

Reducing the Carbon Footprint

With focus on the outbound logistics

A study at Sony Ericsson Mobile Communications

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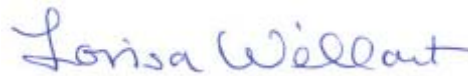
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Lund, February 2008



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Abstract

Title: Reducing the Carbon Footprint - with focus on the outbound logistics
A study at Sony Ericsson Mobile Communications

Problem discussion and purpose

One of the largest environmental concerns today is the climate change. The primary cause is the increased level of carbon dioxide in the atmosphere, released mainly from the burning of fossil fuels for energy extraction. Transport is the single largest source of environmental hazards in the logistics system. Politicians have acknowledged the problem and new environmental regulations affecting the logistics are founded. Furthermore, customers' concern about climate change has increased and companies see an opportunity for preventative actions to generate marketing advantages.

Sony Ericsson Mobile Communications (SEMC) has launched a "Sustainability Program" to work with improvements in social corporate responsibility and environmental issues. The subproject "Supply Chain Greenhouse Project", for which the master thesis serve as starting point, has as one objective to reduce the emissions of carbon dioxide. A great potential for reducing these emissions is in the distribution of finished products. In addition to the environmental concern, they strive to be a state-of-the-art company when it comes to environmental performance.

The purpose of this thesis is to provide SEMC with recommendations of possible means to reduce the carbon footprint from their outbound logistics. A partial objective is to analyse the trends in the external environment that might influence their work within logistics and environment. The recommendations will be given to the Supply Chain Greenhouse Project for further development.

Methodology

The working procedure used in the thesis is to initially create a theoretical frame of reference. It is followed by an empirical study containing an investigation of external factors affecting the outbound logistics, a mapping of the current processes at SEMC, a study of three major freight forwarders and a multiple case study of six companies. Finally an analysis is conducted which results in the recommendations to how SEMC can reduce their carbon footprint. Included in the analysis is a workshop where the applicability and potential of the recommendations are assessed together with representatives from the Sustainability Program and other employees at SEMC.

Theoretical frame of reference

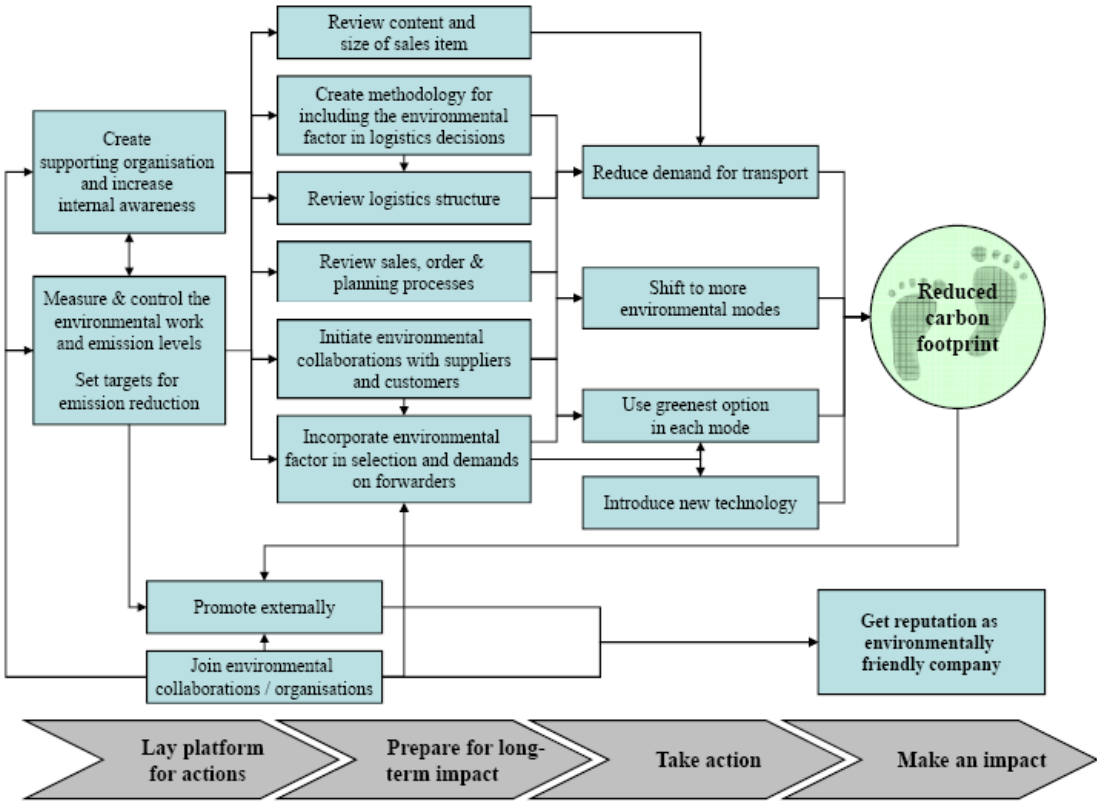
The theoretical frame of reference used includes the causes and effects of the climate change. It is followed by an investigation of possible external factors that may affect SEMC. Further, theories within green logistics management, logistics structure, mode selection, carrier selection and fill rate are explored. Finally the environmental impact from transportation is investigated.

Conclusion

The world is experiencing increasingly stricter regulations on activities that contribute to the climate change. The by the UN assigned Kyoto Protocol is one of the initiatives requiring countries to take actions towards preventing further climate change. Companies have also initiated actions to reduce their carbon footprint. A distinct trend among companies is the shift

towards rail and sea transport. This shift is also promoted by the European Union to thereby reduce the congestion on roads and control the growth in air traffic. It is difficult to predict the price for transportation in the future. Due to the stricter regulations, transportation cost will nevertheless most likely be a larger factor to consider when selecting for example logistics structure. Whether the cost of transportation increases significantly or not, it is still important that SEMC reduces the carbon footprint to achieve the goal to be a state-of-the-art company within sustainability. The major drivers of the emission levels are the direct shipment set-up combined with short lead-times and global production, resulting in large volumes being transported by air.

In order to bring radical changes in the emission levels, structural changes must be made. SEMC are therefore recommended to move away from the direct shipment set-up, preferably by introducing customization centres. This new set-up would enable shipments with more environmentally friendly modes of transport to the centre as well as make shipments in bulk possible. With local sourcing the total transport work would be reduced further. Apart from changes in logistics structure, improving the sales- and order planning process, initiating a dialogue with customers about the environmental impact from the logistics decisions, segmentation of orders and discussions with forwarders etc. were initiatives identified to enable a more environmental mode. Targeting minor drivers of emission levels can however also bring large effects when adding these activities together. In order to increase the internal awareness and to bring about the changes needed, green logistics management need to be introduced. The recommended initiatives to reduce SEMC’s carbon footprint within outbound logistics are illustrated in the figure below.



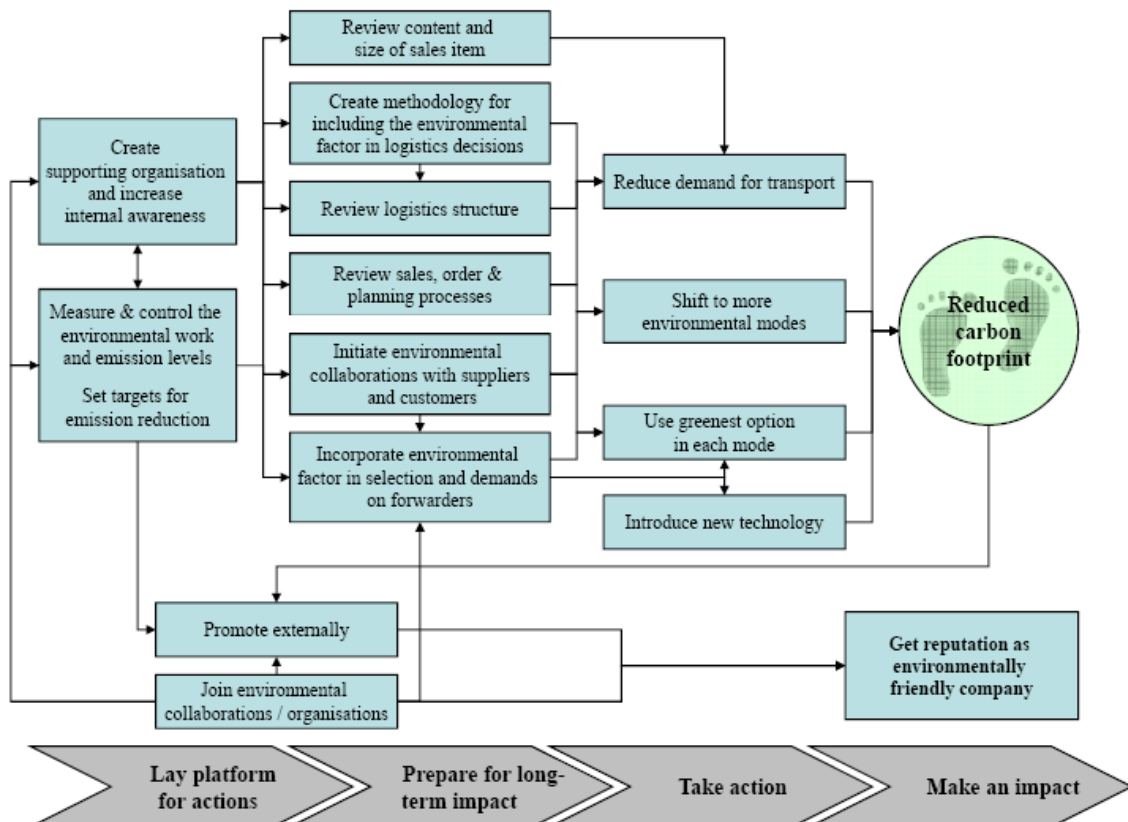
Although significant changes and investments are needed for SEMC to reduce the carbon footprint, the work will most likely pay off. Many of the initiatives bring cost reductions and SEMC will as well benefit from good publicity.

Slutsats

Oron ökar alltmer över de idag påtagliga klimatförändringarna. Både statliga och överstatliga institutioner, som t.ex. EU, investerar i och förespråkar insatser för minskning av koldioxidutsläpp till atmosfären. Ett av de viktigaste initiativen hitintills är Kyotoprotokollet där de länder som skrivit under bundit sig att minska utsläppen. Som ett resultat skapas det alltfler regler som begränsar koldioxidutsläppen.

En tydlig trend som identifierats i omvärldsanalysen är övergången till fler transporter på tåg och sjö. Den framtida kostnaden för att transportera varor är svår att förutspå. Dock kommer troligtvis de allt striktare reglerna medföra att kostnaden för transporter beaktas alltmer i framtiden, exempelvis i beslut gällande val av logistikstruktur.

Den största bidragande orsaken till utsläppen från SEMCs utgående logistik är distributionsstrukturen med direktleveranser. Tillsammans med kravet på korta ledtider och en global produktion har detta resulterat i att nästan alla transporter sker med flyg. Eftersom kravet på korta ledtider består så måste det ske strukturella förändringar för att SEMC ska kunna uppnå en markant minskning av utsläppsnivåerna. Förslagsvis bör dessa ske genom att återintroducera kundanpassningscentra. Att adressera mindre drivkrafter kan också medföra stora förbättringar när effekterna av dessa adderas. För att förändringar ska kunna ske så måste först en organisation upprättas som stödjer dessa. Figuren nedan visar de aktiviteter som SEMC är rekommenderade att arbeta med för att minska utsläppen av koldioxid från den utgående logistiken.



Trots att det kommer krävas betydande förändringar och investeringar för att SEMC ska kunna reducera koldioxidutsläppen från sin utgående logistik så kommer de med stor sannolikhet att löna sig i längden. Många av rekommendationerna har förutsättning att medföra kostnadsbesparingar och även ge god publicitet.

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1. Introduction

This chapter will give an introduction to the thesis including background, problem statements, purpose and delimitations. The disposition of the thesis will be described and frequently used abbreviations explained.

1.1 Background

One of the largest concerns related to the environment today is the climate change. Because of increased temperatures, glaciers are melting and the snow cover is decreasing which result in a rise in sea level. Additionally, a rise in temperature will be accompanied by changes in climate affecting cloud cover, precipitation, wind patterns, and the duration of seasons. The primary cause is the increased level of carbon dioxide (CO₂) in the atmosphere released mainly from the burning of fossil fuels for energy extraction.¹

Transport is the single largest source of environmental hazards in the logistics system. It is a prime consumer of fossil fuels and therefore also contributor to the increase in CO₂ emissions. It additionally generates other chemical emissions and noise. To be more environmental responsive, the distribution should favour shorter shipments, a reduced number of departures and better space utilization.²

Traditionally the environmental aspect has not been included as a criterion when bringing about changes in the logistics system. Recent years, there has been a trend among companies to globalize the supply chain and to move their production to low wage countries such as China. Together with management ideas, for instance Just-in-Time, a technique that require more frequent deliveries, this has resulted in an increase in transportation and consequently also in the emissions.³

It is not only the businesses that affect the climate; the climate change also has an effect on the businesses. For businesses that early adopt preventative actions it can help generate marketing advantages due to the increasing demand for “green” products in the marketplace.⁴ Environmental regulations also force actions to prevent further climate change. The leaders of the world are now working together towards the same goal, to reduce the environmental impact of human activity. One of the core international efforts to address climate change is the United Nations Framework Convention on Climate Change and its Kyoto Protocol (1997).⁵ Important to consider is nevertheless that the environmental steps taken must satisfy not only the demands of society but also those of profitability. Environmental goals must therefore be weighted with economical ones.⁶

1.2 Problem discussion

Sony Ericsson Mobile Communications (SEMC) has launched a so called “Sustainability Project” to work with improvements in social corporate responsibility and environmental issues. The subproject “Supply Chain Greenhouse Project”, for which this master thesis serve as starting point, has as one objective to reduce the emissions of carbon dioxide. In addition to

¹ Lockwood & Stubbs (2007)

² Dunn & Wu (1995)

³ Blinge (2005)

⁴ Lockwood & Stubbs (2007)

⁵ United Nations <www.un.org> 2007-09-11

⁶ Enarson (1998)

the environmental concern, they strive to be a state-of-the-art company when it comes to environmental performance.⁷ However, for SEMC to survive in the competitive telecom industry they also need to offer their customers products at the right quality, at the right price and at the right time. Therefore the environmental factor is only one of many to consider.

To understand how reduction of emissions can be achieved at SEMC, their current processes and logistics set-up must be closely mapped and understood. An analysis of the current situation in the external environment and the trends in the area of logistics and environment also needs to be performed to understand where the potential for improvement lies. By carrying out a multiple case study at companies that are working with reduction of their CO₂ emissions from logistics, practical experience within the area will be explored. As a result of the discussion above, the problem statements are as follows:

- A. What trends within the external environment influence SEMC's work within logistics and the environment regarding:
 - Competitors and other global companies?
 - Regulations and market incentives?
 - Technological development within the transport sector?
- B. What activities affect the emission levels within outbound logistics at SEMC?
- C. What are the currently studied and used methods for reduction of carbon dioxide emissions?
 - Current logistics research in the area?
 - How do the major transport providers work?
 - How are other companies working to decrease the emissions within logistics?
 - What were the effects of the studied companies' efforts? E.g. how have emission levels and other factors such as lead-time, cost and safety been affected?
- D. With help from the findings in previous statements, what are the potential means for SEMC to reduce the CO₂ emissions from the outbound logistics of finished products?

1.3 Purpose and partial objective

The overall purpose of the Supply Chain Greenhouse Project is to reduce the carbon footprint from SEMC's supply chain operations.

The purpose of this thesis is to provide SEMC with recommendations of possible means that will reduce the carbon footprint from their outbound logistics. A partial objective is to analyse the trends in the external environment that might influence their work within logistics and environment.

The recommendations will be given to the Supply Chain Greenhouse Project for further development with the aim to achieve the final purpose.

1.4 Focus and delimitations

As already mentioned, the focus will be on the greenhouse gas CO₂. This is because it is considered to be the largest contributor to the greenhouse effect and because it is targeted in the Supply Chain Greenhouse Project. It is also an appropriate measure since it is directly related to the fuel consumption.

⁷ Pellbäck-Scharp, Mats 2007-09-27

In order to do a complete evaluation of the carbon footprint from the products, the whole lifecycle from raw material to the end of the recycling process should be considered. However, solely the effects from the logistics operations alone is a broad area and in order to get a more thorough study, the focus will be specifically on the outbound logistics of finished products from global production facilities to the customers. The reason for concentrating on the outbound logistics is because it is assumed to be responsible for a large part of the carbon footprint since sourcing is made relatively close to the production sites. Furthermore, it is an area where SEMC have not yet focused their environmental efforts. Take-back of products back to manufacturer, that is considered a part of the outbound logistics, will however not be taken into account. How the presented focus relates to the complete focus of the Supply Chain Greenhouse Project, which includes inbound and outbound logistics as well as recycling, is presented in figure 1.1.⁸

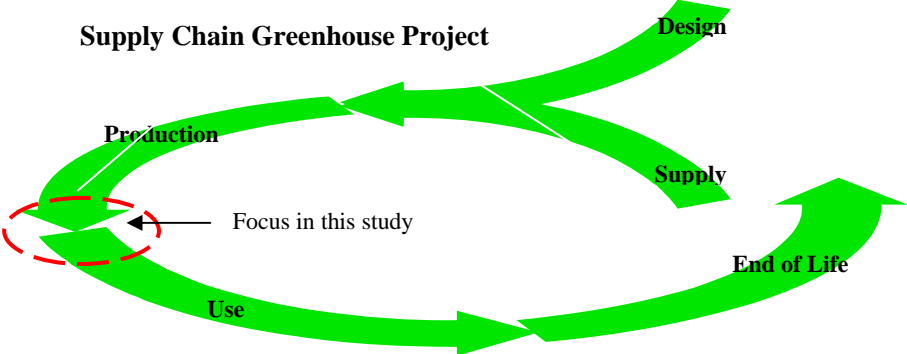


Figure 1.1. Supply Chain Greenhouse Project⁹

As this study is the starting point for further assessment and the current knowledge in the area within the company is poor, the study will provide a broad background. It was believed that if a more specific area was selected, there would be a risk that the wrong focus area was targeted. By first creating a good understanding, the study can instead guide the project into the right direction for further development.

SEMC is considering efforts in the area of logistics and environment to be a priority, whereby the general importance of taking these issues into consideration is not stressed in this study.

Since the largest volumes shipped by SEMC are transported from China to Europe, the discussions on new possible transportation routes was focused on this distance. With the largest volumes going to Europe and the fact that Europe is in the forefront regarding environmental regulations it was also decided to study the upcoming regulations and market incentives within the European Union specifically.

1.5 Target group

The main target group of this thesis is the participants in the Supply Chain Greenhouse Project as well as other employees at SEMC. Within the academic world, the target group is researchers and students within the area of logistics. Last, but not least, parts of the content are of general interest to the public.

⁸ SEMC internal information 2007-12-05
⁹ ibid

1.6 Disposition of the report

In order to guide the reader through this report, table 1.1 presents the disposition and objectives in each chapter.

Table 1.1. Disposition of the report and objectives in each chapter

	Chapter	Title	Objective
<i>Introduction</i>	1	Introduction	Provide the reader with a background to the thesis and present purpose, problems statements and delimitations
	2	SEMC- company presentation	Introduce the studied company
<i>Methodology</i>	3	Methodology	Present and motivate the approach and methods used in the study
<i>Theoretical framework</i>	4	Theoretical framework	Present existing theories and facts of interest to the study
<i>Empirics</i>	5	External factors	Identify and understand the external factors affecting the studied system
	6	The studied system at SEMC	Create an understanding of SEMC's current logistics processes and environmental work
	7	Freight forwarders	Study SEMC's major freight forwarders to understand green alternatives to the current transport set-up
	8	Case studies	Through multiple case studies explore how other companies work to reduce the carbon footprint from their logistics operations
<i>Analysis</i>	9	Analysis	Analyse the empirical data and the theoretical framework in order to fulfil the purpose of the thesis and provide recommendations to SEMC
<i>Conclusion</i>	10	Conclusion	Summarise the findings and discuss the fulfilment of the purpose of the thesis

1.7 Abbreviations

Here the frequently used abbreviations in the thesis are defined:

<i>CO₂</i>	Carbon dioxide
<i>CPFR</i>	Collaborative Planning Forecasting & Replenishment
<i>EU</i>	European Union
<i>EU ETS</i>	EU Emissions Trading Scheme
<i>GHG</i>	Greenhouse Gas
<i>IATA</i>	International Air Transport Association
<i>IPCC</i>	Intergovernmental Panel on Climate Change
<i>LCA</i>	Lifecycle Assessment
<i>KRH</i>	Ericsson ABC standard for complete phone without software and battery
<i>NO_x</i>	Nitric oxides
<i>NTM</i>	Network for Transport and Environment
<i>SEMC</i>	Sony Ericsson Mobile Communications AB
<i>SMARTWAY</i>	The U.S. Environmental Protection Agency's SmartWay Transport Partnership
<i>SO₂</i>	Sulphur dioxide
<i>WWF</i>	World Wide Fund

2 SEMC – company presentation

This chapter provides the reader with a brief presentation of Sony Ericsson. The company's history, organizational structure, markets and customers are described.

2.1 History and basic facts

Sony Ericsson Mobile Communications is an equally divided joint venture created in 2001 by the telecommunications company Ericsson AB and the consumer electronics provider Sony Corporation. Their mission is to establish Sony Ericsson as the most attractive and innovative global brand in the mobile handset industry.¹⁰ The company employs 7,500 people worldwide and they serve the global communications market with mobile phones, accessories and PC-cards. In 2007, volume and sales grew to over 103.4 million units and 12,916 million Euros respectively.¹¹

2.2 Organization

For the complete organizational chart, see appendix 1. The two supervisors to this thesis are Charlotte Richter, Quality Manager at Supply Chain Operations, and Pontus Alexandersson, Project Manager at Environment & SQA within Sourcing. Sourcing and Supply Chain Operations have global responsibilities and are positioned under Operations which is one of the line functions at SEMC, see figure 2.1. The thesis is performed for the Sustainability Program which is a global, cross functional program. The program leader is Mats Pellbäck-Scharp, Director Environment & Supplier QA, and the program owner is Hideki Komiyama, President at SEMC.

