningen önskar vi att skapa en sammanfattande bild av hela marknaden och de relevanta marknads dynamiker som reflekteras från undersökningen. Vi kommer därför **inte** referera till er som företag eller hänvisa till namn.

#### Genomförande

Intervjuerna förväntas inte ta längre än 45 min/ intervju.

#### Konfidentialitet

Största möjliga konfidentialitet eftersträvas i undersökningen genom att ingen obehörig får ta del av materialet. Materialet förvaras så att det bara är åtkomligt för oss som är undersökningsledare. Rapporteringen av resultatet kommer ske i form av en examensuppsats på Chalmers Tekniska Högskola.

#### Frivillighet

Ditt deltagande i studien är helt frivilligt. Du kan när som helst avbryta ditt deltagande utan närmare motivering. Du kan även välja att inte svara på alla frågor.

Ytterligare upplysningar om studien kan lämnas av oss som genomför studien och vi kan nå på:

Anna Mattsson Granlund  
070-4986920  
[anngran@student.chalmers.se](mailto:anngran@student.chalmers.se)

Siri Heggheim  
+47 99373204  
[heggheim@student.chalmers.se](mailto:heggheim@student.chalmers.se)

**Du tillfrågas härmed om deltagande i denna undersökning**

## **Intervju med godsägare**

### **Företag**

### **Intervjuperson**

1. Namn
2. Roll/Tjänst

### **Organisation**

1. Skulle du kunna berätta om er verksamhet?
2. Vilka varuslag tillverkar ni i Sverige som faller in under H&H och/eller BB gods?
3. Vart sker tillverkningen av dessa produkter?

### **Transport**

1. Hur ser logistikkedjan ut för exporten för era H&H/BB produkter? (Från er till slutmarknad)
2. Vilka transportmedel transporteras godset på till internationella kunder?
3. Transporterar ni något på järnväg/väg ner till Europa för vidare transport till översjö marknad?
4. Om ja på föregående fråga, varför transporteras det på järnväg/väg?

5. Hur ser kostnadsstrukturen ut för transporten? (Totala transportkostnader och dess delar)

### **Sjötransport**

1. Vilka faktorer är viktigast för er vid val av sjötransport? (T.ex. Ledtid, frekvens, pris, hamn faciliteter, infrastruktur, sustainability, position av hamn)
2. I förhållande till andra transportalternativ hur viktigt är sjötransporten för er?
3. Vilken typ av fartyg skeppas godset med?
4. Hur transporteras godset på båten?
  - a. Mafi
  - b. Rullande gods
  - c. Kran
  - d. Övrigt?
5. Vilken typ av transport (järnväg/väg) är viktigast till en hamn?
6. Är det viktigt med olika typer av serviceutbud i en hamn?
  - a. Om ja, varför och vilka typer serviceutbud är viktiga?
  - b. Om nej, varför?

### **Transport Nätverk**

1. Hur arbetar ni för att hitta transportörer?
2. Vilka speditörer använder ni?
3. Vilka rederier använder ni?
4. Tycker ni att ni har möjlighet att påverka rederierna?
5. Vilken typ av kontakt har nu med de som arrangerar transport?
6. Hur viktig är det med nätverk och relationer till transportörer?
7. Hur arbetar ni för att bibehålla era relationer till transportörerna?
8. Kategoriserar ni era sjö transportörer, om ja, isåfall hur?
  - a. Varför/Varför inte?
9. Till vilken grad påverkar era relationer er beslutsfattning inom transporter?

## **Volymer**

1. Hur mycket exporteras från Sverige varje år?
2. Hur stor del av dessa volymer transporteras med sjötransporter?
3. Till vilka marknader exporteras godset? (Kontinent räcker)
4. Vilka svenska hamnar exporterar ni ifrån?
5. Hur stora är volymerna till varje marknad (kontinent) från respektive hamn i Sverige?

## **Framtiden**

1. Hur tror ni att framtiden kommer se ut för exportmarknaden?
  - a. Rent generellt i Sverige, ökning/minskning (ex. outsourcing)
2. Tror ni att era rutter kommer ändras? (t.ex. val av svensk hamn)
  - a. Varför/Varför inte?
3. Tror ni att det finns nya potentiella destinationer i framtiden för export av H&H? Om ja, vart?
4. Tror ni att det finns outnyttjad potential på den svenska H&H export marknaden?
5. Skulle ni kunna tänka er att använda andra transportmedel än sjötransport för export?
6. Vem anser ni är det som har makten på marknaden? (Dvs varuägaren, hamnen, rederier)
7. Tror ni maktstrukturen kommer ändras i framtiden?
8. Har ni framtiden i åtanke för beslut ni gör idag?
  - a. Hur påverkar framtiden dagens beslut?
9. Hur arbetar ni med kontrakt av transporter?
10. Arbetar ni med sustainability i samband med era transporter av färdigt gods idag?
  - a. Om ja, hur?
  - b. Om inte, varför?
11. Vad är era tankar om sustainability i samband med transport av H&H framtiden?

# Appendix 2

## Short-edition interview

### Informationsbrev

*Marknadsanalys av Sveriges export av High and Heavy produkter.*

#### Presentation

Vi är två tjejer som läser sista året vid Chalmers Tekniska Högskola. Siri läser programmet Maritime Management och Anna läser Supply Chain Management. Vi skriver nu vårt exjobb om Sveriges export av High and Heavy (H&H) och Break Bulk (BB) produkter via sjötransport med fokus på RORO.

Avsikten med undersökningen är att samla in data för att besvara vårt syfte. Syftet med examensarbetet är att skapa en överblick av H&H och BB marknaden i Sverige och belysa de faktorer som är viktiga i samband med transporten av sådana produkter. Arbetet kommer utgå ifrån följande frågeställningar:

RQ1: What characterizes the current Swedish H&H export market?

RQ2: What are the main influential factors that the exporting manufacturers of H&H goods find important when making transportation choices?

RQ3: How does the H&H manufacturers predict and evaluate the future?

Genom att analysera de svaren från undersökningen önskar vi att skapa en sammanfattande bild av hela marknaden och de relevanta marknads dynamiker som reflekteras från undersökningen. Vi kommer därför **inte** referera till er som företag eller hänvisa till namn.

#### Genomförande

Intervjuerna förväntas inte ta längre än 45 min/ intervju.

#### Konfidentialitet

Största möjliga konfidentialitet eftersträvas i undersökningen genom att ingen obehörig får ta del av materialet. Materialet förvaras så att det bara är åtkomligt för oss som är undersökningsledare. Rapporteringen av resultatet kommer ske i form av en examensuppsats på Chalmers Tekniska Högskola.

#### Frivillighet

Ditt deltagande i studien är helt frivilligt. Du kan när som helst avbryta ditt deltagande utan närmare motivering. Du kan även välja att inte svara på alla frågor.

Ytterligare upplysningar om studien kan lämnas av oss som genomför studien och vi kan nå på:

Anna Mattsson Granlund  
070-4986920  
[anngran@student.chalmers.se](mailto:anngran@student.chalmers.se)

Siri Heggheim  
+47 99373204  
[heggheim@student.chalmers.se](mailto:heggheim@student.chalmers.se)

**Du tillfrågas härmed om deltagande i denna undersökning**

## **Intervju med godsägare**

### **Företag**

### **Intervjuperson**

Namn

Roll/Tjänst

### **Organisation**

1. Vilka varuslag tillverkar ni i Sverige som faller in under H&H och/eller BB gods?
  - a. Vart sker tillverkningen av dessa produkter?

### **Transport**

1. Hur ser logistikkedjan ut för exporten för era H&H/BB produkter? (Från er till slutmarknad)
  - a. Vad för typ av inlandstransport?
  - b. Vilken typ av fartyg skeppas godset med om det går på sjö?
    - i. Hur transporteras godset på båten?
      1. Mafi
      2. Rullande gods
      3. Kran
      4. Övrigt?
2. Transporterar ni något på järnväg/väg ner till Europa för vidare transport till översjö marknad?

## **Sjötransport**

1. Vilka faktorer är viktigast för er vid val av sjötransport?

## **Transport Nätverk**

1. Hur arbetar ni för att hitta transportörer?
2. Vilka rederier använder ni?
3. Hur viktig är det med nätverk och relationer till transportörer?
4. Hur arbetar ni för att bibehålla era relationer till transportörerna?
5. Till vilken grad påverkar era relationer er beslutsfattning inom transporter?

## **Volymer**

1. Hur mycket exporteras från Sverige varje år?
2. Hur stor del av dessa volymer transporteras med sjötransporter?
3. Till vilka marknader exporteras godset och hur mycket till varje marknad? (Kontinent räcker)
4. Vilka svenska hamnar exporterar ni ifrån?

## **Framtiden**

1. Hur tror ni att framtiden kommer se ut för exportmarknaden?
  - a. Rent generellt i Sverige, ökning/minskning (ex. outsourcing)
  - b. Tror ni era rutter kommer ändras? (t.ex. Val av svensk hamn)
2. Tror ni att det finns nya potentiella destinationer i framtiden för export av H&H? Om ja, vart?
3. Vem anser ni är det som har makten på marknaden idag (Dvs varuägaren, hamnen, rederier) och tror ni att den kommer att ändras i framtiden?
4. Har ni framtiden i åtanke för beslut ni gör idag?
  - a. Hur påverkar framtiden dagens beslut?
5. Vad är era tankar om sustainability i samband med transport av H&H framtiden?

## Appendix 3

<b>Factors</b>	<b>Definition</b>
<i>Lead Time</i>	The amount of time between process initiation and completion.
<i>Price</i>	The amount required as payment.
<i>Cargo Safety</i>	A guarantee of safe and secure transport + protection from elements as weather and water.
<i>Correct Origin/ Destination Port</i>	Sea transport offered between the desired origin and destination ports.
<i>Frequency</i>	The amount of departures that is offered on a specific route.
<i>Punctuality</i>	The level that transporters stick to planned time schedule.
<i>Consolidated Shipment/ Shipment of Complete Products</i>	Product or order being shipped as one shipment /product being shipped fully assembled.
<i>No Transshipment</i>	The level that transshipment is avoided.
<i>Vessel Characteristics</i>	The vessel's condition and how it is structured.
<i>Service</i>	The transporters ability to "go the extra mile".
<i>Information Sharing</i>	The level the transporters share information about potential changes or delays in time schedules.
<i>Knowledge about</i>	The knowledge the transporter has about cargo, in order to be able to handle it correctly during the entire transport chain.
<i>Relationship</i>	The degree that there is a relationship between the transporter and the manufacturer.
<i>Equipment</i>	The equipment used by transporters to handle the cargo (e.g. cranes, wagons etc.)
<i>Infrastructure</i>	The infrastructure available on the different transportation routes.
<i>Industry Reputation</i>	The transporter's reputation within the industry.
<i>Communication</i>	The transporters ability to meet the communication requirements of the manufacturer (could be as little as possible or an extensive communication flow).
<i>Invoice Handling</i>	Smoothness of invoice handling.
<i>Customs Clearance</i>	Smoothness of customs clearance process.