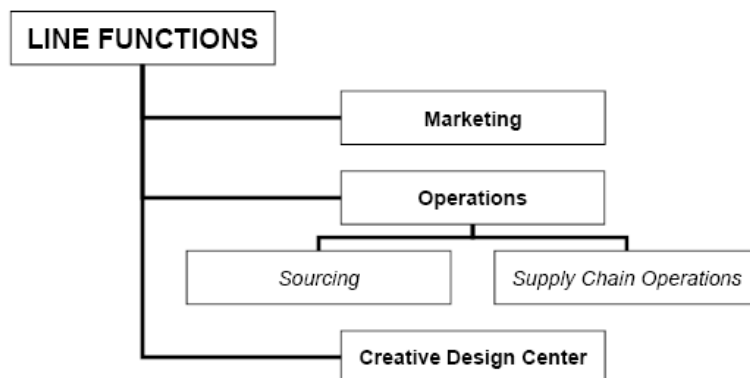


Figure 2.1. Line functions within the SEMC organization¹²

2.3 Markets and customers

The three main customer segments are operators, retailers and distributors. Consumers are however very important stakeholders to understand since their behaviours directly affect those of SEMC's direct customers. They target consumers who seek value-added products and not exclusively a low price.¹³

¹⁰ SEMC Intranet 2007-09-26

¹¹ ibid

¹² ibid

¹³ ibid

The type of customer that contributes to the largest volumes of sales differs between different markets. In most markets the operators are the distributors of handsets to the consumers, e.g. in Europe, but in some markets national distributors act as intermediaries, see figure 2.2.¹⁴

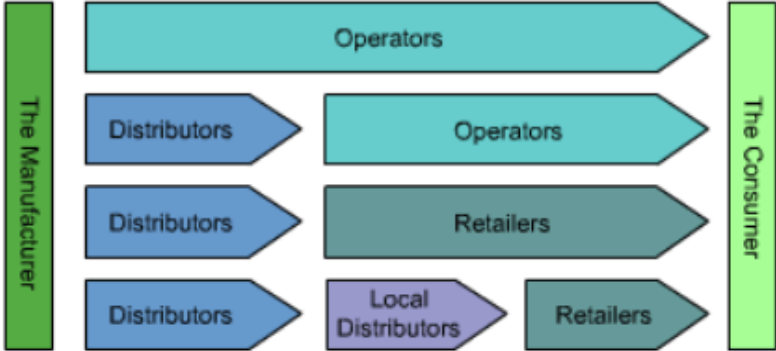


Figure 2.2. Differences in market structure¹⁵

SEMC has divided their global market into seven regions:

- Asia Pacific (APAC)
- China
- Western Europe (WE)
- CEEMEA including 104 countries in Central and Eastern Europe (CEE), Nordic, Russia, Turkey, Middle East and North Africa (MENA) and Southern Africa (SA)
- Japan
- Latin America (LAM)
- North America (NAM)

The percentage of sales in each region is presented in figure 2.3. Japan works relatively independent, serves only the local market and are not included in the figure.

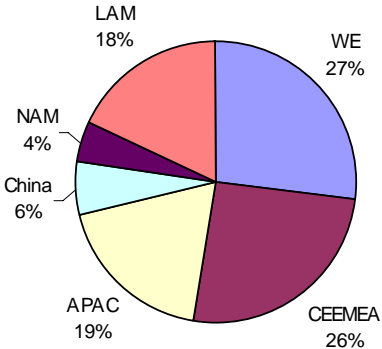


Figure 2.3. Percentage of sales volumes in each region 2007¹⁶

¹⁴ SEMC Intranet 2007-10-08
¹⁵ ibid
¹⁶ Richter, Charlotte 2007-12-21

3 Methodology

This chapter presents the scientific approach, research methods and data collection techniques selected for this study. Having a well thought through methodology is a prerequisite for a serious investigation and for creating credible results. The undertaken procedures are therefore analysed and thoroughly presented.

3.1 Research approach

Arbnor and Bjerke distinguish between three methodological approaches in business research today; the analytical approach, the systems approach and the actors approach. They differ in their assumptions of reality, how they are carried out and in what results they aim for.

3.1.1 The analytical approach

In the analytical approach, knowledge is seen as independent of the observer. The “truth” is found by discovering invariant elements, which is done by verifying that the same results are obtained regardless of changes in the environment and different individual’s perceptions. The aim is to separate objective facts from subjective impressions and present an objective and complete description of reality. Another assumption made in the analytical approach is that the reality, the whole, is seen as a sum of its parts. Elements of an object under study can thereby be regarded as relatively independent of each other. The relations between causes and effects can as a result be identified for parts separately and added together to get a complete picture of reality. The goal with an analytical study is to give explanations to why things occur and the models and other existing data created using this approach are considered valid also for other objects in reality.¹⁷

3.1.2 The system approach

Similar to the analytical approach, the systems approach wants to give an objective description of reality, but the approach differ in the sense that the whole is not seen as the sum of the parts. Instead, parts are seen as mutually dependent on each other and it is the relations between a system’s different parts that are analysed with the intention to understand the synergetic effects between them. As a result, in order to get a true and complete picture of reality, all factors in the system must be included. Reality can not only be explained but must also be understood in order to predict the results of changes in the different parts.¹⁸

3.1.3 The actors approach

The actors approach is the most recent of the three and it differs markedly from the other two in the assumption of an objective reality. Here the reality is instead assumed to be a social construction that is affected by, and has an influence on, the actors in it. Knowledge is seen as dependent on the individuals, and how different actors experience, interpret and act is used as a starting point to describe the reality. This means that reality is not fixed but changes over time depending on the actors in it. Thus the findings of a study made with an actors approach are more about creating an understanding and knowledge of the processes that constructs reality than explaining it as shown in figure 3.1.¹⁹

¹⁷ Arbnor & Bjerke (1997)

¹⁸ ibid

¹⁹ ibid

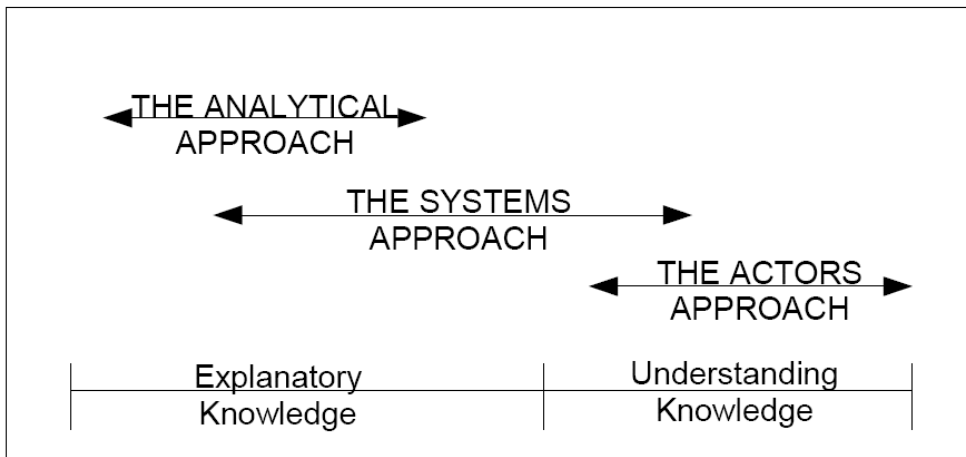


Figure 3.1. Type of knowledge in the different approaches²⁰

3.1.4 The approach in this thesis

The purpose of this thesis is to provide SEMC with recommendations of possible means that will reduce the carbon footprint from their outbound logistics. A partial objective is to analyse the trends in the external environment that might influence their work within logistics and environment. The systems approach was believed to give this study the best results. The approach is frequently used within the field of logistics since it is appropriate to utilize when structuring, analysing and solving the kind of complex research problems often faced within this area.²¹ Because of the interrelations perceived between different factors in the systems and in the effects changes in one factor has on another, this approach was considered most appropriate.

The first step was to decide the limits and the part of reality to be included in the system. When deciding what to include in the system, it was discussed which activities in the outbound logistics that affect the emission levels. Based on the findings from the initial research, the answers relevant to SEMC's outbound logistics within the limits of this study could be divided into four areas. The first area is the logistics structure including how and where in the supply chain different operations are performed and where warehouses are located. Second is mode selection since the emission levels from different modes vary to a great extent. The third area is carrier selection and to this area is also included collaboration with and demands on the transport provider. Since SEMC purchases all transport services from external parts, their possibility to affect for instance vehicle technology, driving techniques, use of alternative fuels and to some extent the logistics structure is through collaborations and demands on transport providers. Finally the improvements in fill rate are considered. This can be achieved through reduced size of products and packages, more efficient packaging, consolidation and changes in ordering process. These factors are all interrelated meaning for instance that the decision to use a more environmentally friendly mode of transport is sometimes depending on changes in logistics structure. Apart from these different areas for emission reduction possibilities, the management and work for internal awareness is explored. It includes targets and objectives, how the work is organized and promoted and how the environmental aspect is taken into consideration in decision making. These green management issues affect what areas within logistics and environment the company decides to focus on. The green logistics management is influenced by the corporate strategy, an area touched but not explored in depth in this study.

²⁰ Arbnor & Bjerke (1997)

²¹ Björklund (2005)

The second step was a description of the system environment which is found outside the system’s boundaries and is beyond its control. The system in this study is considered open which means it is given input from external factors. These factors are consequently important to consider and include political and market based incentives such as taxes, subsidises and regulations but also stakeholder influence and technological development in the field of transport and material handling. The study of the external factors answers the problem statement regarding trends within logistics and environment that are, or may, influence SEMC’s work within green logistics.

The output factor in focus is the CO₂ emission levels. The effects from changes in the system will most likely also impact on other factors such as cost, lead-time, security, service and delivery accuracy. Since these can affect the applicability of the different initiatives, they are important to keep in mind. See figure 3.2 below for a visual description of the external influence on the system, the studied system and its output.

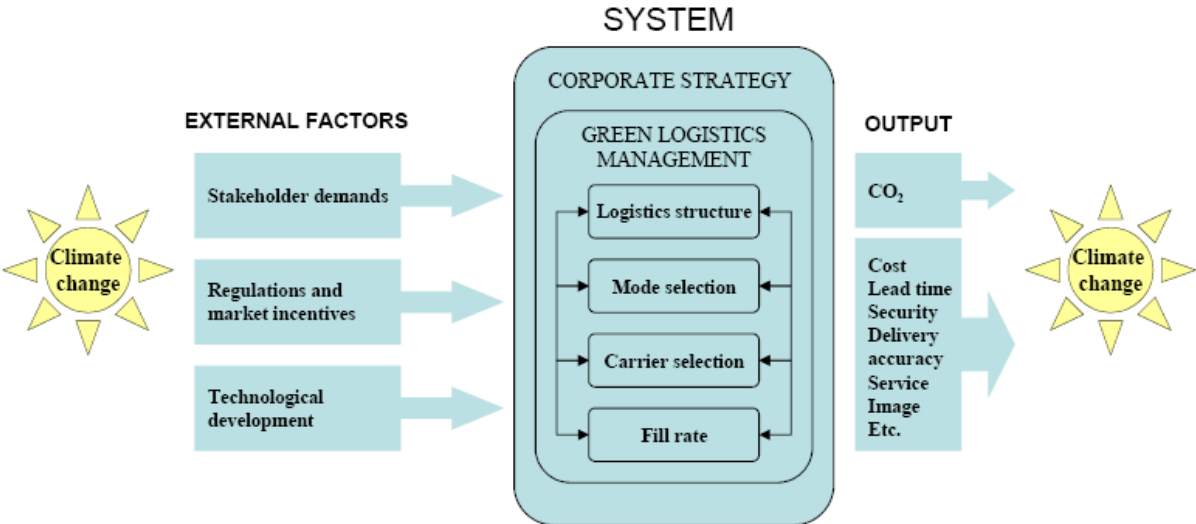


Figure 3.2. System description

The system is studied first from the perspective of SEMC today. In order to understand how the general system practically can be modified to change the output and reduce the emissions, the system was also studied from the perspective of three major transport providers and of six case companies. As SEMC purchases all transport services from external forwarders, it can give valuable input to know what green services they offer, and what opportunities they see for collaborations with SEMC for reducing the emissions. Case studies show which areas are most common to target in order to achieve emission reductions. By analysing how the specific characteristics of the case companies have affected their results, interrelations can be found and used in order to predict what possible effects changes in the system at SEMC could have on the output. Together with the earlier analysed trends in the external environment, it can be used in order to give recommendations on how SEMC should continue in their work for reducing the carbon footprint. This process is shown in figure 3.3 and the results aimed for will be specific for SEMC and the distinct conditions and demands on their distribution system. Consequently, the findings will not be general and can not be applied to any other company without modification.

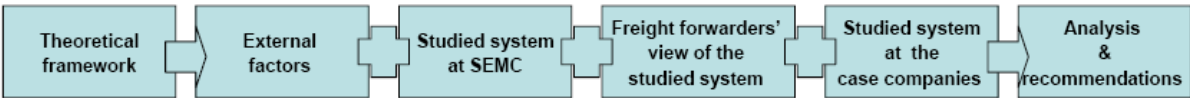


Figure 3.3. Outline of study

3.2 Research methods

Different from research approaches which are the principal ideas pervading the whole study, methods can differ between parts in the study and explains the procedures of collecting, structuring and analysing data.

3.2.1 Inductive, deductive and abductive methods

The relations between the theoretical and empirical world affect the method in a study and two main approaches can be distinguished; the inductive and the deductive as illustrated in figure 3.4. In the inductive approach the starting point is the collection of empirical data from which general and theoretical conclusions are drawn. Research according to the deductive approach has its origin in the theory and from there predictions of expected empirical results are developed. These predictions are later tested and verified through empirical studies.²² Abduction is a combination of the two earlier mentioned approaches. It is similar to the inductive approach in the sense that it originates from an observation in the empirical world and then theory to match that observation is searched for. However, instead of moving from the empirical to the theoretical world or vice versa this approach circulates between the two levels.²³

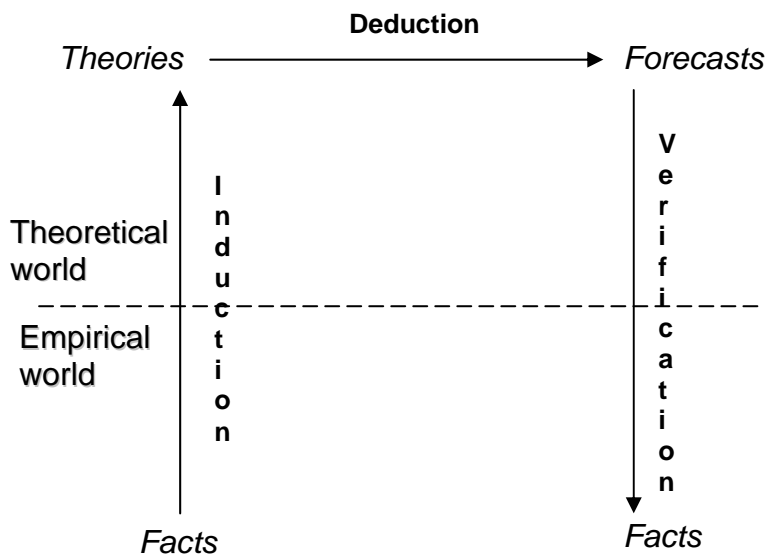


Figure 3.4. Illustration of the deductive and the inductive approach²⁴

This study did not commence with a hypothesis and there is not a great amount of theory available within the field, whereby it was decided not to apply a deductive approach in the research. As a theoretical background was required in order to understand what areas to target in the empirical studies; the inductive approach was neither found appropriate. Instead the abductive approach was used. Because of the authors' limited knowledge within green logistics before the commencement of this study, the project was initiated by a broad scanning of available theories to set up a theoretical framework. This was later used for structuring the gathering of empirical information. However, to follow up on the observations made, the authors returned to the theory to complement the initial framework.

²² Björklund & Paulsson (2003)

²³ Wallén (1996)

²⁴ Arbnor & Bjerke (1997), s. 92

3.2.2 Quantitative and qualitative studies

If the information from a study can be measured or evaluated numerically, it is said to be quantitative. Methods of data collection such as surveys and utilisation of mathematical models for the analysis are common for this type of study. However, if the study is performed with the objective to create a deeper knowledge in a specific area or about a specific problem or situation, the information used could also be qualitative. Interviews and observations are often more suitable for this type of study. It is the purpose of the study that determines whether the study should be quantitative or qualitative. If the study should result in generalisations, a quantitative study is to be preferred.²⁵

In this study qualitative information will be most common since quantitative information to support the study is difficult to obtain. Most companies that have started emission reduction initiatives in logistics have just recently begun with these efforts. As a result, not much quantitative data can be found. For the case studies, interviews were preferred before surveys since the aim was to gain deeper understanding of their work in detail which can not be gained through surveys.

3.2.3 Data collection

Data can be either primary, meaning the information is gathered to be used for the specific study, or secondary meaning the information was initially gathered for another purpose. When it comes to the secondary data it is important to have in mind that the information can be biased or intended for another purpose. Primary data can be gathered through questionnaires, observations, interviews and experiments. Literature, including books, brochures, journals etc. and seminars are examples of secondary data.²⁶

Literature studies have the advantage of providing much information fast and to a low cost. It gives an idea of current knowledge and research in the area. The disadvantage is that the source of information, the methods used and the purpose are not always presented. How well the information suits the study should therefore always be considered. Interviews have the advantage of providing primary data relevant to the study. It gives the opportunity to adapt the questions to the individual correspondent and gives a deeper understanding. On the other hand, interviews can be time consuming.²⁷

In this study secondary data such as publications and journals were used initially to give a better understanding of the work in the field including the current research etc. The authors made a thorough review of the publications on green logistics in the major international logistics journals. This information was complemented by interviews with Swedish researchers within the field. Secondary research was also the main source of information when identifying trends in the external environment. Since the studied system is dynamic it was important that the information was up to date. Laws and regulations changes quickly and to some extent also the technology and trends within logistics and transportation.

Interviews were made for the mapping of the current system at SEMC, the work at the transport providers and at the case companies. Since many companies only recently started to focus on their contribution to climate change and not much research is made in the area seen

²⁵ Björklund & Paulsson (2003), p.63

²⁶ *ibid*

²⁷ *ibid*

from a micro perspective this was considered the most efficient way of gathering data. The main sources of information in the thesis are presented in table 3.1.

Table 3.1. Main sources of information

Chapter	Main sources of information
SEMC- Company presentation	<ul style="list-style-type: none"> • Intranet • Internal information
Methodology	<ul style="list-style-type: none"> • Arbnor, Ingeman & Bjerke, Björn • Björklund, Maria & Paulsson, Ulf • Eisenhardt, Kathleen M. • Yin, Robert K.
Theoretical framework	<ul style="list-style-type: none"> • European Union (EU) • United Nations • Intergovernmental Panel for Climate Change (IPCC) • Logistics journals and literature • Other publications on green logistics issues <p>Main authors were:</p> <ul style="list-style-type: none"> • Aronsson, Håkan & Huge Brodin, Maria • Björklund, Maria • Blinge, Magnus • Dunn, Steven C. & Wu, Haw-Jan • Lumsden, Kenth • Swahn, Magnus
External factors	<ul style="list-style-type: none"> • EU • Eyefortransport • United Nations • IPCC • Swedish Environmental Protection Agency • Swedish Ministry of the Environment • Researchers • Seminar
The studied system at SEMC	<ul style="list-style-type: none"> • Interviews with employees at SEMC • Intranet
Freight forwarders	<ul style="list-style-type: none"> • Interviews with DHL, Panalpina and Schenker • Environmental reports and websites
Case studies	<ul style="list-style-type: none"> • Interviews with representatives from the six case companies • Environmental reports and websites

3.2.4 Case studies

Case study research is a valuable research method to use when relatively unknown areas are to be explored. It can be defined as: “A *research strategy which focuses on understanding the dynamics present within single settings.*”²⁸ The purpose of the case study in this thesis is to answer part of problem statement C:

- How are other companies working to decrease the emissions within logistics?
- What were the effects of their efforts? E.g. how have emission levels and other factors such as lead-time, cost and safety been affected?

The findings from the case study will eventually be used in the analysis in order to fulfil the purpose of the thesis.

The selection of the cases to study is an important part of the case study, because it is from these cases that generalisations are made. The number of cases studied is also of importance.

²⁸ Eisenhardt (1989), p.534

The analysis benefits substantially from multiple cases and more than one case should be selected when resources allow it.²⁹ Four to ten cases are recommended in a multiple-case study.³⁰ The number of cases should be limited to when the collected information answers the research questions in a satisfactory way.³¹ In this study a multiple case study at six case companies was performed. When selecting number of cases there was a trade-off between time and what further cases could bring to the study. However, at six companies the authors were convinced that the information gathered from the different studies was enough to be able to generalize about the findings.

When a multiple case study is performed it is vital that the cases selected are connected to the research questions. In the research preparation, parameters that define the population need to be identified, and it is important that they are held constant across the sample.³² The parameters considered when selecting the case study objects in this study are product characteristics such as size, weight and value of products, expected lead-time, location of production sites and customers, mode of transport used and finally the distribution set-up. The parameters location of production sites and customers were selected because to be comparable to SEMC, only companies with global distribution were of interest. The product characteristics and lead-time are of interest as they affect the applicability of different initiatives. These parameters are presented in table 3.2.

Table 3.2. Parameters to consider when selecting case study objects

Parameters	Explanation
Product	<i>Size, weight, value, number of shipments</i>
Lead-time	<i>Order to customer</i>
Customers	<i>Location, dispersion</i>
Production	<i>Location, dispersion</i>
Distribution set-up	<i>Direct shipments or regional warehouse, ship to order or stock</i>
Transport mode	<i>Rail, sea, road, air</i>

The potential research objects were identified in discussions with researchers, through organizations and networks for logistics and environment and from newspapers and journal articles. The members of the Swedish organization NTM, the Network for Transport and Environment, were targeted and some of the major electronics companies. Contact was also taken with SEMC's major competitors, but with no success. The work was initiated by reviewing the companies' environmental reports and finding appropriate contacts within the organization. The Case Study Protocol, see appendix 2, was sent to the companies that were interested in participating in the study.

Several different data collection methods can be used in case studies, such as interviews, archives, questionnaires and observations. Case studies can be based on either quantitative or qualitative evidence or a mix of the two.³³ The data collection methods in these case studies were observations on the websites and interviews, mainly by telephone and e-mail but a few

²⁹ Yin (2003), p.53

³⁰ Eisenhardt (1989)

³¹ Frohlich et al. (2002)

³² *ibid*

³³ Eisenhardt (1989)

face-to-face. To verify the information, the case study report was sent back to the respondents for approval.

The initial companies in the study were ICA, Volvo Logistics, IKEA, Tetra Pak and Sony Ericsson's parent companies, Sony and Ericsson. ICA was excluded from the study because they only had control and knowledge about the logistics within the Nordic Countries. The transport provider Volvo Logistics was excluded as the interview unfortunately did not give any information of interest to the thesis.

Without competitors in the study, other consumer electronics companies were contacted to get insight in businesses with similar product characteristics. Two of them agreed to participate, Sharp and Panasonic. The case companies do not match all of SEMC's characteristics, but they matched well enough to be of interest to the study, see table 3.3.

Table 3.3. The studied companies' characteristics compared to SEMC's characteristics

Parameters	SEMC	Ericsson	Sony	Panasonic	Sharp	IKEA	Tetra Pak
Product	<i>Mainly high value per weight unit</i>		X	X	X		
Lead-time	<i>Short</i>		X		X		
Customers	<i>Global</i>	X	X	X	X	X	X
Production	<i>Global</i>	X	X	X	X	X	X
Distribution set-up	<i>Direct shipments</i>						
Transport mode	<i>Mainly air</i>	X		X			

When the case companies are selected and interviews performed, a single-case analysis of each case is conducted. A single-case analysis should provide the researcher with in-depth understanding of the case.³⁴ When the single-case analysis is completed to satisfactory, patterns are searched for across the six cases. To search for patterns is a key strategy in providing explanations and to validate the results.³⁵ When a thorough analysis has been made, both single- and cross-case analysis, conclusions can be drawn from the case studies.³⁶ The conclusions from the case studies underlie the analysis of the thesis.

3.2.5 Analysis

The analysis is made in order to answer the problem statements and in the end fulfil the purpose of the thesis. The problem statement to identify trends within the external environment that may influence SEMC's work within logistics is answered by using the empirics concerning the external factors, the freight forwarders and the studied companies. The theoretical framework has been used together with a study of SEMC's processes as help to identify the decisions within outbound logistics at SEMC that affects the emission levels.

The analysis continues with an investigation of the gap between the identified green initiatives within the studied system and the studied system at SEMC. Furthermore, the initiatives are related to theory and to the previously determined decisions that affect the emission levels at SEMC's outbound logistics. Thereby the green initiatives most appropriate for reducing the carbon footprint at SEMC are identified. This analysis ends up in the recommendations to

³⁴ Frohlich et al. (2002)

³⁵ Ellram (1996)

³⁶ Frohlich et al. (2002)

SEMC. In order to create further depth to the analysis, a workshop is conducted at SEMC where the proposed initiatives are discussed. The possible initiatives are prioritised regarding the possibility for SEMC to implement them concerning the match with current strategy and the amount of resources needed as well as regarding the possibility for emission reduction.

3.3 Credibility of the study

To make a study convincing, the findings must be well emphasised so that the reader understands how the results have been obtained and can make their own judgements on the credibility of the study.³⁷

The credibility of a study can, according to Björklund and Paulsson, be measured in three ways: validity, reliability and objectivity. Validity means to what extent the study actually measure what is intended to measure. The validity can be improved by using more than one method to examine the same phenomena in order to get different perspectives to it. This technique is called triangulation and can be used also by applying more than one source of information, having several persons evaluating the material or using different theories to the same set of data. Another way to increase the validity is to formulate distinct and non biased questions. Reliability is the degree of trustworthiness in the measuring instruments used, so that a repeated study will give the same results. It has to do with the reliability in how data is gathered and analysed to oversee random variation. Control questions in interviews, questionnaires and triangulation are ways to increase the reliability of a study. Objectivity is to what extent personal values affect the study and it is therefore important to show the reader how decisions are motivated. The source must be quoted so that the facts are correct and the selection of facts must not be distorted in order to reinforce the point of view emphasised by the researchers.³⁸ The tactics used to construct validity and reliability of this thesis is illustrated in table 3.4.

Table 3.4. Tactics to construct validity and reliability in the thesis

Chapter	Tactics
Theoretical framework	<ul style="list-style-type: none"> • Multiple sources of data • Use of different theories
External factors	<ul style="list-style-type: none"> • Multiple sources of information • Both authors present at interviews
The studied system at SEMC	<ul style="list-style-type: none"> • Multiple sources of information • Both authors present at interviews • Have key informants review draft report
Freight forwarders	<ul style="list-style-type: none"> • Triangulation • Both authors present at interviews • Have key informants review draft report
Case studies	<ul style="list-style-type: none"> • Multiple case study • Use of case study protocol • Use multiple sources of evidence • Both authors present at interviews • Have key informants review draft case study report

The validity and objectivity in the theoretical frame of reference is assured by a broad literature review and cross referencing of multiple sources of data. Several theories have also been analysed in the area of green logistics management.

³⁷ Björklund & Paulsson (2003)
³⁸ *ibid*

Much of the empirical data is collected through interviews. Here, a case study protocol is been used to prevent the authors from asking biased questions. Additionally, the draft report is sent back to the interviewees for validity, but also for ensuring that the authors do not unconsciously restructure the data to reflect their personal view. To increase the validity and reliability further, several people within the same company could have been interviewed. However, it was difficult to get the time and opportunity to do this, why it was decided to interview only one or two employees. For the interviews, the most suitable person in the organization was contacted. For the case studies this person was often the one responsible for environmental issues within logistics. As some case companies did not have such a position, interviews were then made with people within logistics as well as in environmental departments. Since the person with best insight in the area was selected, results are believed to be reliable. The conducting of the case studies also followed theoretical framework of how to perform case studies.

The system was studied from the perspective of researchers, case companies, freight forwarders and SEMC in order to get different perspectives to it. The applicability of the recommendations to SEMC was validated through a workshop with the supervisors, project leader and other employees at SEMC. The recommendations were discussed and positive as well as negative aspects were brought to the authors' attention, which resulted in further depth to the analysis.

4 Theoretical Framework

This chapter presents the theoretical frame of reference that together with the empirical data underlies the analysis. Initially the causes and effects of climate change are explored. It is followed by a presentation of external factors that influences the studied system. Furthermore theories regarding green logistics management are explained and the activities that affect the emission levels are identified and described. These are logistics structure, mode and carrier selection and fill rate. Finally the output of the studied system is explained in terms of the environmental impact from transports.



4.1 Climate change

*“Climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.”*³⁹

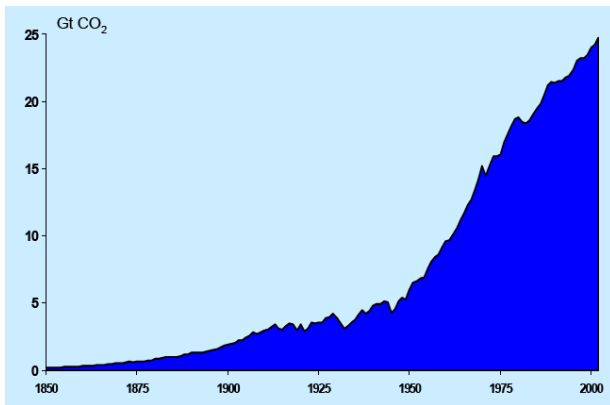


Figure 4.1. Global CO₂ emissions from fossil fuel burning and cement over the long-term⁴⁰

CO₂ is released from the burning of fossil fuels such as gas, oil and carbon. The amount of CO₂ released is strictly related to the amount of fossil fuel that has been combusted and can not be destroyed in any way.⁴¹ Figure 4.1 illustrates the change in the amount of CO₂ that has been released into the atmosphere from the pre-industrial age until today. Currently, atmospheric levels of CO₂ are rising by over ten percent every 20 years. The result of this is known as the enhanced greenhouse effect which is a warming of the earth's surface and lower atmosphere. CO₂ is responsible for over 60 percent of the enhanced greenhouse effect.⁴²

The natural greenhouse effect on the other hand is a prerequisite for life on earth. Without it, the temperature would be 35°C colder at the earth's surface. The most common greenhouse gases (GHG) are CO₂ and water vapour. They prevent some of the infrared radiation from the earth from leaving the atmosphere, which results in a warmer climate.⁴³ The phenomenon can best be explained with figure 4.2.

³⁹ United Nations Framework Convention on Climate Change <unfccc.int> 2007-10-02

⁴⁰ Stern (2007), p.175

⁴¹ Swedish Environmental Protection Agency <www.naturvardsverket.se> 2007-10-02

⁴² United Nations Framework Convention on Climate Change <unfccc.int> 2007-10-02

⁴³ Swedish Environmental Protection Agency <www.naturvardsverket.se> 2007-10-02

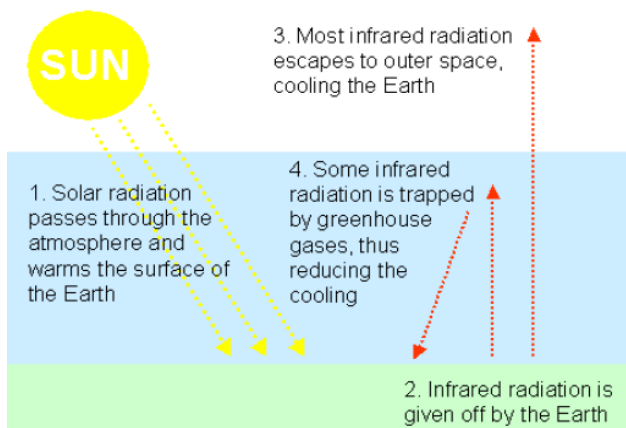


Figure 4.2. The greenhouse effect⁴⁴

Although the greenhouse effect is a natural phenomenon, it is now due to the increased emissions starting to become a threat to the planet. So far it has resulted in an increase of 0.8°C in the average temperature of the earth since the end of the 19th century.⁴⁵ The rise in temperature has more effects than the melting of ices, which cause a rise in sea level. Higher temperatures are also expected to expand the range of some dangerous vector-borne diseases, such as malaria, cause extinction of many endangered species and bring about disruptions in food supply etc.⁴⁶

In addition, a rise in temperature will be accompanied by changes in climate concerning cloud cover, precipitation, wind patterns and the duration of seasons. Several long-term changes in the climate have been observed including extreme weather such as droughts, heavy precipitation, heat waves and the increased intensity of tropical cyclones.⁴⁷ The link between the increased amount of GHG in the atmosphere and the climate change as well as the effects of climate change, are illustrated in figure 4.3.

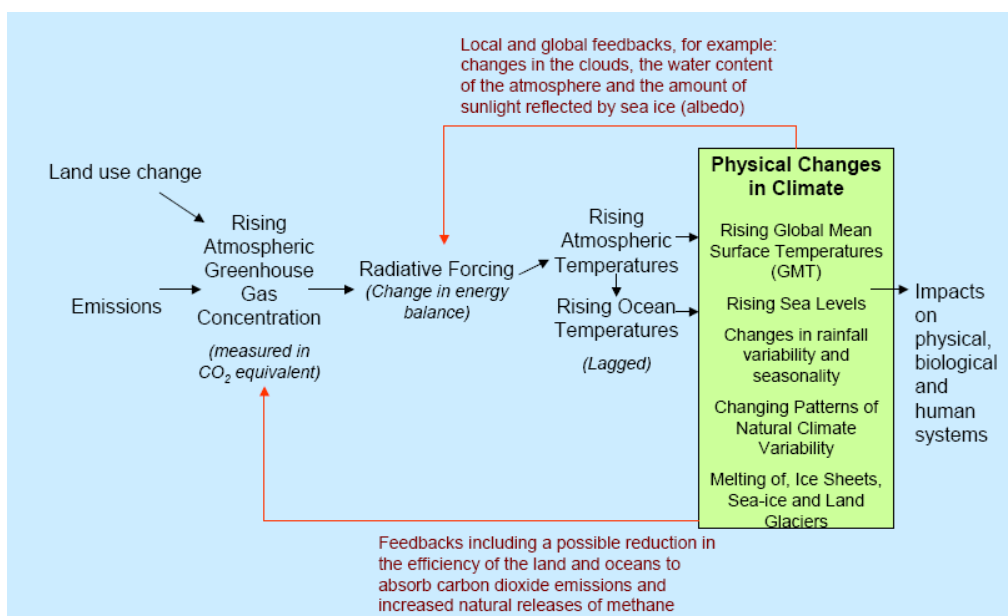


Figure 4.3. The link between climate change and greenhouse gases⁴⁸

⁴⁴ Stern (2007), p.4

⁴⁵ Swedish Environmental Protection Agency <www.naturvardsverket.se> 2007-10-02

⁴⁶ United Nations Framework Convention on Climate Change <unfccc.int> 2007-10-02

⁴⁷ ibid

⁴⁸ Stern (2007), p.8

4.2 External factors

Actions towards preventing further climate change can be taken either in the micro environment by companies, or in the macro environment by governments and legislative authorities.⁴⁹ Influence can also come from other stakeholders as shown in figure 4.4.

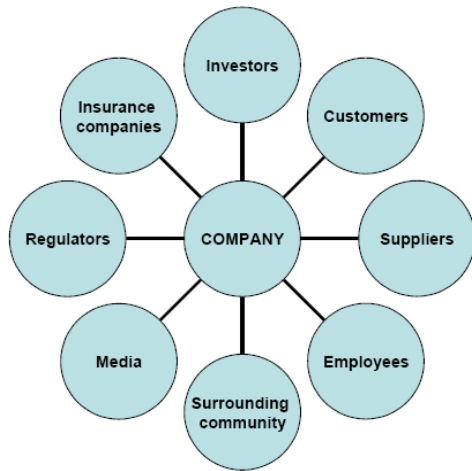


Figure 4.4. Stakeholders that can make demands on the company's environmental work⁵⁰

The roles of governments as regulator, facilitator and buyer give them resources to help preserve the environment.⁵¹ They can influence the companies' and the consumers' actions in a number of ways. Monetary in terms of taxes and subsidises, regulatory such as making some standards mandatory or regulating the maximum emission levels and finally communication policies, making the consumers more aware of the consequences of their choices. With the right mix of policies, these can work as incentives for companies to invest in new technology.⁵² The emission trading system is one example of a policy that is regulatory as well as monetary. The aim with such system is to reduce the emissions in the most cost effective way. An actor that needs to pay a significant amount of money in order to reduce the emissions can instead purchase carbon credits from another actor who can reduce the emissions to a lower cost. An actor that does not need all the carbon credits can sell them to another actor. As the number of carbon credits is limited and the total number of carbon credits assigned will decrease, the system will lead to a reduction of the total emissions.⁵³

Activities on a micro level are not only made as response to governmental actions. For businesses that early adopt preventative actions it can help generate marketing advantages due to the increasing demand for "green" products in the marketplace.⁵⁴

4.3 Logistics terminology

The supply chain is the entire set of activities to produce and deliver products to the final customer.⁵⁵ Logistics can be seen as a part of the supply chain and the management of it can be defined as:

⁴⁹ Aronsson & Huge Brodin (2006)

⁵⁰ Ammenberg (2004), p. 144

⁵¹ Dunn & Wu (1995)

⁵² European Conference of Ministers of Transport (2007)

⁵³ Swahn (2007)

⁵⁴ Lockwood & Stubbs (2007)

⁵⁵ Schary & Skjøtt-Larsen (2001)

”Logistics management is that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers’ requirements.”... “Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfilment, logistics network design, inventory management, supply/demand planning, and management of third-party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service.”⁵⁶

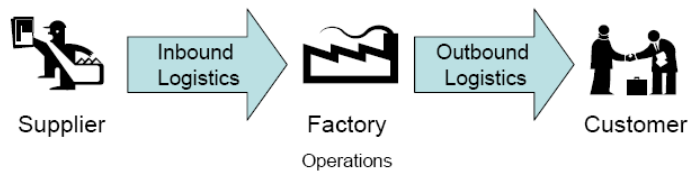


Figure 4.5. Inbound and outbound logistics

Logistics can be divided into inbound and outbound activities as shown in figure 4.5. The outbound logistics which is the focus in this study is defined as:

“Distribution is the outbound logistics, from the end of the production line to the end user. The activities associated with the movement of material, usually finished goods or service parts, from the manufacturer to the customer. These activities encompass the functions of transportation, warehousing, inventory control, material handling, order administration, site and location analysis, industrial packaging, data processing, and the communications network necessary for effective management. It includes all activities related to physical distribution, as well as the return of goods to the manufacturer. In many cases, this movement is made through one or more levels of field warehouses.”⁵⁷

Transportation is a central part of the distribution, and it is measured in tonne-kilometres which is the weight of the goods in tonnes multiplied with the number of kilometres the goods are transported.⁵⁸ A transport service can be divided into a tangible and an intangible part as shown in figure 4.6. The tangible part is the movement and handling of the goods and the intangible part is the information, quality and safety. The information systems are used for administration but also for tracking and controlling the flow.⁵⁹

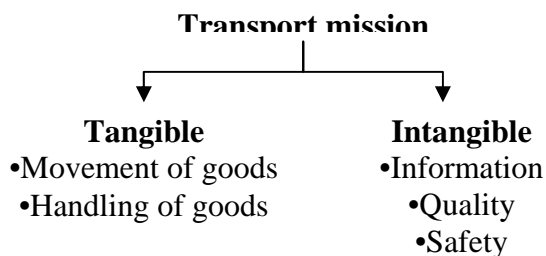


Figure 4.6. Definition of transport.⁶⁰

⁵⁶ Vitasek (2006), p. 89

⁵⁷ ibid, p. 48

⁵⁸ Persson & Virum (1999)

⁵⁹ Lumsden (2006)

⁶⁰ ibid, p. 72

4.4 Green logistics theory

Even though the debate has been strong, not much research has been made on green logistics. A literature review made showed that between 1995 and 2004 only 45 out of 2026 research articles published in the major logistics journals addressed environmental issues.⁶¹ The research that does exist in the area is mainly about new technology and new fuels for vehicles. Additionally, most research is from a macro perspective and not from a business point of view.⁶²

Common goals within logistics have been zero tolerance when it comes to response times, defects and stock levels. These all make environmental goals hard to achieve. Low stock levels results in more frequent deliveries and zero defects can involve packaging material that creates more waste or take up more space. The demand on response time increases the use of faster transports, such as aviation, that causes larger emissions and also makes it difficult to plan and consolidate the transports. On the other hand, many of these philosophies focus on efficient use of resources and elimination of non value adding activities, which can as well have positive effects on the environment.⁶³

Green logistics means that companies in their logistics work strive to use resources and available technology in a way that minimizes the environmental impact and the use of natural resources. The interest began in connection with the Bruntland commission, assigned on behalf of the UN in 1987. There the importance of recycle thinking and sustainable development were established.⁶⁴ Green logistics broadens the original term in two main areas. The first is that the environment is used in addition to the economical factor as a criterion in the evaluation of the results from selected solutions and actions. As an example, when the environmental aspect is taken into consideration the reduced stock levels and Just-In-Time deliveries may have to make way to larger lots due to the transport related emissions. Secondly, the complete material flow from the extraction of raw material through production and distribution to the recycling and waste disposal is examined in a so called life cycle assessment (LCA). This includes the input material, its effect on the environment and the possibility to recycle it. The impact throughout the lifecycle should be considered already in the design phase to select environmentally friendly materials, enable an effective production process and simplify the recycling by making separation less complicated and costly. For it to work, it is important that the suppliers can document the supply sources of material in addition to the impact of their own processes.⁶⁵

The environmental improvements in logistics can be logistical, including better planning, consolidation and structure. It can also be achieved by technological developments such as cleaner vehicles, new fuels and the use of IT for optimization of flows.⁶⁶ This can be in-vehicle communications to avoid traffic congestions, using routing and scheduling systems, utilising backhaul capacity, good driving behaviour and moving materials in the largest loads possible.⁶⁷

⁶¹ Aronsson & Huge Brodin (2006)

⁶² Huge Brodin, Maria 2007-10-29

⁶³ Persson & Virum (1999)

⁶⁴ Lumsden (2006)

⁶⁵ Persson & Virum (1999)

⁶⁶ Lumsden (2006)

⁶⁷ Kohn (2005)

Within transportation, actions to reduce the environmental impact can be divided into three areas; reducing the total demand from transport, making transports more effective and introducing more environmental technology. Possibilities to influence the different areas for a manufacturing company are illustrated in table 4.1, in the cells without shading.⁶⁸

Table 4.1. Examples of areas that influence the environmental impact from transports⁶⁹

Influence on...	... traffic (Infrastructure/vehicle)	... transportation (Unit/goods)	... fossil fuel and emissions (fuel and engines)
... limitation	Distance fees and prohibitions	Information over the internet	Taxes, fees and subsidies
... making more effective	Traffic control	Fill rate	Emission Trading
...new technology	Roads and the size of vehicles	Products and packages	Cleaner and renewable fuels and more efficient engines

Lumsden presents a model, based on McKinnon, that distinguishes four strategic levels for companies to work on in order to be more environmental responsive. The last two are the most common ones to work with today, but it is within the first two that the greatest potentials for improvements can be found.⁷⁰

1. Physical structure of the logistics system where decisions such as number, location and size of factories, warehouses and consolidation centres are made.
2. Purchasing- and distribution patterns which includes the selection of suppliers, distributors and customers.
3. Time management of orders to determine the flows.
4. Control of transport resources. Given the above decisions selecting transport modes, route planning and optimal consolidation.

In a similar manner Aronsson and Huge Brodin present a framework for how decisions on different levels create opportunities and set limitations for decisions made on another level. This framework is presented in figure 4.7. The funnel like model starts on a strategic level with the decisions about the product design. It then narrows down through tactical and operational levels, where the freedom of choice gets more and more limited because of the decisions made in previous steps. The second level is about structural decisions such as number of suppliers and if there should be both regional and central storage of a product. The choices concerning planning and management on the next level often concern one large market or customer. Finally, the operational decisions are day-to-day decisions about handling of deliveries, orders and single shipments. This model can be used in order to foresee the consequences on the environment from different decisions. It also illustrates that to achieve the greatest improvements; changes need be made at a higher level.⁷¹

⁶⁸ Swahn (2007), p. 105

⁶⁹ Based on Swahn (2007), p. 105

⁷⁰ Lumsden (2006) based on McKinnon A, 1994, *Logistics and the Environment*, Heriot-Watt University Business School, Edinburgh, UK

⁷¹ Aronsson & Huge Brodin (2006)

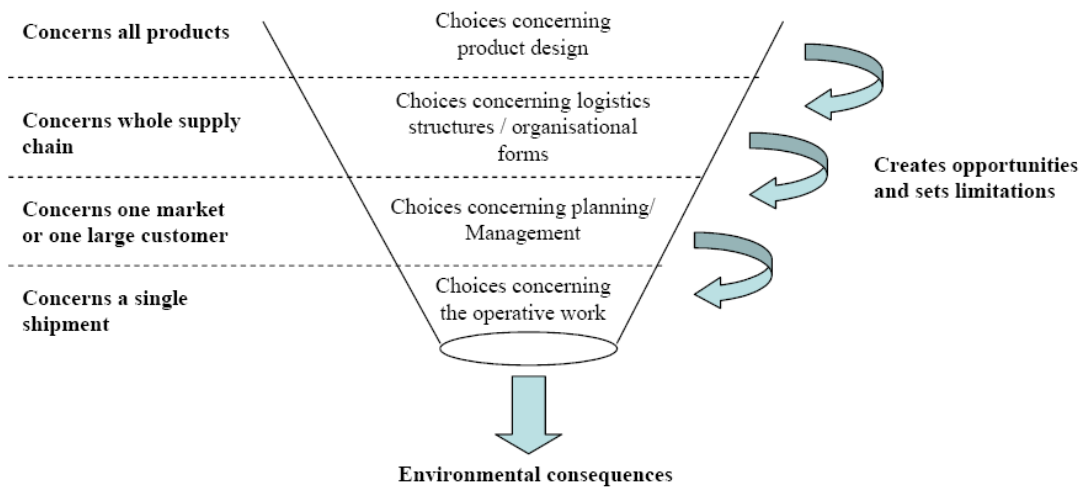


Figure 4.7. Different logistics decision levels and their relationships⁷²

Dunn and Wu have created a framework showing the decisions in the supply chain that affects the environment. The framework is illustrated in figure 4.8 below. Besides structural decisions it includes how carriers are selected, how things are packaged, what mode of transport to use, decisions about inventory levels and finally consolidation options.⁷³ These decisions and their environmental impact are explained in the next sections. The decisions should promote an environmental response such as shorter and more direct transportation routes, larger and fewer shipments and better and more environmentally friendly utilization of vehicles.⁷⁴

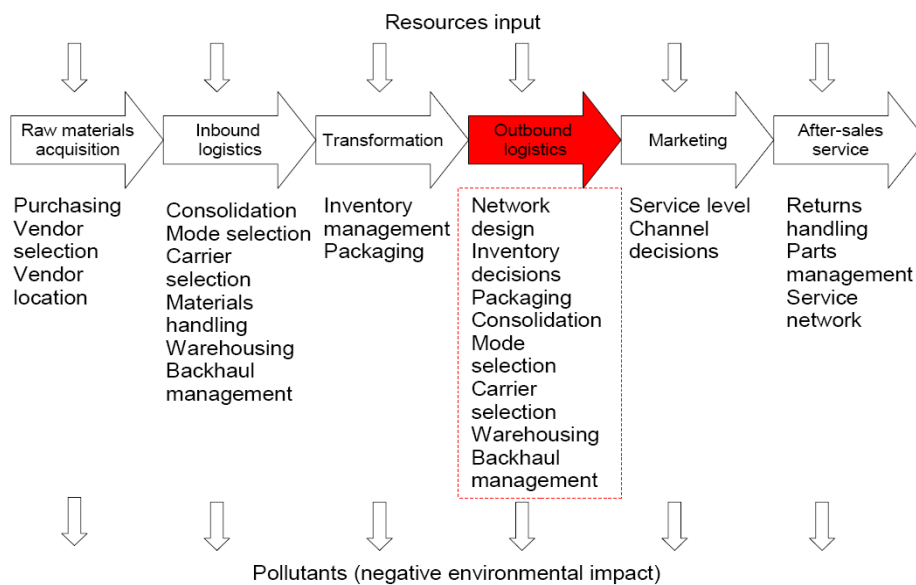


Figure 4.8. Logistics decisions that affect the environment⁷⁵

⁷² Aronsson & Huge Brodin (2006) p. 400

⁷³ Dunn & Wu (1995)

⁷⁴ *ibid*

⁷⁵ *ibid*

4.5 Logistics structure

As explained, changes in the logistics structure are considered to bring the largest possibilities for reductions in emission levels. The structure can from a macro perspective include support to shift in mode to more environmentally friendly alternatives and infrastructure development, which directly affect the environment due to the travel distances. From a micro perspective, structural issues are poorly researched. Still, Aronsson and Huge Brodin presents in their framework, figure 4.9, important areas relating directly and indirectly to emissions from a macro as well as from a micro perspective.⁷⁶

	Technology	Structure
Macro Perspective	<ul style="list-style-type: none"> • more energy efficient technology • reduce usage of fuels with high emissions e.g. fossil fuels 	<ul style="list-style-type: none"> • infrastructure, e.g. road network, railways, airports • education • modal shift • reducing the demand for transport
Micro Perspective	<ul style="list-style-type: none"> • fuel efficient technology if it saves money • saving energy for heating or cooling if it saves money 	<ul style="list-style-type: none"> • economy of scale & scope • fleet/structure utilization • reduce transport costs • reduce overall logistics

Figure 4.9. Important areas relating to emissions⁷⁷

Important to consider is that a structural change does not only imply physical changes but may as well change the company's governance, control and information system.⁷⁸

4.5.1 Network design

All transports can be arranged into a network structure with nodes and links. A node is where the flow is, or can be stopped, for instance for warehousing, terminal handling and processing. All movements of goods are represented by the links.⁷⁹ Two different distribution structures are presented in figure 4.9. The throughput time increases with more warehouses and it also brings a risk for increased costs. One advantage of having multiple warehouses is being close to customers which enable short delivery times. Another is that it is easier to coordinate shipments to and between warehouses. The selection of numbers and location of warehouses is often driven by the demands on lead-time. Centralisation of warehouses has the advantages to reduce the fixed costs of staff, warehouse and administration. It also reduces the cost of tied-up capital since safety stock is only needed at one location. In addition, the management and control of the flow is also simplified. Apart from reducing costs, centralized warehouses also increases the service to the customer, for instance through increased delivery reliability as it is possible to keep a more complete assortment available.⁸⁰

⁷⁶ Aronsson & Huge Brodin (2006)

⁷⁷ ibid

⁷⁸ ibid

⁷⁹ Lumsden (2006)

⁸⁰ Aronsson et al. (2003)

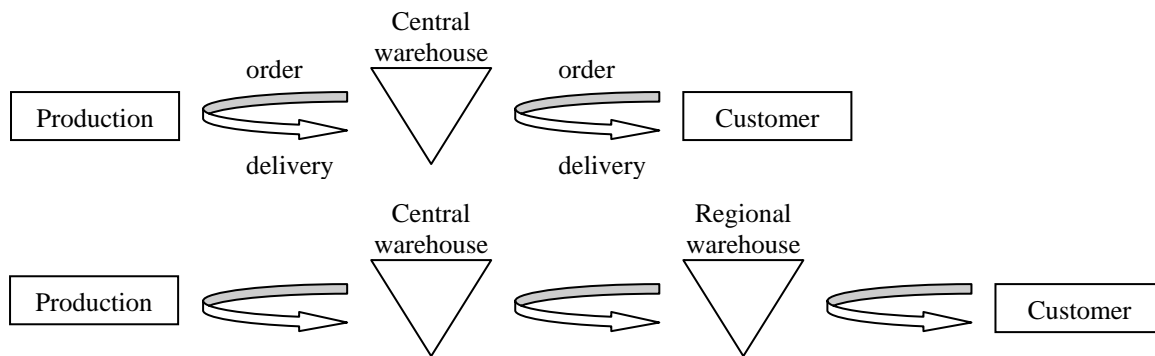


Figure 4.10. Different distribution set-ups for manufacturing companies⁸¹

4.5.2 Design for Supply Chain Management

The design of the products can affect factors such as logistics and distribution costs, inventory investment, product availability, customs duties, serviceability and flexibility.⁸² Design for supply chain is a term used to describe the concept of designing products and processes to support the operational efficiency of supply chains. A key concept in design for supply chain management is delayed product differentiation, a so called postponement strategy.⁸³ Delaying customization increases the company's flexibility to respond to changes in demand. It means the company can improve its responsiveness to orders and reduce inventory.⁸⁴

For companies serving global markets, the complexity and consequently also the potential for design for supply chain are even greater.⁸⁵ Production in a global company serves multiple market segments that may have different requirements because of differences in taste, language etc. To better manage the relationship between design and eventual customization, distribution and delivery to different markets, the additional concepts design for localization and design for customization have been introduced. In these strategies the operational and delivery service considerations for multiple market segments are taken into account in the design phase.⁸⁶ Design for localization is about delaying differentiation to meet local region requirements, for example power supply modules and manuals in different languages, whereas design for customization is a strategy to meet needs of different models and market segments.⁸⁷

To be suitable for different markets, products are made in basic units that contain most features and components of the finished products.⁸⁸ The product is often in modular form with a few key modules as differentiator that can be added late in the production process. Inventories held in generic form can be held much lower than in individual model form and the flexibility makes it easier to respond to fluctuations in demand.⁸⁹

⁸¹ Aronsson et al. (2003), p.67

⁸² Lee (1992)

⁸³ ibid

⁸⁴ Lee et al. (1993)

⁸⁵ Lee (1992)

⁸⁶ Lee et al. (1993)

⁸⁷ Lee (1992)

⁸⁸ Lee et al. (1993)

⁸⁹ Lee (1992)

Design for logistics is another strategy and with postponed product differentiation, the final packaging can be made at the distribution centre instead of the factory and thereby enable shipments in bulk which reduces the freight costs. Design for logistics can also involve design of packaging of products to maximize the pallet density.⁹⁰

The obstacles to overcome when introducing these strategies are to change the mindset of the design team to take a broader perspective than product functionality and performance. The cost of e.g. distribution and customization must also be included in the evaluation of alternative designs.⁹¹ Table 4.2 presents the different requirements for localization at DC compared to if it is made at the factory.

Table 4.2. Requirements for localization at DC vs. at the factory.⁹²

DC-localization	Factory-localization
Generic product made at central manufacturing site, customized (power supply & manuals) at regional DCs for local demands	Customized product made at central manufacturing site
Stocks of generic finished products + localization materials required at regional DCs	Stocks of customized finished product required at regional DCs
Final configuration ability needed at regional DCs	Stocks of localization materials required at central manufacturing site

4.5.3 Delivery patterns

Delivery patterns are another part of the distribution structure. Figure 4.10 shows some examples of different delivery patterns. Traditionally the supplier delivers quantities according to customers’ orders to their warehouse. A pull based delivery pattern is when the supplier delivers the demanded quantity directly to production or cross docking. Delivery via logistics centres can be used for instance for kitting. In vendor managed warehouses the supplier is responsible for the size and replenishment of the warehouse. In vendor administrated warehouses the supplier is also responsible for the material handling and administration at the warehouse and is called “in plant store”. In the last example, deliveries go directly from suppliers to the customer’s customer.⁹³

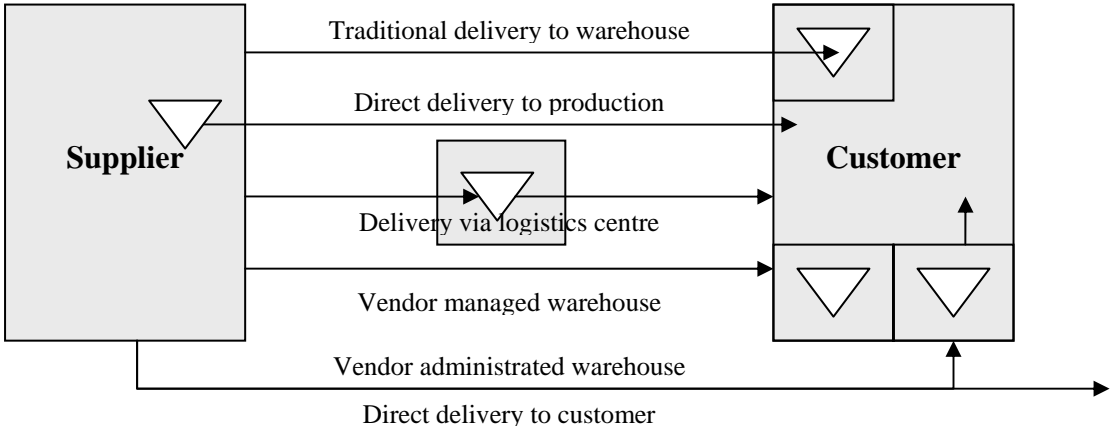


Figure 4.11. Alternative delivery patterns⁹⁴

⁹⁰ Lee (1992)
⁹¹ ibid
⁹² ibid
⁹³ Mattsson (2002)
⁹⁴ ibid, p.223

4.5.4 Environmental effects of structural changes

How, and if, structural changes in the logistics system can promote cost-, service-, and environmental performance at the same time is investigated by researchers at Linköping University (especially the effect of centralisation of distribution). The results from a study at a few Swedish companies that changed their distribution from direct shipments to shipping via a central warehouse have shown that changes that fulfil all three criteria are possible. This was mainly because of the decrease in emergency deliveries, which has a positive effect on the environment since they are often sent by air. Other factors behind the reduced environmental impact are opportunities to change to other modes of transport, increased fill rates, improved coordination, more bargaining power and easier standardisation of pallets and packages which in turn leads to easier control of material flows. Some consequences of the centralisation process have however negative effects such as the increase in tonne-km compared to direct shipments. Whether centralisation is profitable, or not, depends on the geography, volumes, the concentration of suppliers and customers and whether it makes consolidation of flows easier. High volumes being transported on the same routes are necessary to benefit from the need of extra transport.⁹⁵

4.6 Mode Selection

The different modes of transportation are air, road, rail and sea. They are used for different kind of goods where air and road are more frequent for transport of higher value goods as explained in figure 4.12. The environmental impact from each mode and the factors that determines these, are investigated in this section. Furthermore the terms multi- and intermodal transportation are defined.

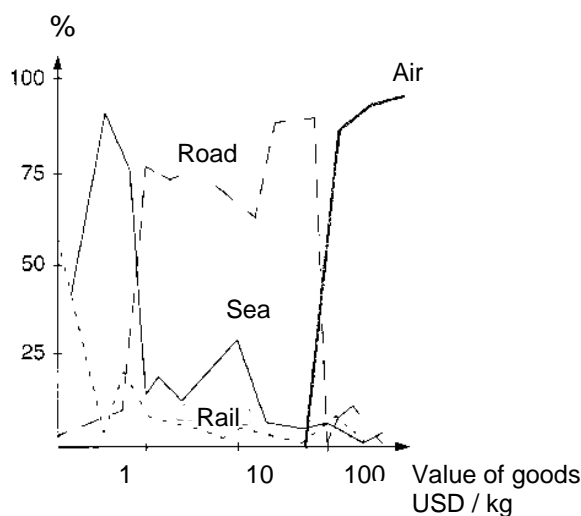


Figure 4.12. Popularity of different modes for goods of different value⁹⁶

There are several criteria that a company take into consideration when selecting mode of transport. The factors most crucial to companies are reliability, flexibility, transportation time, safety and of course cost. Other aspects are environmental impact, company image, regulatory elements and waiting cost.⁹⁷ Further examples of factors that determine the selection of transport mode are:⁹⁸

⁹⁵ Hüge Brodin, Maria 2007-10-29

⁹⁶ Lumsden (2006), p. 63

⁹⁷ Björklund (2005)

⁹⁸ *ibid*, p. 97

- Type of goods
- Transport volumes
- Transport distances
- Time of day and demand for punctuality
- Service in the system
- Development possibilities
- Policy aspects, commerce and goodwill
- Information provided
- Accessibility of the infrastructure
- Equipment at the company
- Risk of accidents involving goods and employees

Generally, air and road freight are considered to be more environmental harmful than rail and sea borne shipping. Emission levels per tonne-km are kept low for sea shipments because of the high capacity of vessels. It however loses some of its environmental advantages if the fill rate is low.⁹⁹ Weight, speed, engine and driver behaviour are additional factors that has an impact on the energy consumption per weight unit transported.¹⁰⁰ Average figures on emission levels for the different modes show that large container vessels emit around 10 grams CO₂ per tonne-km and for trucks the figure is 50 g. Rail is depending on the energy source, but the average number in Europe today is 26 g and for air freight the figure reaches numbers between 500 and 600 grams. These figures are also presented in figure 4.13.¹⁰¹

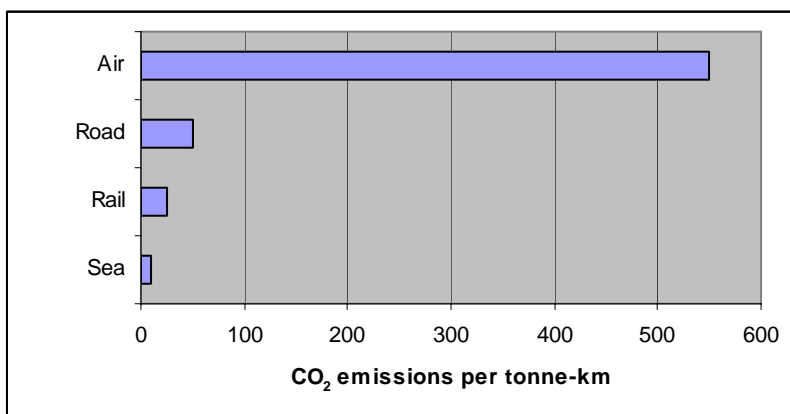


Figure 4.13. CO₂ emissions per tonne-km from the different modes of transport¹⁰²

4.6.1 Air

Lumsden distinguishes four main types of goods that are normally transported by air. These are perishables such as fruit, vegetables and some chemical substances, newsworthy goods such as newspapers, fashion garments and computer software, goods with special demands on fast delivery such as spare parts and finally high value goods such as electronic products.¹⁰³

Deregulations within the international aviation politics have resulted in open competition and free price formation. The increased number of departures has increased the emissions, but has also made the air freight more effective, in planning and new solutions, faster goods handling

⁹⁹ Blinge & Svensson (2005)

¹⁰⁰ Enell, Magnus. External expert, Swedish Government's Council for Sustainable Development. 2007-11-01

¹⁰¹ Swahn, Magnus 2007-12-03

¹⁰² ibid

¹⁰³ Lumsden (2006)

and faster transferring of goods between different modes of transport. The importance of time between ordering and delivery, to get the products to market before the competitors, is one factor behind the increase in air freight. The increased level of technically advanced products with high value and low weight and volume is another. Reduced delivery times mean savings in tied-up capital and the exposure to theft is lower in comparison to other transport modes.¹⁰⁴

The aviation industry accounts for about 12 percent of the annual worldwide emissions from transportation.¹⁰⁵ The emissions have increased by 86 percent from 1990 to 2004, and it is the transport mode with the fastest growing level of CO₂ emissions.¹⁰⁶ Aviation is in addition contributing to climate change by the emissions of nitric oxides (NO_x) and particles and by contributing to the formation of contrails and cirrus clouds. Fuel efficiency is of great concern for aircraft operators since 20 percent of total operating costs are represented by the fuel cost.¹⁰⁷ Still, as flights take place in international space, they are exempt of value added tax and fuel taxes resulting in prices not reflecting the costs of the environmental impact.¹⁰⁸

Emissions from aviation are caused by the combustion of aviation fuel and are similar to the emissions from other fossil fuel combustion. However, since emissions are emitted at an altitude, it affects the global as well as the local air quality.¹⁰⁹ To reduce the fuel consumption and thereby also the emission levels, engines and vehicles with better environmental performance need to be developed. Savings can be made as well through optimization of routes.¹¹⁰

4.6.2 Road

Road freight has the advantage of keeping high standards of control, punctuality, flexibility, security and cost. The infrastructure is well developed and it is the only transport mode that can provide door-to-door solutions. However, it is no longer the only practical option due to a mixture of technical innovation and the deregulation and privatisation of formerly state-controlled modes of transport.¹¹¹

One method for reducing the CO₂ emissions from road transport is decreasing the loads and therefore also the work needed to operate the vehicle. These loads can be weight, rolling and air resistance and accessory loads. Other options are to increase the efficiency of converting fuel into energy or using alternative fuels.¹¹² Eco-driving is another method for reducing the energy consumption. No large investments are needed, only education of drivers. The savings in petrol from eco-driving can be as much as ten to 15 percent.¹¹³ The environmental performance of trucks is classified by the diesel engines that are divided into and regulated through Euro classes depending on their particulate matter and NO_x emissions.¹¹⁴

¹⁰⁴ Lumsden (2006)

¹⁰⁵ Blinge (2005)

¹⁰⁶ European Environment Agency (2007)

¹⁰⁷ Kahn Ribeiro et al. (2007)

¹⁰⁸ Swahn (2007)

¹⁰⁹ International Civil Aviation Organization <www.icao.int> 2007-11-14

¹¹⁰ Swedish Civil Aviation Authority <www.luftfartsstyrelsen.se> 2007-12-11

¹¹¹ Lumsden (2006)

¹¹² Kahn Ribeiro et al. (2007)

¹¹³ Enell, Magnus. External expert, Swedish Government's Council for Sustainable Development. 2007-11-01

¹¹⁴ Swahn (2007)

4.6.3 Rail

The idea of rail transport is that the friction between wheels and rails is low, and less force is needed to move the carriage. As a result, larger volumes can be transported and the fuel consumption is relatively low. However, the rail freight requires large investments in infrastructure and the network is sparse compared to the network of roads. If there are no direct connections between the origin and final destination, rail transports can be time consuming. Rail is most suitable for large shipments and only routes where large volumes can be transported are profitable. The opportunities for new routes are therefore limited. An option is to combine rail with other modes of transport and consolidate goods from different shippers at a rail terminal. The extra handling needed when transferring goods between trucks and rail makes it slower and less flexible. A great deal is nevertheless invested in making the rail transport more efficient. This includes coordination of standards between countries and more efficient transferring of goods between different modes for instance in standardized containers that can be transferred as a unity.¹¹⁵

The environmental impact from transportation by rail is strongly dependant on the energy source. If they are driven by electrical power generated from burning of fossil fuels, such as carbon, the environmental impact can be of the same magnitude as from road transport. If generated from renewable energy sources, the emissions are basically nonexistent.¹¹⁶

4.6.4 Sea

Transportation by sea accounts for a total of 90 percent of all trade by volume to and from the 25 members of the European Community and almost 80 percent by weight to and from the United States. The demand on infrastructure is low and it can transport large volumes of goods at relatively low energy consumption.¹¹⁷ However due to the large amount of goods transported by sea, maritime transports accounts for 13 percent of the world's total transport GHG emissions. Furthermore a growth of 35–45 percent in absolute levels of emissions is foreseen between 2001 and 2020.¹¹⁸

Additionally, the fuel used for sea transport is based on fossil bunker oil with high sulphur content and the combustion results in high levels of NO_x and sulphur dioxide (SO₂).¹¹⁹ The maritime fuel contains thousands times more sulphur than the petrol used on land.¹²⁰ Sea transport also emits harmful substances to the water with an effect on marine life.¹²¹

4.6.5 Multi- and intermodal transportation

There is often a need to combine different modes of transport since most modes can not provide door-to-door solutions.¹²² Multimodal transport is the term used if goods are carried by two or more modes of transport. Intermodal transport has the same meaning except that the movement of goods is in one and the same loading unit without handling the goods themselves when changing modes.¹²³ Intermodal transport allows making use of the advantages of each mode, e.g. potential capacity, high levels of safety, flexibility, low energy

¹¹⁵ Lumsden (2006)

¹¹⁶ Blinge & Svensson (2005)

¹¹⁷ Clean Shipping Project <www.cleanshippingproject.se/projektet.html> 2007-12-06

¹¹⁸ European Environment Agency (2007)

¹¹⁹ Swahn (2007)

¹²⁰ Feuk (2007)

¹²¹ Swahn (2007)

¹²² Lumsden (2006)

¹²³ European Conference of Ministers of Transport (2007)

consumption and low environmental impact, to make transport chains which overall are more efficient, cost effective and sustainable.¹²⁴ There are however some negative aspects, for instance that the handling and imprecise timings between modes can delay the time of transportation. The sizes of the carriers and the pallets to fit in them also differ between different modes.¹²⁵

4.7 Carrier selection

Transports or the whole distribution process can be outsourced to a third part, a so called freight forwarder. Their responsibility is to provide logistics services as an intermediary between the shipper and the carrier. The freight carrier is the company that hauls freights including trucking, railroads, airlines and sea borne shipping. By coordinating the transports, the forwarders provide quick and efficient response to changes in customer demands and shipping requirements.¹²⁶ Factors that influence the selection of carrier are:¹²⁷

- Transportation cost
- Transit time
- Reliability – the consistency of the transit time a carrier provides
- Capability – ability to provide the equipment and facilities required
- Accessibility – carriers physical access to facilities
- Security – arrival of goods in same condition as when they became carrier responsibility

Many companies only contract their logistics and transport provider to deliver the goods in good condition at an agreed price. However, the purchasers of transport services can take a larger role and stipulate how it moves and ask for greener options.¹²⁸ Björklund has in her dissertation developed guiding principles on how shippers can increase the environmental ambition in their purchasing practices. They are the following:

- *Principle 1: See the process as a whole*
To see the process as a whole gives a more representative view of the environmental performance of a company than if viewing them as separated practices.
- *Principle 2: Strive to apply a more uniform level of ambition*
Often the environmental ambition is higher in the beginning of the purchasing process than in the end. It is instead recommended to have a continuous level of ambition throughout the process.
- *Principle 3: Be aware of the strengths and weaknesses*
To be able to improve the environmental performance effectively and efficiently, the shipper need to know its strengths and weaknesses.
- *Principle 4: Strive to apply similar practices within the company*
If similar practices within the company are achieved, the work efforts necessary and the risk of misunderstandings decrease.
- *Principle 5: Initiate, if needed and possible, changes in the internal conditions*
Some changes internally may be necessary in order to apply a more environmentally preferable purchasing practice, e.g. priorities of management, the character of the production system and the product as well as measures and follow-up routines.
- *Principle 6: Continuously improve the practices applied*

¹²⁴ European Commission <ec.europa.eu/transport/intermodality> 2008-01-03

¹²⁵ European Conference of Ministers of Transport (2007)

¹²⁶ Vitasek (2006)

¹²⁷ Bardi et al. (1996)

¹²⁸ MacLeod (1998)

If the purchasing process is to become more environmentally friendly, the environmental ambition in the individual practices and sub-practices first need to improve. Improvements often need to be made simultaneously in the different practices.

- *Principle 7: Be as clear as possible in all communication*
It is important to be clear in the interpretation of measures and concepts used. By doing so, the risk of misunderstandings and hurting the company's reputation are avoided.
- *Principle 8: Increase the information exchange, if necessary*
Increased information exchange provides several benefits, e.g. decreased risk of conflicts and that work efforts are made twice as well as that the interest and understanding of other functions increases.¹²⁹

4.8 Fill rate

Consolidation is a method for increasing fill rates while still making frequent deliveries possible. "Consolidation means combining two or more shipments in order to realize lower transportation rates."¹³⁰ By increasing the fill rate, large economical but also environmental savings can be made. Using global forwarders that coordinate the freight carriers with the shippers simplify the process of consolidation. However, to facilitate the planning of transports and improve the fill rate it can help to give the freight forwarders early notice on planned deliveries or give them more flexibility on the delivery dates.¹³¹ Better integration of inbound and outbound transportation will as well lead to better use of the capacities of the vehicles.¹³²

The fill rate can be considered on different levels from the size and shape of each single parcel to the use of infrastructure. Swahn presents the model in figure 4.15. On an infrastructural level, transportation can be made more effective with for instance night distribution.

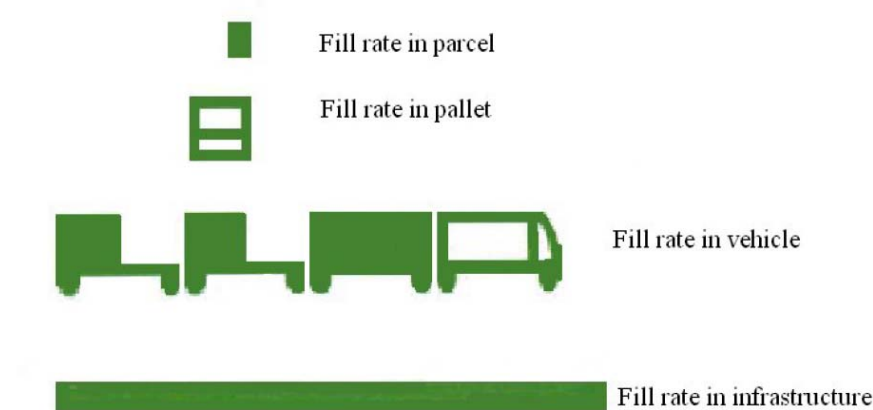


Figure 4.14. Fill rate from infrastructure to products being transported¹³³

Packaging can affect the fill rate by making parcels that require less space and fit well into the freight containers. The package is directly related to the container used in the distribution system and in order to reach maximum utilization, these have to fit each other.¹³⁴ Packaging can be considered having three main purposes. The first is logistics related and has to do with

¹²⁹ Björklund (2005)

¹³⁰ Vitasek (2006), p. 33

¹³¹ Blinge & Svensson (2005)

¹³² Persson & Virum (1999)

¹³³ Swahn (2007), p. 106

¹³⁴ Lumsden (2006)

protection of goods from damage, spoilage, or loss through theft and misplacements. The second is a marketing function with purpose to attract attention and present an image. The last purpose is to provide convenience for the middle men as well as for the consumer in their handling and storing of the product.¹³⁵ Packaging has an influence on the environment through the packaging material and its recycling ability, but also through the possibility to effectively store and transport products. The volumes of parcels have increased caused by for example packaging of whole kits to the manufacturing industry. Consequently, the vehicles get filled volume wise, but there is still more capacity weight wise.¹³⁶

Imbalances have a large impact on fill rates and affects especially sea borne transports that have large capacities. These imbalances can be divided into four categories: structural, constructional, operational and commercial. Structural imbalances are results of the underlying industrial system causing variations in volumes between incoming and outgoing goods. Construction dependent imbalances are caused by the construction of the vessel to allow transport of for instance inflammable liquids. Operational imbalances have to do with the availability of vessels, these imbalances are caused by how vessels are used and positioned. Commercial imbalances are determined by the market forces and are created by the operator and the market.¹³⁷

4.9 Environmental impact from transports

Emissions and other environmental effects come as output from the logistics system. In transportation the environmental focus is mainly on the air pollution but noise and landscape fragmentation are additional factors with negative impact on the environment. In the life cycle assessments, where the total impact from raw material extraction to recycling of products is analysed, transportation has often been identified as an area with major environmental effects. In 2004 the transport sectors accounted for 26 percent of world total energy use and 23 percent of world energy related GHG emissions. That means a total of 6.3 GtCO₂ emissions. 95 percent of the transport energy comes from oil-based fuels like diesel and petrol. Motorised transport accounts for almost half of the world oil consumption and this dependence is a threat to the transport sector due to declining oil supply and rising oil prices.¹³⁸ Improvement in technology for internal combustion engines and fuel can improve the emission levels. However, the carbon dioxide emissions can not be cleared through catalytic converters.¹³⁹ Consequently, the level of emissions is approximately proportional to the energy use for all different transport sub-sectors, if oil-based fuels are used.¹⁴⁰

The transport sector is steadily increasing its GHG emissions, which are expected to more than double by year 2050.¹⁴¹ Even the improvements in energy efficiency and renewable fuels are not sufficient to offset the growth. Some reasons for the growth are the removal of barriers to trade and the globalization of production chains. Since the differences in production costs between regions are higher than the transportation costs, it becomes more profitable for companies to benefit from the variation in skills and labour costs than having local production.¹⁴²

¹³⁵ Prendergast & Pitt (1996)

¹³⁶ Blinge & Svensson (2005)

¹³⁷ Lumsden (2006)

¹³⁸ Kahn Ribeiro et al. (2007), p. 328

¹³⁹ Lumsden (2006)

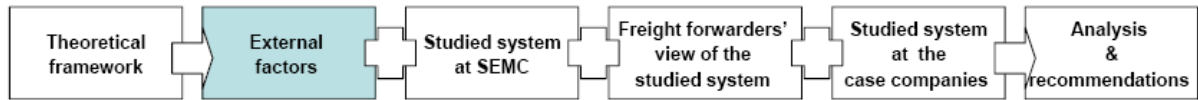
¹⁴⁰ Kahn Ribeiro et al. (2007), p. 328

¹⁴¹ Stern (2007)

¹⁴² European Environment Agency (2007)

5 External factors

In this chapter external factors that affect the studied system will be explored. The factors considered are regulations and market incentives and technological development within the four modes of transportation. Another strong influence is how the competitors and the industry in general react to the external factors.



5.1 Regulations and market incentives

In this section it will be described how governments and international organizations are acting to prevent further climate change. Politicians around the world have started to acknowledge the climate change and the need for immediate preventative actions. The European Union in particular has invested in environmental issues and mitigation of climate change. There are however difficulties with mitigation policies for international transport since laws and regulations vary between countries. If for instance the fuel is taxed in one country, airlines could fill the tank with fuel from a country where it is untaxed. The result can be an even greater impact on the environment.¹⁴³

The demand for vehicles, vehicle travel and fuel use are relatively price inelastic and in order to achieve major changes in emission levels, large increases in prices and taxes are required.¹⁴⁴ Companies within transport logistics are today experiencing tough competition and prices for transports are relatively low.¹⁴⁵ The price of transports does not reflect the external cost, the cost of their effect on the environment. It is considered likely that policies will be introduced so that these costs will be better reflected in the price. Depending on what substances will be prioritized, different modes will be favoured. Sea transport for instance would be more affected by regulations on nitrogen and sulphur as their CO₂ emission levels are relatively low. Regulations on CO₂ emissions are likely to affect the cost of air transportation the most.¹⁴⁶ As seen in figure 5.1, the external cost of air transport is today much larger than for other transport modes.¹⁴⁷

¹⁴³ Kahn Ribeiro et al. (2007)

¹⁴⁴ ibid

¹⁴⁵ Swahn (2007)

¹⁴⁶ Jadsén Holm, Monica. Environmental Coordinator Sweden, Schenker AB. 2007-11-27

¹⁴⁷ Kahn Ribeiro et al. (2007)

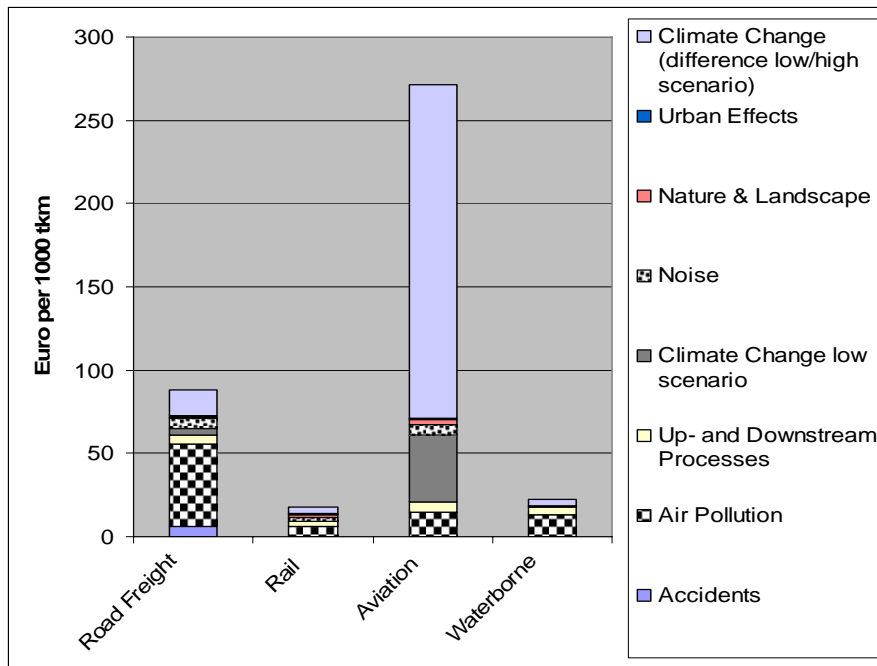


Figure 5.1. Average external cost of freight transport, excluding congestion, in € per 1,000 tonne-km, in the EU17¹⁴⁸

There is large potential for further development of environmental technologies, but it will not be achieved by itself. Initial costs of new technologies are often high and they can not always perform as good as conventional technology. Additionally, R&D investments are required upfront and there is a risk that the technology will not even reach the market.¹⁴⁹ Consequently, without political interference it is difficult to introduce more environmentally friendly technology. The cost-effectiveness of the different options are however important and to avoid damaging the economic growth and welfare, emission reductions should be achieved at the lowest possible overall cost.¹⁵⁰

5.1.1 Major actions against climate change

The most important action within the macro environment was the creation of the Kyoto Protocol. It was formed by the United Nations Framework Convention on Climate Change in 1997 and is signed by 174 countries. Emission reduction targets differ between countries depending on their economical development. The EU committed to reduce emissions of GHG by eight percent from 1990's levels in 2008-2012.¹⁵¹ Additionally, the European Council¹⁵² has set its own target to reduce the emissions by 20 percent until year 2020, with the levels of 1990 as baseline. Furthermore they have proposed that through an international agreement, the developed countries' joint efforts should result in about a 30 percent reduction by the same year and with the same baseline. Finally they propose a reduction of 60-80 percent for the same countries by year 2050. In the action plan, the goals to increase the energy efficiency and the share of renewable energy were supported together with the goal to increase the use of biofuel for transports within EU. The target for fuel from biomass is to reach at least 10 percent of the fuel consumption in year 2020.¹⁵³

¹⁴⁸ T&E & CAN Europe (2006), p.37

¹⁴⁹ European Conference of Ministers of Transport (2007)

¹⁵⁰ ibid

¹⁵¹ United Nations <www.un.org> 2007-09-11

¹⁵² Spring European Council of 8th and 9th March 2007

¹⁵³ European Union (2007b)

The Kyoto protocol will elapse in 2012 and an important step towards a post-2012 international agreement on climate change was taken at the United Nations Climate Change Conference in Bali in 2007. There the Bali roadmap was adopted, which charts the path for the new negotiation process that will conclude in 2009. The four key areas of the Bali roadmap are mitigation, adaptation, technology and financing. There were more than 180 countries represented at Bali and they all agreed on the roadmap, even the United States that did not sign the Kyoto protocol.¹⁵⁴ No quantitative targets of emission reduction are stated in the road map. However, it is stated that the scientific reports from IPCC shall be advisory.¹⁵⁵ The IPCC is a scientific intergovernmental body set up by the World Meteorological Organization and by the United Nations Environment Programme. It was established to provide decision-makers and others interested in climate change with an objective source of information about climate change.¹⁵⁶

The European Commission's white paper: "European transport policy for 2010" submitted in 2001 aims to, by proposing 60 or so measures, promote the shift in balance between the different modes of transport by revitalizing the rail infrastructure, promoting transport by sea and inland waterways and controlling the growth in air transport.¹⁵⁷ Below follows a more in depth description of the regulations and market incentives of the four modes.

5.1.2 Air

Since the emissions from international aviation are difficult to attribute to specific countries, they are not counted as part of the national greenhouse gas inventories according to the Kyoto protocol.¹⁵⁸ The European Commission has instead suggested other means of control such as including aviation emissions into the EU Emissions Trading Scheme (EU ETS), the creation of a "Single European Sky" and fuel taxation.¹⁵⁹

The proposal from the European Commission to bring the emissions from aviation into the EU ETS will cover all aircraft operators flying to and from EU airports from year 2012. The emission levels are suggested to be capped at 100 percent of the average levels from 2004-2006.¹⁶⁰ As the emissions are growing significantly caused by increased air traffic, this will have a great impact on the environment and on the industry. Purchasing allowances from other sectors will allow them more emissions but it will bring additional costs.¹⁶¹ The level of auctioning will be at 10 percent and the revenue from the auctioned allowances should be invested in the combat against climate change.¹⁶²

According to Kalle Keldusild, expert on emission trading at Swedish Civil Aviation Authority, it is hard to predict what effect the EU ETS will have on the price of transportation. He believes that initially it will probably not affect the price significantly and only bring a few percentages increase. The later effects depends on how much CO₂ the airlines and other

¹⁵⁴ United Nations <http://unfccc.int/meetings/cop_13/items/4049.php> 2007-12-27

¹⁵⁵ Karlsson (2007)

¹⁵⁶ IPCC <www.ipcc.ch> 2008-01-20

¹⁵⁷ European Union (2001)

¹⁵⁸ European Conference of Ministers of Transport (2007)

¹⁵⁹ European Union (2005)

¹⁶⁰ European Union (2007a)

¹⁶¹ Kahn Ribeiro et al. (2007)

¹⁶² European Union (2007a)

industries are allowed to emit and to what extent the airlines transfer the cost to their customers etc.¹⁶³

An additional focus for reducing the emissions from aviation is the creation of a “Single European Sky”. The air traffic management within Europe is fairly costly, hampered by diverse working practices and constrained by national borders instead of air traffic flows. The intergovernmental organization EUROCONTROL works with the objective to create a “Single European Sky” by coordinating efforts from all aviation stakeholders to achieve common goals.¹⁶⁴ According to the International Air Transport Association, IATA, the creation of a Single European Sky could save up to 12 million tonnes of CO₂ annually. They state that practical measures such as route shortening have already resulted in savings of up to 15 million tonnes of CO₂ in 2006 alone.¹⁶⁵ SAS believes that with a Single European Sky they can save up to as much as 12 percent fuel.¹⁶⁶

Finally, the European Commission wants member states to eventually remove the exemption from fuel taxation traditionally applied to the airline sector. However, there are major obstacles to overcome before fuel can be taxed for international flight, even between member states, as a result of legally binding commitments made in air service agreements between third countries and member states. Therefore, fuel taxation is considered a long-term solution.¹⁶⁷

5.1.3 Road

The European Commission’s objectives for road transport are to improve quality and apply existing regulations more effectively. The later they aim to achieve by tightening up controls and penalties. Examples of proposed measures are to harmonize fuel taxes for commercial road users and to promote uniform road transport legislation.¹⁶⁸

Carbon and fuel taxes are seen as the best measures for addressing the emissions of CO₂ and these are also widespread.¹⁶⁹ The use of tolls is another method of including the external costs of road transport. The proceeds from the tolls can be used for improving the road conditions or for other environmental initiatives.¹⁷⁰

A focus within the transport sector is on subsidies for biofuels, a high cost option. This focus should now, according to the European Conference of Ministers of Transport, switch to lower cost options as labelling of tyres and other vehicle components, support for eco-driving and tightening of vehicle emission standards. They also consider it a top priority to reform the vehicle taxation so that it is based on the vehicles specific emission levels.¹⁷¹

5.1.4 Rail

The incompatibility of technical and security regulations within EU’s member states is a major obstacle for the development in the railway sector.¹⁷² The European Commission’s

¹⁶³ Keldusild, Kalle. Expert on Emission Trading, Swedish Civil Aviation Authority. 2007-11-21

¹⁶⁴ EUROCONTROL, *Single European Sky* <www.eurocontrol.int/> 2007-12-27

¹⁶⁵ IATA (2007)

¹⁶⁶ Nertun, Niels-Eirik. Environmental Director, SAS. 2007-11-15

¹⁶⁷ European Union (2005)

¹⁶⁸ European Union (2001)

¹⁶⁹ European Conference of Ministers of Transport (2007)

¹⁷⁰ Enell, Magnus. External expert, Swedish Government’s Council for Sustainable Development. 2007-11-01

¹⁷¹ European Conference of Ministers of Transport (2007)

¹⁷² *ibid*

objectives concerning rail transport are to revitalize the railways by increasing the competitiveness, efficiency, safety and by making it more integrated. Additional focuses are to remove barriers of entry to the rail freight market and to gradually set up a dedicated rail freight network. One of the initiatives made was to introduce an effective steering body, the European Railway Agency, with the mission to act as a driving force for modernization.¹⁷³ They are developing common safety and technical regulations that all member states need to pursue.¹⁷⁴

5.1.5 Sea

It is stated in the Kyoto Protocol that the GHG emissions from vessels should be reduced.¹⁷⁵ Maritime transport is governed by international bodies of regulation. The United Nations Convention on the Law of the Sea establishes global regulations which to some extent regulate the emissions to air. In addition, the environmental impact is regulated by the International Maritime Organization through the clause Convention on the Prevention of Pollution from Ships (Marpol, annex VI). Since vessels emit relatively low levels of CO₂, but high levels of NO_x and SO₂, the regulations mostly encompass the later two.¹⁷⁶

The European Commission has made a proposal to abolish custom controls for goods moving between ports in the EU. Cargo transported by sea within the EU stand for 40 percent of the internal trade, measured in tonne-km. Today any vessel leaving a port is treated as entering international waters. Consequently, cargo has to go through customs with its time-consuming and complex procedures. The new proposal would support a shift from road to sea.¹⁷⁷

The Commission has decided to not set carbon and sulphur emissions standards, but to leave this to international bodies to decide. However, they have decided to exclude vessels from electricity tax when connecting to onshore power supplies in port, in order to encourage the shippers to switch off the engines.¹⁷⁸

5.1.6 Multimodal

In order to make the balance between the four modes more equal and thereby reduce congestion, the European Commission promotes the use of multimodal transportation. The major initiative is the founding of the “Marco Polo” community support programme. The aim with the programme is to make multimodal transportation competitive and economic viable, particularly by focusing on shift from road to rail and inland waterways. One of the major problems concerning multimodal transportation within Europe is that there is no close connection between rail, sea and inland waterways.¹⁷⁹

5.2 Technological development

The technological development of vehicles, fuels, infrastructure and other transport equipment together with better maintenance provide opportunities for emission reductions.^{180,181} Therefore, this section contains information about the current development

¹⁷³ European Union (2001)

¹⁷⁴ European Conference of Ministers of Transport (2007)

¹⁷⁵ European Union (2002)

¹⁷⁶ Swahn (2007)

¹⁷⁷ Global Institute of Logistics <www.globeinst.org> 2007-11-19

¹⁷⁸ *ibid*

¹⁷⁹ European Union (2001)

¹⁸⁰ European Conference of Ministers of Transport (2007)

¹⁸¹ Enell, Magnus. External expert, Swedish Government’s Council for Sustainable Development. 2007-11-01

and expectations on future technologies for the four modes. This information can later be used when forming environmental requirements on carriers and selecting mode. Main focus has been on the technological development in aviation, since this is the primarily used mode at SEMC today. Air is also the mode considered having the largest negative impact on the environment and is therefore in need for major actions.

In order to reduce the CO₂ emissions from transportation, research and development should promote lighter weight materials, engines that consume less fuel, renewable energy sources, equipment for easier transferring of goods between modes and finally better utilization and maintenance of vehicles.^{182, 183}

Even if technology improves, it takes time for old technology to be phased out. For a demonstration of the variation in length of life for vehicles of different modes see table 5.1.

Table 5.1. Length of life for vehicles of different modes¹⁸⁴

<i>Transportation mode</i>	<i>Length of life (years)</i>
Road	8 - 15
Rail	~ 40
Air	20 - 30
Sea	~ 40

5.2.1 Air

Air traffic is forecasted to increase over the following years and since fuel cost account for a large part of the cost of air transport, the research and development to reduce the fuel consumption is given much attention. However, the safety aspect of aviation makes the testing of alternative fuels and technology limited.¹⁸⁵

Sir Richard Branson, the chairman of Virgin Atlantic, has launched an alternative fuels division, “Virgin Green Fund”, pledging the profits from his airline and trains for the next ten years. The Virgin Green Fund invests in companies within the renewable energy and resource efficiency sectors in Europe and the US.¹⁸⁶ Virgin has announced that they will have the first commercial aircraft powered by biofuel ready in year 2008. Other participants in the project are Boeing and General Electric. The airline and its partners are performing tests of up to eight different biofuels in order to determine which one is the most effective at an altitude. Biofuels are processed from biomass, a renewable resource.¹⁸⁷ Virgin hopes that these types of aircrafts can be operating commercially within five years.¹⁸⁸ The Swedish Aviation Authority predicts that within a few years, biofuel could be used together with synthetic fuel from biogas. They state that it will probably take more than a few years before pure biofuel can be introduced to commercial aircrafts. With an increase in oil price, this development is however expected to accelerate.¹⁸⁹

The main hope is on biofuels that could eliminate the oil dependence entirely. Other investments are however made in the aircraft industry, such as introducing lighter aircrafts

¹⁸² European Conference of Ministers of Transport (2007)
¹⁸³ Enell, Magnus. External expert, Swedish Government’s Council for Sustainable Development. 2007-11-01
¹⁸⁴ Swahn (2007), p. 113
¹⁸⁵ Kahn Ribeiro et al. (2007)
¹⁸⁶ Virgin Green Fund <www.virginfuels.com> 2007-11-07
¹⁸⁷ European Commission (2006)
¹⁸⁸ Robertson (2007)
¹⁸⁹ Swedish Civil Aviation Authority <www.lfv.se> 2007-11-08

and new engines to improve fuel efficiency.¹⁹⁰ European aircraft research and airlines predict that by year 2020, planes have been developed with 50 percent less fuel consumption and 80 percent less emissions of NO_x compared to today.¹⁹¹ IATA announced this summer that their vision is that by 2030, aircrafts will account for zero CO₂ emissions. According to Niels-Eirik Nertun, Environmental Director at SAS, in about 15 years from now focus will be on eliminating other emissions. IATA's vision is that by year 2050, all other emissions will also be zero.¹⁹²

The airline companies moreover try to be inventive in the way they operate in order to further cut the emissions. Virgin has for example started to tow their planes to the runway at Heathrow.¹⁹³ SAS has together with the Swedish Civil Aviation Authority initiated a project called "Green Approaches", with the intention to reduce the fuel consumption. A flight with a "green approach" does not take off until the flight path and permission to land have been set. The shortest possible path is selected and with no waiting time in the air, a successive descent begins from the cruising altitude to the runway. In 2006 around 800 green approaches were performed and the results have been positive, showing an average fuel saving of about 100 kg per landing which is the equivalent of a reduction in CO₂ emissions of just over 300 kg. Another benefit with this type of flight is that the noise around the airport is reduced. Considering that SAS Group airlines makes an average of 1,515 landings per day, green approaches bring great potential for reduced emissions. However, to be used in international traffic, much preparation is needed regarding air traffic control systems and coordination between air traffic control and the cockpit.¹⁹⁴ With existing technology, SAS' goal is to cut emissions by 5-7 percent through the fuel saving programme where the green approach is included.¹⁹⁵

Some of the airlines, for example British Airways and SAS, offer a service where the customer can calculate how much CO₂ emissions they contribute with from the particular flight. A price is then set on the emissions. If the customer decides to pay for the emissions, the money is invested in energy projects that replace fossil fuels with alternative fuels. This type of initiative will eventually be replaced by the EU ETS.¹⁹⁶

5.2.2 Road

Various investments are made within the automotive industry to reduce GHG emissions by making cleaner and more fuel efficient vehicles.¹⁹⁷ Furthermore, there is a trend towards replacing petrol with biofuel.¹⁹⁸ Biofuel can directly substitute petrol and diesel as well as be integrated in the fuel supply systems.¹⁹⁹ Other alternative fuels are e.g. ethanol, natural gas, propane and hydrogen.²⁰⁰ When assessing the environmental impact, not only the emissions from combustion of alternative fuels can be considered. To understand the best option, a complete lifecycle assessment should be performed.²⁰¹

¹⁹⁰ Robertson (2007)

¹⁹¹ Swedish Civil Aviation Authority <www.lfv.se> 2007-11-08

¹⁹² Nertun, Niels- Eirik. Environmental Director, SAS. 2007-11-15

¹⁹³ Frøyland (2007)

¹⁹⁴ SAS Group (2006)

¹⁹⁵ Nertun, Niels-Eirik. Environmental Director, SAS. 2007-11-15

¹⁹⁶ *ibid*

¹⁹⁷ European Commission (2006)

¹⁹⁸ Robertson (2007)

¹⁹⁹ European Commission (2006)

²⁰⁰ <www.fueleconomy.gov/feg/current.shtml> 2008-01-02

²⁰¹ Enell, Magnus. External expert, Swedish Government's Council for Sustainable Development. 2007-11-01

According to Magnus Enell, external expert for the Swedish Government's Council for Sustainable Development, ethanol can to a large extent replace petrol and diesel. Enell nevertheless argues that the use of alternative fuels is only a transition period before the fuel cells take over as energy source. He believes it will be in use in about 15 years, but not commercially viable until 25 years from now.²⁰² Fuel cells produce electricity, with water and heat as its only by-product and it is two to three times more efficient than fuel combustion.²⁰³

Projects are currently also conducted with the aim to power trucks with hydrogen gas and the hopes are high. One of the initiators is a Public-Private-Partnership called "Hydrogen in Sweden" with Schenker as one of the members. A difficulty with hydrogen gas is that it has to be delivered under high pressure which makes it very difficult to distribute.²⁰⁴

Finally investments are made in developing improved electrical vehicles. Focus is on increasing driving range, decreasing recharging time and replacement frequency etc. These factors together with weight and cost will ultimately determine the future for the electrical vehicles.²⁰⁵

Due to safety reasons there are length restrictions on trucks but in order to achieve more effective road transports road trains have been introduced on certain major roads in some countries, for instance Australia.²⁰⁶

5.2.3 Rail

Investments in research and development within the rail sector are made with the goal to increase speed, reduce cost, improve safety and comfort and increase punctuality. In order to reduce the CO₂ emissions, mainly for electrical trains, investments are made to reduce the train weight and aerodynamic resistance, regenerate braking and improve efficiency of the propulsion system. For trains powered by diesel, engines investments are made in diesel switchers, including common rail injection system as well as onboard use of braking energy in diesel-electric vehicles.²⁰⁷

One of the negative aspects of rail transport is the long transit time. Many companies are therefore interested in finding an effective way to load the goods from trucks to rail. One idea on how to do this is to drive the truck up on a ramp onto the train.²⁰⁸

5.2.4 Sea

The commercial vessels in use today generally do not have the best available environmental technology. If the technologies were to be more widely used, the negative environmental and health impact would decrease significantly.²⁰⁹

²⁰² Enell, Magnus. External expert, Swedish Government's Council for Sustainable Development. 2007-11-01

²⁰³ Fuel Cells 2000 <www.fuelcells.org> 2007-11-07

²⁰⁴ Jadsén Holm, Monica. Environmental Coordinator Sweden, Schenker AB. 2007-11-27

²⁰⁵ <www.fueleconomy.gov/feg/evtech.shtml> 2008-01-02

²⁰⁶ Swahn, Magnus 2007-12-03

²⁰⁷ Kahn Ribeiro et al. (2007)

²⁰⁸ Trouvé, Johan. Branch Manager for Gothenburg, Schenker AB. 2007-11-15

²⁰⁹ Clean Shipping Project <www.cleanshippingproject.se/projektet.html> 2007-12-06

5.3 Findings from the development within each mode

In this section the reader is provided with a short summary of the external factors affecting the four modes. Since SEMC's main mode of transportation is air, an overview of the findings from the external analysis concerning this mode is presented with a time line in figure 5.2. Table 5.2 summarizes the findings in the external factors analysis of the four modes.

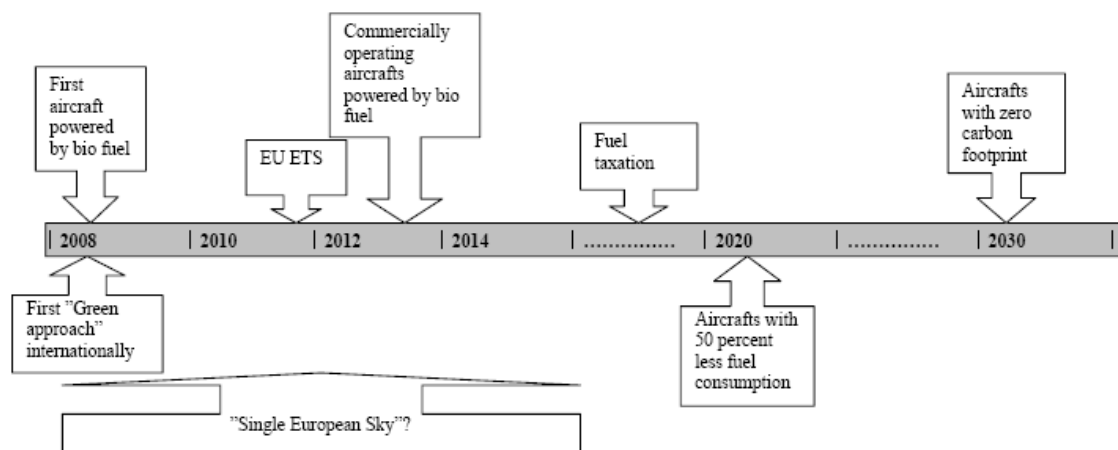


Figure 5.2. Time line for regulations, market incentives and technological development within aviation

Table 5.2. A summary of the external factors within the four modes

Mode	Bodies of regulation	Regulations & market incentives	Technology development	Obstacles	Comments
<i>Air</i>	The European Union	See figure 5.2	Biofuel New materials Improvement in energy efficiency	The safety aspect makes the testing of alternative fuels and technology limited	The EU intends to control the growth in air traffic
<i>Road</i>	The European Union The government in each country	Carbon and fuel taxes Tolls Subsidies for biofuel	Cleaner vehicles Alternative fuels Vehicle length	Traffic congestions	Shift towards other modes promoted by the EU
<i>Rail</i>	The European Railway Agency	Development of common safety and technical regulations for EU's member states Initiatives for development of intermodal terminals	Increase speed, reduce cost, improve safety and increase punctuality Equipment for effective loading of goods from truck to rail	Incompatibility of technical and security regulations Lack of infrastructure No close connection between rail, sea and inland waterways in Europe Expensive to invest in development of infrastructure Sensible to disturbances and long transit time	Mode promoted by EU
<i>Sea</i>	United Nations Convention on the Law of the Sea The Marpol convention Annex VI	Abolishment of customs control within the EU Vessels are excluded from electricity tax when connecting to onshore power supplies in port		No close connection between rail, sea and inland waterways within Europe Long vehicle life time Commercial vessels do not have best available environmental technology	Emits relatively low levels of CO ₂ , more focus on NO _x and SO ₂ Mode promoted by EU

The regulations together with increased supervision of their fulfilment will increase the costs for the transport industry, according to Per Kågesson, Ph.D. Environmental System Analysis. Kågesson estimates the increased cost of transportation to between 20 and 30 percent in the long term. Technology development reducing the emissions will as well reduce the costs resulting from regulations. It is therefore hard to predict the cost of transportation in the future. Kågesson still believes that they will become increasingly expensive and be a larger consideration when selecting location of production sites and suppliers. However, because of many companies' low transportation costs and the price inelasticity; the increased cost will most likely not result in a reduction of volumes transported. The growth rate of transportation is nevertheless believed to be lower than the economical growth.²¹⁰

5.4 Environmental trends within the industry

This section presents how competitors and other global companies claim to work for reduced carbon footprint from their logistics operations. This is of interest to the thesis since it explores how other companies are reacting to the changes in the external environment. Furthermore, SEMC aims to be the industry leader within sustainability and thereby need to be aware of the current environmental activities within the industry.

5.4.1 Competitors

Sony Ericsson's three main competitors are Motorola, Samsung and Nokia. Summaries of the competitors' environmental work in general, and if available within logistics specifically, is presented below. The information has been gathered through environmental reports and corporate websites.

5.4.1.1 Motorola

Motorola presents environmental reports and communicates their environmental work on their website. They state that the threat from the climate change is recognised and that they work for reduced carbon footprint. In order to reduce the emissions, their objective is to increase the energy efficiency of their processes and products, and to use renewable energy where it is practical.²¹¹

Motorola are founding members of the Chicago Climate Exchange, a voluntary but legally binding organization for GHG reduction, registry and trading system. They are thereby committed to track and report their GHG emissions and to reduce the carbon footprint by 6 percent by year 2010, with year 2000 as baseline. Motorola are also members of the Carbon Disclosure Project (CDP). This membership encourages them to report GHG emissions and to set up strategies for examination of the impact that climate change has on their businesses.²¹² One of Motorola's environmental goals for 2010 is to reduce their emissions.²¹³ However, no goal could be found for emission reduction from the logistics operations specifically.

5.4.1.2 Samsung

Samsung also present their environmental work on their website and in environmental reports. Samsung states that they have adopted a proactive stance to global warming and that they are engaged in several activities to help prevent it. They target five areas for improvement:

²¹⁰ Kågesson (2007)

²¹¹ Motorola <www.motorola.com> 2007-12-18

²¹² ibid

²¹³ Motorola (2006)

Greening of Management, Greening of Product, Greening of Process, Greening of Workplace and Greening of Communities.²¹⁴

They claim on their global website that they are the industry leader regarding the reduction of the environmental load. They say this position have been achieved by reducing the substances that contribute to global warming, energy control, development of products that conserve electricity and reduction of energy use. They also target production processes and development of new technologies that reduces the required amount of various input material and industrial water. When it comes to the emissions from logistics, Samsung has worked to reduce these emissions by decreasing the transportation distances. This has mainly been achieved by improvements in the distribution system made with help from transportation route optimization software and a transport management system.

Samsung has initiated a project called the “Catch CO₂ 1030 project”. It aims to reduce the emissions of substances that contribute to global warming in the energy category by 30 percent by year 2010 from the levels of 2001.²¹⁵

Samsung has also initiated projects to reduce packaging material. They have for one of their TV types started to consider maximising delivery efficiency, from product design to packaging design. By changing the external appearance of the product, the packaging volume decreased. The result was a 66 percent cost reduction of distribution when the shipment is from Korea to LA, U.S.A.²¹⁶

5.4.1.3 Nokia

Just like Motorola and Samsung, Nokia reports extensively on its environmental work. According to their environmental reports, Nokia aim to be a leader in regards to their environmental work. They strive to achieve this by producing sustainable products and developing environmentally sound business practices. Their environmental focus is within the three following areas: substance management, energy efficiency as well as take back and recycling. They perform life cycle assessments in order to reduce the environmental impact of their activities and products.²¹⁷

Nokia are working with the packaging of their products to be more environmentally friendly. They have been exploring a reduction in size of the final packaging solution. Their efforts have reduced the amount of packaging materials by 54 percent compared to the previous solution. Furthermore, the recycling ability of the packages increased as the same paper-based material was used on the inside and on the outside of the package. Finally, the transportation efficiency has doubled as a result of the smaller size. To clarify the effects from the new packaging solution, in year 2006 Nokia shipped 60 million devices in this new package and the final result was 1200 less trucks required.²¹⁸

Nokia reports on their carbon footprint with quantitative figures on their website²¹⁹, something that neither Motorola nor Samsung do. No information could however be found about emission reduction targets within logistics.

²¹⁴ Samsung Electronics (2006)

²¹⁵ Samsung Electronics (2005)

²¹⁶ Samsung Electronics (2006)

²¹⁷ Nokia (2006)

²¹⁸ ibid

²¹⁹ ibid

5.4.2 Industry in general

In a survey created by Eyefortransport's, a worldwide partnership for environmentally responsible transportation and logistics, 536 transport and logistics professionals from different industries worldwide were interviewed about the greening of their logistics operations and transportation. As illustrated in figure 5.3, the study showed that the green issues were considered most important among European companies, which could be explained by Europe being introduced to these issues earlier. Middle East and Asia had most respondents considering green issues very important, but they also had the most participants considering it not important at all. This could be indicating that green issues are important only in some sectors at the moment.²²⁰

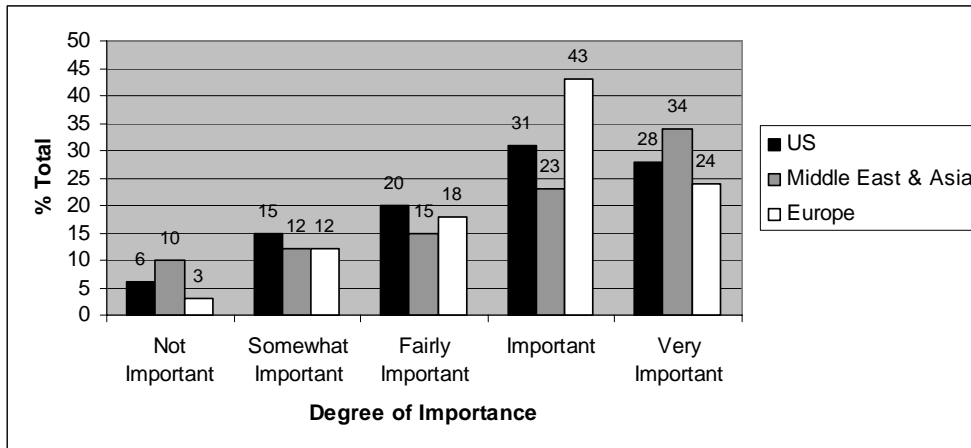


Figure 5.3. Importance of green issues to companies' overall strategy by region²²¹

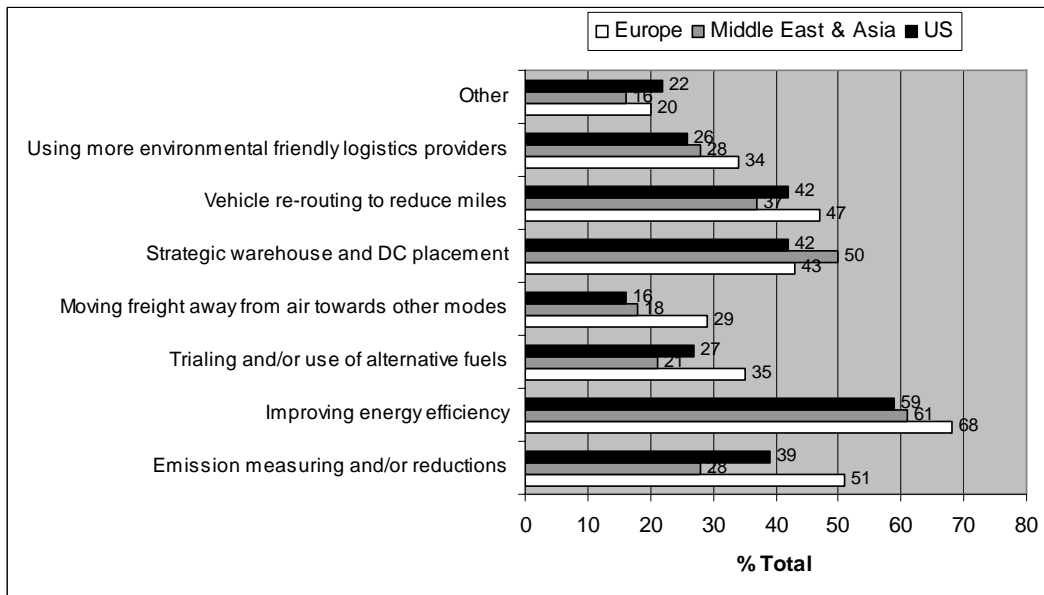


Figure 5.4. Current or planned green transportation and logistics initiatives by region²²²

Figure 5.4 shows the most frequent green initiatives in the different regions. Improvement of energy efficiency is most common followed by warehouse and DC placement, reduced miles and in Europe emission measuring and/or reductions. In addition to the means mentioned in

²²⁰ Eyefortransport (2007), p.14

²²¹ ibid, p.14

²²² ibid, p.26

figure 5.4, respondents pointed out product design and packaging, recycling programs, the U.S. Environmental Protection Agency's (EPA's) SmartWay Transport Partnership (SmartWay)²²³ which is a collaboration between EPA and the freight industry with one aim to reduce GHG emissions.²²⁴ Furthermore technologies like RFID and GPS, maximizing loads, monitoring fuel use, staff training, routing efficiency, shift of mode from road to rail, short sea transport, carbon offsetting and carbon trading were mentioned.²²⁵ The different initiatives for each region are found enclosed in appendix 3.

5.5 Findings from the trends within the industry

The study of the competitors showed that all three companies are expressing their concern for climate change. They also provide environmental reports and information about their environmental work on their websites. Regarding climate change, it is mainly the work with energy efficiency that is targeted according to the environmental reporting. Nokia however presents examples of practice for reduced need of transportation through their work with packages.

Samsung states that they are the industry leader in reducing the environmental load and Nokia state that they aim to be the environmental leader. Consequently, the competition for this title is believed to be tough. A summary of the initiatives for reduced emission levels presented by the competitors and in the Eyefortransport study is presented in table 5.3.

Table 5.3. Summary of identified green initiatives, by competitors and by industry in general

Area	Findings	Comments
Green logistics management	Emission monitoring and reduction	
	Monitoring fuel use	
	GHG emission reduction targets	Motorola: At least 6% by 2010 compared to levels in 2000 (not specifically from logistics) Samsung: 30% by 2010 compared to levels in 2001 (in the energy category)
	Environmental reporting	
	Membership in environmental collaborations and organizations	Motorola: Chicago Climate Exchange, CDP
	Carbon offsetting and trading	
Logistics structure	Strategic warehouse and DC placement	
	Vehicle re-routing to reduce miles	Samsung: By introducing new software
Mode selection	Modal shift from air towards other modes	
	Shift from road to rail	
	Short sea transport	
Carrier selection	Increased use of alternative fuels	
	Using more environmentally friendly logistics providers	
Fill rate	Reduced packaging	Nokia: New solution resulted in doubled transportation efficiency due to smaller size Samsung: Reduced cost of distribution by 66 % due to modification of product and package for a TV model.
	Maximising load factor	

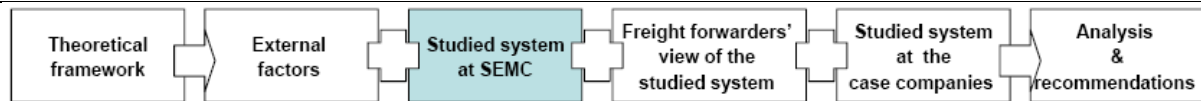
²²³ Eyefortransport (2007)

²²⁴ SmartWay Transport Partnership <www.epa.gov/smartway> 2008-01-02

²²⁵ Eyefortransport (2007)

6 The studied system at SEMC

To be able to recommend SEMC how to reduce their carbon footprint, the current processes must first be mapped and understood. This chapter will therefore present the studied system at SEMC. It includes the current focus in the supply chain and a description of the green logistics management. It is followed by an examination of the logistics structure, the selection of mode and freight forwarder and finally the work to increase the fill rate.



6.1 Current focus in the supply chain

SEMC has during the last years developed their supply chain to be customer integrated and work with solutions such as Vendor Managed Inventory (VMI) and Collaborative Planning Forecasting & Replenishment (CPFR). CPFR is a sales planning process where SEMC together with the customer reviews the performance, stock levels and the forecasts based on the commercial and marketing plans. By creating transparency they become quicker at responding to changes in the market. Other means to customer integration is development of new sites, local solutions and distribution set-ups. SEMC strive to improve several aspects in the supply chain including the order to delivery lead-time where they today are behind the competition but also in areas where they are on par with competition as in sustainability, customer focused solutions and delivery quality.²²⁶

6.2 Green logistics management

SEMC's vision is to be the industry leader in sustainability. They intend to go from compliance to be business driven, not only fulfilling the legal requirements, but to be ahead and find competitive advantages by profiling themselves as green.²²⁷ In order to achieve this vision, SEMC has initiated a sustainability program. This program does not only consider the environmental issue but aim as well to develop the social and economical aspects. The vision for a sustainable future involves fair treatment of the workforce, community involvement and proactive environmental conservation. A life cycle approach is applied to product development that takes into account design, manufacturing, product use and end of life treatment of all products in order to reduce global resource consumption and emissions to air, land and water.²²⁸

There are many reasons to why SEMC believes sustainability is an important area to work with. They believe it can make their existing employees keep their heads high, help the company attract the right people and improve the team spirit. Sustainability issues also create new business opportunities and can help build a more attractive brand. To work proactively for sustainability can also be a necessity for surviving in the industry since recycling and substance requirements become global and can cause shipment stops and breaches which can be devastating for the business. Customers' requirements are another driving force behind the effort put into the sustainability area. Moreover, SEMC is aware of their carbon footprint and consider it their responsibility towards the society to reduce it. Being a multinational company

²²⁶ SEMC Intranet 2007-10-01

²²⁷ Pellbäck-Scharp, Mats 2007-09-27

²²⁸ SEMC Intranet 2007-09-26

with global participation, the company can also help spread knowledge and develop awareness in China and other developing countries.²²⁹

6.3 Logistics structure

Before the joint venture with Sony, Ericsson had sold off all of their production sites to Flextronics. However, today one third of the production is made in-house; the rest is outsourced to the partner companies Flextronics, Arima, Foxconn and Sagem. 75 percent of the production is situated in China, but they have additional production sites in Japan, Malaysia, India, Mexico and Brazil. The introduction of the last two was custom duty driven and they serve only the regional markets. However, since the factories do not provide the complete product range, some products are still imported. The sites in India are recently introduced and serve today only the local market but will expand and include also R&D in the future.²³⁰

Some production sites, the so called EMS, are only responsible for the manufacturing and are provided with finished designs and help with the processes from SEMC. Others, the so called ODMs have their own R&D and they design products after specifications given by SEMC. The production sites manufacturing the complete product with exception from software and battery are called KRH production sites.²³¹ For the location of these sites, see figure 6.1.

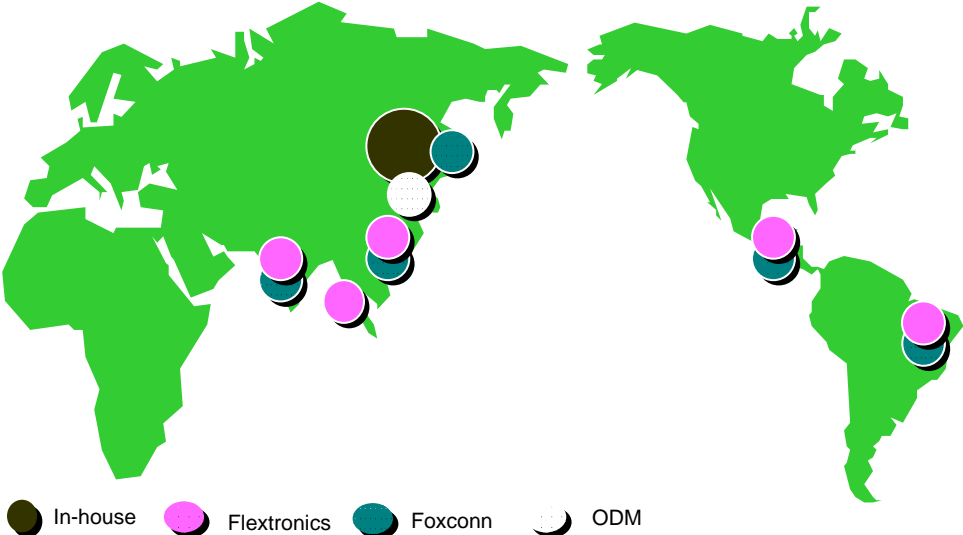


Figure 6.1. KRH production set-up 2007²³²

For an overview of the flow of finished handsets, see figure 6.2. Japanese production facilities are not included in the chart and these also serve the local market only.

²²⁹ Pellbäck-Scharp, Mats 2007-09-27
²³⁰ Axmin, Sven 2007-10-04
²³¹ ibid
²³² SEMC Intranet 2007-10-09

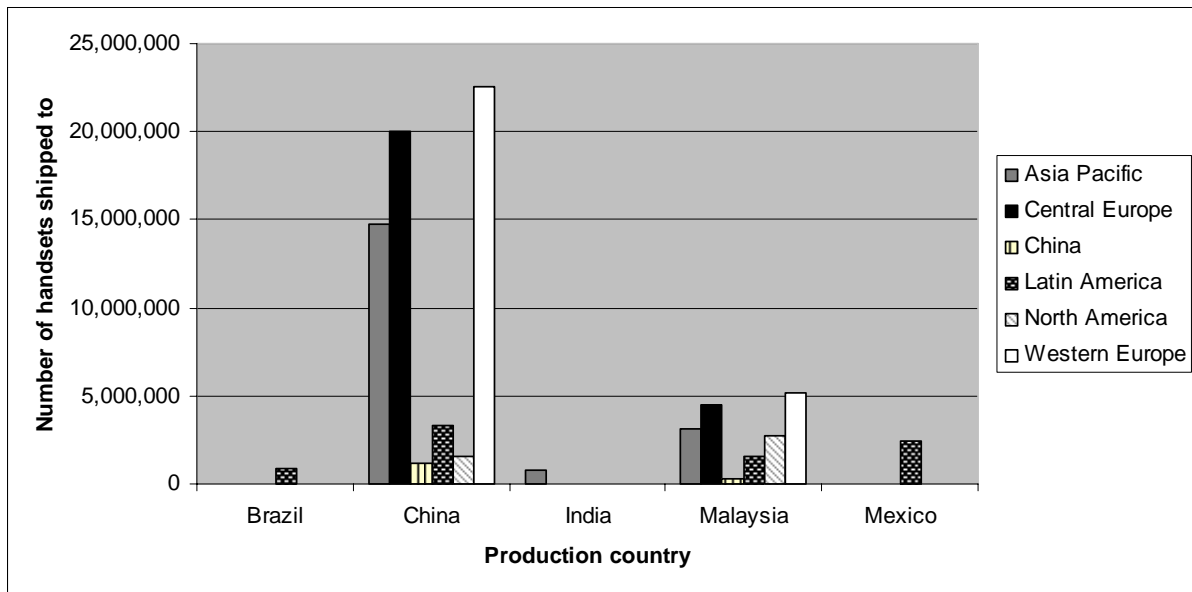


Figure 6.2. Flow of handsets from country of production to regional markets²³³

China is as shown the major producer and exports the greatest volumes within the Asia Pacific region and to Europe. Two years ago SEMC took over the responsibility for organizing the transport services to customers from the production sites. The distribution set-up has since changed so that instead of having all production sites sending their products directly to customer, products from the different production sites are consolidated and sent to customer in one shipment.²³⁴

SEMC's logistics structure is characterized by direct shipments. They do not have any regional distribution centres for storing or customization but they have several hubs worldwide. The hubs are terminals where goods are transferred for further transport. In Europe these are located in Luxemburg, Frankfurt and Amsterdam.²³⁵ They however had regional warehouses and customization centres before the direct shipment set-up was introduced in 2005. The inventory control for semi-finished goods was however complex since there were several different variants but no common KRH standard. The result was that the customization centres did not fulfil its original purpose; to enable shorter lead-times. To simplify the inventory control and reduce stock levels, customization centres were closed down.²³⁶ A positive aspect with the customization centre was that the handsets could be shipped in bulk to the centre, which enabled 2000 handsets to be transported in the same volume that SEMC today transports 240 handsets.²³⁷ It is currently under discussion if customization centres should be set up closer to the markets again, with the intention to decrease the lead-times and thereby be able to win orders that they today are unable to deliver.²³⁸

During 2007 SEMC shipped approximately 100 million phones. The normal transportation time from factory in China to the global customers is around one week.²³⁹ The direct shipment

²³³ Berglund, Monica 2008-01-02

²³⁴ Axmin, Sven 2007-10-04

²³⁵ Berglund, Monica 2007-10-17

²³⁶ Richter, Charlotte 2008-01-11

²³⁷ Ehrling, Stefan 2008-01-08

²³⁸ Richter, Charlotte 2008-01-11

²³⁹ Axmin, Sven 2007-10-04

set-up has resulted in lead-times that often are longer than for the competitors.²⁴⁰ SEMC is aiming to reduce their order lead-times, the time from order to delivery, to seven days in year 2008, compared to about 22 days in 2005.²⁴¹

SEMC has three different types of ordering systems today. The most common one is illustrated in figure 6.3. Finished handsets are in general delivered to customer’s centralized warehouses. A small part of the volumes are ordered according to the VMI concept where a customer order is equal to a replenishment order to SEMC’s own warehouse. VMI is today only used in Canada but will most likely be more common in the future. Vodafone use a so called VMR, Vendor Managed Replenishment, which is a set-up where the customer owns the stock, but the supplier has the right to replenish within a certain maximum and minimum level.²⁴² SEMC are fairly restrictive with VMI implementations and use it only for mature customers and on their initiatives. Before the introduction of VMI, they want to communicate the meaning and significance by implementing CPFR.²⁴³

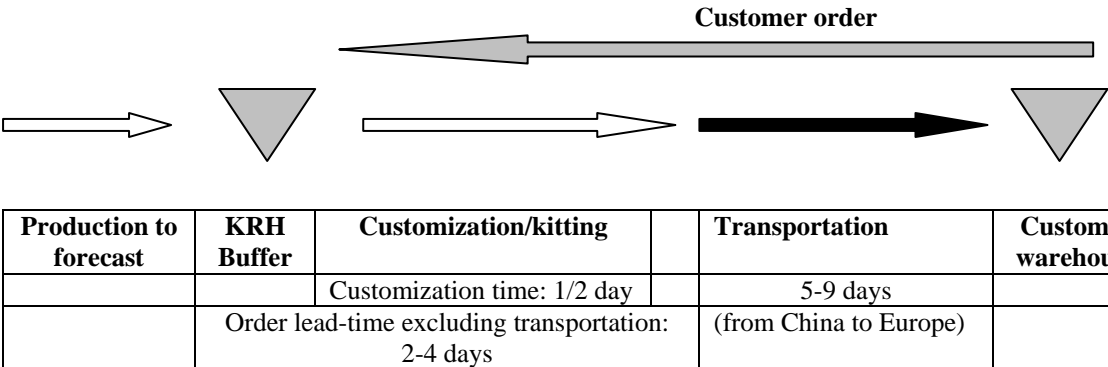


Figure 6.3. SEMC’s ordering system and lead-times²⁴⁴

The customization is today performed at the KRH production sites and handsets are there put together in their final packages, the so-called sales items.²⁴⁵

Sales units at SEMC are currently working together with supply to create a more controlled and focused flow of goods. The idea to introduce weekly execution is discussed, having customers ordering once a week at a given cut off day. Only one shipment to each region will then be required. This is believed to result in reduced reliance on forecasts in high demand fluctuation countries and increased utilisation of available production capacity over regions. The idea is also that it will benefit customers through shorter customer perceived delivery lead-time, consistency in deliveries, improved reliability etc. They also work to consolidate goods to each operator so that they only receive deliveries once a week.²⁴⁶

6.4 Mode selection

Most of SEMC’s products are delivered by air. The Asian sites have global production and large volumes are distributed out of Beijing, Shanghai and Hong Kong. Aircrafts used are passenger planes, pure cargos and if the volumes are large, chartered aircrafts.²⁴⁷

²⁴⁰ Axmin, Sven 2007-10-04
²⁴¹ Richter, Charlotte 2007-12-21
²⁴² ibid
²⁴³ Persson, Mikael 2008-01-15
²⁴⁴ Richter, Charlotte 2007-12-21
²⁴⁵ ibid
²⁴⁶ Persson, Mikael 2008-01-15
²⁴⁷ Axmin, Sven 2007-10-04

For the local customers within Asia, the most common mode of transport is road freight. The deliveries of handsets from the hubs in Luxemburg, Frankfurt and Amsterdam to customers within the EU are also by road.²⁴⁸ SEMC does not use rail freight and does not see it as an option because of their short lead-times and their direct shipment set-up.²⁴⁹ Furthermore earlier trials by other companies have shown security problems in the rail sector. Since SEMC have high-value products it is important that safety is assured for rail transport to be an option. Packaging solutions that would reduce the risk for theft is currently under development.²⁵⁰

SEMC has recently shifted mode from air to sea for some handset models on the route Hong Kong to Mexico. This has resulted in an increased delivery time and today the transport time to customer is three weeks. However, the cost is only one fifth of that of air freight and as an additional effect it brings environmental savings. According to the figures presented in the theoretical framework, these savings can be around 50 times lower CO₂ emission levels. Still, due to the cost of tied-up capital and the importance of having short time-to-market, only simpler standard handsets are delivered by sea today.²⁵¹

6.5 Carrier selection

To simplify the new set-up where products from the different production sites are consolidated, SEMC decided to use only one freight forwarder per region.²⁵² The forwarder has the door-to-door responsibility, from the production sites to the customer. If the forwarder specializes in air freight, like Panalpina does, they use subcontractors such as Schenker and TimeShuttle for the road freight. They are then also responsible for the subcontractors' fulfilment of SEMC's demands.²⁵³

The procurement of transport services is currently repeated once every two years. When selecting freight forwarder, several factors are taken into consideration. One of the most crucial factors is high capacity in air freight. This capacity can be seen as the bottleneck when it comes to transportation, especially around certain periods of the year such as Christmas and the Chinese New Year when the competition is fierce among companies for the available capacity. Usually around these seasons, the lead-time increases by a day or two.²⁵⁴

On top of a high capacity, the forwarder also need to offer a spread of risk, which means that they should be able to provide different types of transport, such as passenger planes, pure cargos and chartered aircrafts. It is also vital that they can offer daily departures and have an information system that supports EDI and some kind of Track-and-Trace system that can provide real time information. Most forwarders can provide the tangible part of the transport. However, the performance on the intangible aspects varies between forwarders and is by SEMC considered just as important.²⁵⁵ SEMC sees information as particularly crucial for the partnership to be a success. They have worked a lot with their suppliers in order to improve this, and it has paid off. However, they still demand more visibility in the supply chain. If a shipment is delayed in the beginning of the route, then it should be acknowledged and

²⁴⁸ Axmin, Sven 2007-10-04

²⁴⁹ Berglund, Monica 2007-10-17

²⁵⁰ Ehrling, Stefan 2008-01-08

²⁵¹ Axmin, Sven 2007-10-04

²⁵² *ibid*

²⁵³ Berglund, Monica 2007-10-17

²⁵⁴ *ibid*

²⁵⁵ Compare with figure 4.6

appropriate measures should be taken to prevent a delay in delivery or to at least forward the information to the customer. Other information requested in the procurement process is if there are alternative transport solutions. Also strict safety requirements must be followed.²⁵⁶

Delivery accuracy is the most important factor for SEMC; the goal is 100 percent. Lead-time is also important but for customers it is often more important knowing when the products will be delivered than having the lead-time reduced by a day. In order to pass this message on to the freight forwarders, SEMC has a bonus and penalties program. If the supplier has higher delivery accuracy than stated in the contract, they get a bonus, and if they can not deliver on time they get penalized. 100 percent accuracy gives a bonus of six percent of the price. With this system SEMC encourages their suppliers to prioritize their products when they are short on capacity.²⁵⁷

The environmental aspect is becoming increasingly important in the evaluation. Only the transport providers that fulfil SEMC's environmental requirements continue to the final negotiations. The environmental factor is as well taken into consideration in the final decision. Regarding the environmental performance, SEMC requires the freight forwarders to:²⁵⁸

- Have an environmental management system
- Consider the environmental aspects when selecting vehicles and fuels
- On request can provide SEMC with figures on energy use and emissions for the transport of their products.
- Use most efficient and optimized carrier means to minimize the environmental impact.

SEMC are working in close partnerships with their suppliers. They have meetings each quarter with suppliers and representatives from the sales companies where they discuss the suppliers' delivery accuracy, communication etc. from a strategic perspective. It is important for SEMC to predict potential circumstances and formulate all demands properly in the terms of the contracts as it otherwise is difficult to make demands on the freight forwarders.²⁵⁹

6.6 Fill rate

The contents in the sales items²⁶⁰ are the handset, charger, CD, instruction manuals, cables and headset. The cables and the headset are packaged in plastic bags and the complete contents are packaged in a cardboard box. SEMC is restrictive when it comes to changes in the contents and better cooperation with customers to test new solutions could help bring new opportunities. Regarding manuals there is a trade-off between the amount of products in the system and the weight, since manuals in only one language reduces weight but also reduces the flexibility.²⁶¹

When it comes to the design of the packages, the design team have until now not been designing for logistics, but solely for marketing purposes. This is however changing because of the increased attention to the cost of transportation and the possibilities that exists to reduce it. SEMC are consequently working to optimize the efficiency of packages throughout the distribution chain. Furthermore, some customers are requesting a smaller package for delivery

²⁵⁶ Berglund, Monica 2007-10-17

²⁵⁷ ibid

²⁵⁸ ibid

²⁵⁹ ibid

²⁶⁰ SEMC denomination for final package

²⁶¹ Ehrling, Stefan 2008-01-08

to the final customer through the regular mail system. The communication between the logistics department and the designers is therefore increasing.²⁶²

Focus when designing packages is on weight as well as on volume. In air transportation weight is determining the price for delivery of normal sized pallets. Much of the focus is therefore on creating a pallet with as light weight as possible that still is durable and fulfils handling requirements. The size of the pallet is also changed to be optimized for air transportation instead of for trucks as today.²⁶³ Optimization of pallets is however complicated due to the differing requirements from freight forwarders, customers, their logistics partners and the consumers. Quality is also an issue because if the packaging material does not protect the goods properly this could involve transport of goods that later gets discarded. SEMC is therefore putting a lot of effort into the design of pallets.²⁶⁴

Furthermore, work will be initiated to create a packaging solution for deliveries of small order quantities, mainly for delivery within SEMC. Today these are transported in the same pallets as larger orders, resulting in unnecessary space and use of packaging material. It is also discussed at SEMC that sales people should not accept small orders for entry-level phones. It is however argued that this initiative should not only include entry-level phones, but all phones.²⁶⁵

6.7 Summary of SEMC's characteristics

Table 6.1 summarizes the information gathered from the mapping of the studied system at SEMC and presents the characteristics of SEMC's products and supply chain.

Table 6.1. The characteristics of SEMC's products and supply chain²⁶⁶

Factors	Characteristics	Comments
<i>Product</i>	B2B, high value per weight unit	100 million handsets shipped in 2007
<i>Lead-time</i>	~ 2 weeks	From customer order to delivery
<i>Product lifecycle</i>	~ 18 months	Various between different type of handsets
<i>Customers</i>	Global	Operators, retailers and distributors
<i>Production</i>	Global	Sites in China, Japan, Malaysia, India, Mexico and Brazil
<i>Distribution set-up</i>	Ship- to-order Direct shipments	Direct shipments mainly to customer's warehouses. Hubs worldwide. Minor volumes ordered and shipped according with the VMI and VMR concepts.
<i>Transport mode</i>	Mainly air	Long distance shipments by air, except for the route China-Mexico where sea transport is used. Road used for regional customers and from hubs to customer.

²⁶² Ehrling, Stefan 2008-01-08

²⁶³ ibid

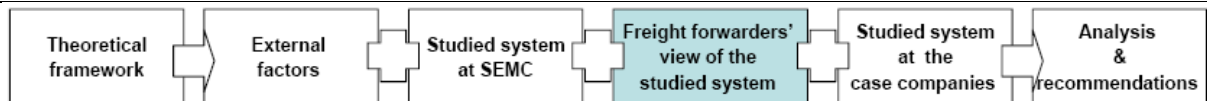
²⁶⁴ ibid

²⁶⁵ ibid

²⁶⁶ Axmin, Sven 2007-10-04

7 Freight forwarders

The aim with this chapter is to understand alternatives to SEMC's current transport set-up, explore green services and how the collaboration between freight forwarders and purchasers of their services can help reduce the environmental impact from transport. Additionally the green logistics management of the freight forwarders and their demands on carriers are explored. Finally, the forwarders' suggestions for improvements are discussed, including new transportation routes.



7.1 Brief description of the forwarders

Three major forwarders providing transport services to SEMC are DHL, Panalpina and Schenker. The information on their environmental work has been gathered both through interviews with representatives from each company and by observations on their websites. At Schenker, the main source of information was Monica Jadsén Holm, Environmental Coordinator Sweden. Additional information was collected from a seminar about transportation in the future where Johan Trouvé, Branch Manager, Gothenburg and former Environmental Manager for Schenker AG, spoke. Panalpina was represented by Anna Törmänen, Business Process and Quality Manager/HSE Manager at Panalpina Nordic. At DHL Peter Axelsson, Director Head of Supply Chain Logistics GCS EMEA, situated in Belgium, was interviewed.

All three transport providers act on a global scale. DHL offers transportation with all four modes. They are the market leaders in express and road transports as well as in air and sea freight. They own some, but not all of their vehicles.²⁶⁷ Panalpina focuses on long distance transports mainly by sea or air.²⁶⁸ They are the third largest air forwarder and fourth largest sea forwarder in the world.²⁶⁹ Land transport is limited to transportation to and from ports and airports. They do not own any of the vehicles themselves.²⁷⁰ Schenker has carriers from which they purchase all transports and they are the number one forwarder on road transport in Europe, second on global air transport and third on global sea transport. The company is divided into three divisions: land, air & ocean and finally logistics that are responsible for assembly and other services for their customers.²⁷¹

7.2 Customer demands regarding environmental issues

Both DHL and Schenker say they experience an increased interest in environmental demands from customers. In 2004 only 5 percent of DHL's received RFI contained questions on green issues. In 2007 these types of questions were found in 45 percent of the requests. This shows an increased environmental concern and according to Axelsson, it is the retail sector that is leading the way, with the technology sector in second place. The most common demands that DHL experience from customers are provision of alternative energy sources and to understand

²⁶⁷ DHL <www.dhl.se> 2007-12-04

²⁶⁸ Törmänen, Anna 2007-11-29

²⁶⁹ Panalpina <www.panalpina.com> 2007-11-29

²⁷⁰ Törmänen, Anna 2007-11-29

²⁷¹ Jadsén Holm, Monica 2007-11-27

DHL's position on biofuels. In addition they are requested for information on the company's approach and strategy for:²⁷²

- Environmental policy
- Environmental management system
- ISO 14001 certification
- Emission reports

Schenker, as mentioned, also experience an increased interest in environmental issues. Nevertheless, among their 42 000 customers in Sweden only a fraction have demands on environmental solutions. However, if these are major customers they can still be of great influence.²⁷³ Panalpina on the other hand does not experience many environmental demands from their customers. Törmänen states that their customers instead focus on price and lead-time. Except from demanding ISO 14001 certification, the one demand that some customers have on them is to calculate the carbon footprint from their logistics operations. It is the demands from customers that drive Panalpina's environmental work. Törmänen states that it is crucial that the demands from the customers are clear in order for a change to happen.²⁷⁴

According to Jadsén Holm it is common that the environmental departments in companies provide them with questionnaires that are later not being followed up on by the department responsible for purchasing the transport services. This shows a lack of internal communication and what was initially considered demands does not get included in the contracts. She states that it is important to include all demands in the terms from the beginning to be able to consider them. It is better if companies limit the demands only to the most important ones and those that they will actively follow up on. Additionally she claims that demands should preferably be made in dialogue with them.²⁷⁵

Previously mentioned NTM and QIII, a non profit organization aiming to improve the quality of heavy road transports have developed evaluation forms with suggested demands in conversation with forwarders. These demands include environmental management systems, fuel use, Euro Class and emission calculations.²⁷⁶ NTM's environmental evaluation of freight forwarders is attached in appendix 4. There is also a more specific environmental evaluation for air transportation included. QIII's environmental evaluation regarding freight forwarders' CO₂ emissions is to be found in appendix 5.

7.3 Green logistics management

The work for green logistics management at each freight forwarder will be explored in this section. This shows how far they have come in their environmental work and what green services they offer their customers.

7.3.1 DHL

In March 2007 DHL set up a company called The Neutral Group (TNG) to focus on the creation and execution of GHG reduction strategies for DHL and its customers. TNG works with in-house carbon consultancy and provide various services and solutions to the customers. They use the methodology to assess, reduce and neutralize the carbon output and replace

²⁷² Axelsson, Peter 2007-11-22

²⁷³ Jadsén Holm, Monica 2007-11-27

²⁷⁴ Törmänen, Anna 2007-11-29

²⁷⁵ Jadsén Holm, Monica 2007-11-27

²⁷⁶ ibid

technologies with less polluting alternatives. DHL has a green vehicle fleet but it is still modest compared to the total volumes.²⁷⁷

TNG are searching for means of emission reduction in different areas. They look at DHL's direct impact where they themselves can control emission levels as from combustion of fuels. In addition they look at purchasing more environmental electricity for their warehouses and operations and all the other indirect emission from for instance subcontractors. As the initiative is relatively new, the starting point is to make a carbon footprint assessment, set minimum standards and investigate best practices. In December 2007 clear goals are expected to be set. New global methods for emission calculations including all transport modes are under development by TNG in conjunction with the SmartWay partnership. Approximately 30 of the largest global customers are working with DHL and TNG to establish their emissions from operations today.²⁷⁸

To reduce emissions, DHL chooses efficient carriers that are ISO certified, have control and have low emissions. They also work to plan right to be able to affect transport mode, transport volumes and load factors. The environmental impact can also be reduced through improved vehicle design, transport optimisation, increased use of rail and alternative technologies. DHL and TNG are currently undertaking detailed review of air freight route emission factors and costs, and plan to propose carbon reduction options in 2008.²⁷⁹

One of the green options provided by DHL is GoGreen Express for express services often involving air transport. It is a service that combines CO₂ reporting with full offsetting of the emissions. The emission levels are calculated and the same amount of emissions are later offset in projects such as investments in alternative vehicles, solar power generation, green fuels and reforestation. All products transported with this service get a sticker on them for marketing purposes. It is available for large customers in all European countries and also for small customers in some countries. The hope is to expand both in terms of geography and product groups. Another GoGreen service is GoGreen Tonnage provided to Scandinavian customers. This service lets the customer decide an amount of their goods to be transported by alternative fuels. It might not be that specific delivery that is transported by green trucks, but DHL guarantees that an equivalent amount of goods is transported on renewable fuels elsewhere in the system. Additional GoGreen services are GoGreen Cent in Switzerland and GoGreen Parcels in Germany. Even though the green services are well received by customers, at this point very few are willing to pay the extra cost which is a few percent more than normal costs. For the future DHL is open to work together with customers and help them to evaluate the distribution set-up according to emission targets. It is the customers that are driving the changes when it comes to making ideas reality but DHL has started to look at questions as how emissions will be valued in the future and the future cost of fuel.²⁸⁰

7.3.2 Panalpina

As mentioned earlier, the environmental work within Panalpina Group is not prioritized as the head office in Switzerland does not consider the issue to be of high importance. Panalpina Nordic is the area most aware of the issue and was the first area within Panalpina to get certified according to ISO 14001 in 2004. In Panalpina Nordic they work internally to increase the awareness. They evaluate the internal environmental footprint, such as business

²⁷⁷ Axelsson, Peter 2007-11-22

²⁷⁸ ibid

²⁷⁹ ibid

²⁸⁰ ibid

travels and promote the use of alternative modes of travel for example. They have also added some of the environmental demands that Panalpina has on their carriers. One of these demands is ISO14001 certification.²⁸¹

Panalpina does not offer many green services. As mentioned earlier, they perform calculations of their customers' carbon footprints when requested. However, the great amount of different airlines and aircrafts involved means the calculations are not very accurate since simplifications and assumptions must be made. Another green service offered is calculations of the effect a possible change in a customer's logistics structure has on the CO₂ emissions.²⁸²

7.3.3 Schenker

Schenker's strategy to become an environmentally sustainable logistics provider is to:

1. "Implementing management and measurement systems to monitor and control a systematic approach to environmental issues.
2. Raise environmental awareness and competence among Schenker staff.
3. Identify and quantify the environmental impacts of current and new products and services.
4. Promote and participate in research and development in the areas of logistics, transport technology and fuels.
5. Identify potentials and initiate co-operation with customers, suppliers and other players.
6. Strive to continuously improve environmental performance and efficiency in terms of utilization of resources.
7. Set up goals and guidelines for reducing air pollution and carbon dioxide emissions.
8. Influence, set standards for and collaborate with suppliers and subcontractors.
9. Maintain and strengthen dialogues and co-operation with local, national and international environmental authorities and networks.
10. Produce and publish annual environmental/sustainability reports."²⁸³

Schenker Sweden has as a goal to halve the carbon footprint per tonne-km by year 2020. 20-30 percent of this will be achieved by an optimization of its transports, the rest will be achieved by new technology, such as hybrid trucks, biofuel etc.²⁸⁴ To achieve this goal they need to have a closer collaboration with more players, such as carriers, governments and administrators of a country's infrastructure. Schenker Sweden has a strategy that covers seven different areas of improvement possibilities. The areas are the following:

1. Eco-driving
2. Longer trucks in night traffic
3. Reduced velocities
4. Intermodality and combined traffic
5. New vehicles and better fuels
6. Increased fill rate/shorter route
7. Better planned city logistics²⁸⁵

The basis in their environmental work is considered to be their set-up with a network of hubs and terminals and fixed departures between them. It can be compared to a public transport

²⁸¹ Törmänen, Anna 2007-11-29

²⁸² ibid

²⁸³ Schenker <www.schenker.com> 2007-11-21

²⁸⁴ Trouvé, Johan 2007-11-15

²⁸⁵ Schenker <www.schenker.se> 2007-11-21

network and enable them to keep high fill rates.²⁸⁶ Tools that are used to improve the route planning are GPS and route optimization program Mobitex. All Schenker AB is ISO14001 certified.²⁸⁷ Schenker works continuously to reduce the environmental impact of their land based transports and believe it is doable to halve the CO₂ emissions by 2020 in relation to the output of transport production.²⁸⁸ It is believed that it is often the lack of planning by the customers that complicates the forwarders work.²⁸⁹

Instead of offering their customers finished green service packages, Schenker works with, and aims to keep developing, customer specific solutions. These solutions and optional structures for the customers' transports can be discussed with the respective sales departments when purchasing the transport services. If the companies let Schenker get involved early in the processes, they are able to make complete logistics investigations that include the environmental factor. Schenker Consulting AB works as independent logistics consultants and can make calculations and simulations on lead-times and costs for the whole supply chain.²⁹⁰

There are however some green services available. For instance is it possible for customers to pay an extra fee for their transport that is later invested in new environmental technology or solutions at Schenker. For sea transports they can advice their customers on green shipping options. At this point no environmental service offers are provided for aviation but they are currently mapping how airlines are handling the environmental issues through a questionnaire.²⁹¹

CO₂ emission calculations can also be provided to customers. For regular land transports these are free of charge and for other transport modes they are available at an additional fee. In Sweden the calculations of emission levels for Schenker's operations are calculated from the carriers' fuel consumption. For calculations of the emissions from road transports from one specific shipper they use an emission calculating program with three modules that they themselves developed in 1999. One module is taken from NTM and holds emission data from different modes and vehicles. The second has information about Schenker's operations including fleet, fill rate and routes. Finally the third one has the information on the customer's specific transports and together these three models automatically calculate the emissions. For air and sea transports they still need some hands on the calculations but they are aiming to automate these too.²⁹²

Schenker can fulfil most environmental demands from customers but mean that sometimes the demands do not bring the desired effect. When customer requires transports with trucks from certain Euro classes, trucks driven on biofuel or trucks with particle filters installed it might affect the overall filling rate in a negative way.

7.4 Carrier selection

In this section the environmental demands that the freight forwarders has on their carriers will be investigated. This is of interest since the forwarders mainly do not own their own vehicles

²⁸⁶ Jadsén Holm, Monica 2007-11-27

²⁸⁷ Schenker <www.schenker.se> 2007-11-21

²⁸⁸ Jadsén Holm, Monica 2007-11-27

²⁸⁹ Trouvé, Johan 2007-11-15

²⁹⁰ Jadsén Holm, Monica 2007-11-27

²⁹¹ ibid

²⁹² ibid

but purchase transport services from different carriers. The environmental demands that customers have on the forwarders therefore need to be transferred to the carriers.

DHL are working to use carriers that are ISO certified, have control and have low emissions.²⁹³ Additional information on their demands has not been obtained.

Panalpina has a questionnaire with 91 questions within Health, Safety & Environment and Security that they give all their suppliers globally. Not many of these are environmental questions. Examples of this type of questions are if they are environmentally certified, if they have demands on their suppliers and if they evaluate these, as well as what means they use to reduce their environmental footprint. These are questions, not demands but in 2008, the plan is to consider the environmental factor when selecting carriers. However, some carriers they simply have to use because of the specific rights they have, for example the right to transport goods within a certain port. If this type of supplier does not live up to the environmental demands, they can not exclude them, but then they will try to cooperate with them in order to influence and help them to fulfil the demands.²⁹⁴

Schenker calculates green performance indicators on all their carriers from a questionnaire with 60 questions where they also need to provide fuel consumption data. The performance indicators are used as an incentive for the carriers to improve their environmental performance. They are given feedback on their improvement since last year and on how well they are performing compared to the competition. Through the IT development Schenker is now able to communicate with their carriers in real time which provides new opportunities that were not available when the performance indicators were first developed and these are now considered to be replaced.²⁹⁵

7.5 Opportunities for improvement

Finally the interviewees were asked about opportunities for improvement for companies like SEMC, when it comes to reducing the environmental impact from the logistics operations. Schenker points at better communication between the shippers and their customers. It is argued that if the dialogue would open up throughout the supply chain and all parts cooperated, it would make new set-ups possible. At the same time it would help if freight forwarders get noticed earlier. Today they are often the last ones to get the information. With integration between the transport providers' and the shippers' IT-systems the transport providers could be able to see the customers call-offs in real time.²⁹⁶ Furthermore a logistics evaluation is recommended to make a specific environmentally friendly solution.²⁹⁷

Other possibilities for improvements are to change to new transportation routes. Politicians in Europe and in Asia support the search for new trade routes. Europe's current policy is to extend the trans-European networks to encompass 25 countries towards the Central Asian and CIS²⁹⁸ countries. In Asia, China is investing heavily in rail and highway infrastructure with the aim to encompass the whole country and connect to Kazakhstan, Russia and Mongolia. Furthermore the CIS countries are also adapting the infrastructure from Russia to the Central Asian and Caucasus countries, together with Iran, Kazakhstan and Turkmenistan. Countries

²⁹³ Axelsson, Peter 2007-11-22

²⁹⁴ Törmänen, Anna 2007-11-29

²⁹⁵ Jadsén Holm, Monica 2007-11-27

²⁹⁶ *ibid*

²⁹⁷ *ibid*

²⁹⁸ The Commonwealth of Independent States

further south such as Pakistan, India and Pakistan, are also gradually incorporated into a network of major links.²⁹⁹

DHL are exploring the possibility to increase the use of rail transportation for freight between Asia and Europe. Solutions exist, but many are at this point not considered practical due to the lack of infrastructure, poor safety and relatively high costs. Some routes are however actively being considered today and others as routes via Siberia are believed to be future options when safety is improved and it is profitable. Even in Europe where rail has been given attention for many years, the development has not advanced as fast as expected. It is mainly companies with large volumes that are transported long distances that use rail, e.g. automotive companies transporting goods between Turkey and Europe.³⁰⁰

Shipping by sea from China to Europe takes around 35 to 40 days which for many is considered too long. In order to benefit from the advantages of different modes and decrease time, cost and emissions, companies are exploring an increased use of intermodal transportation, mainly sea/air, but also road/rail and rail/air. A common route for products transported from Asia to Africa, Middle East and Europe is to ship goods from Asia to Dubai by sea and then fly them to the final destinations. Another route is to transport the goods from China by rail to Ürümqi (URC), located in the north-west of China, and then fly them to Europe, Central Asia or Africa (via Middle East).³⁰¹ Figures on the CO₂ emissions on the different routes have been estimated and compared. The routes are illustrated in figure 7.1.

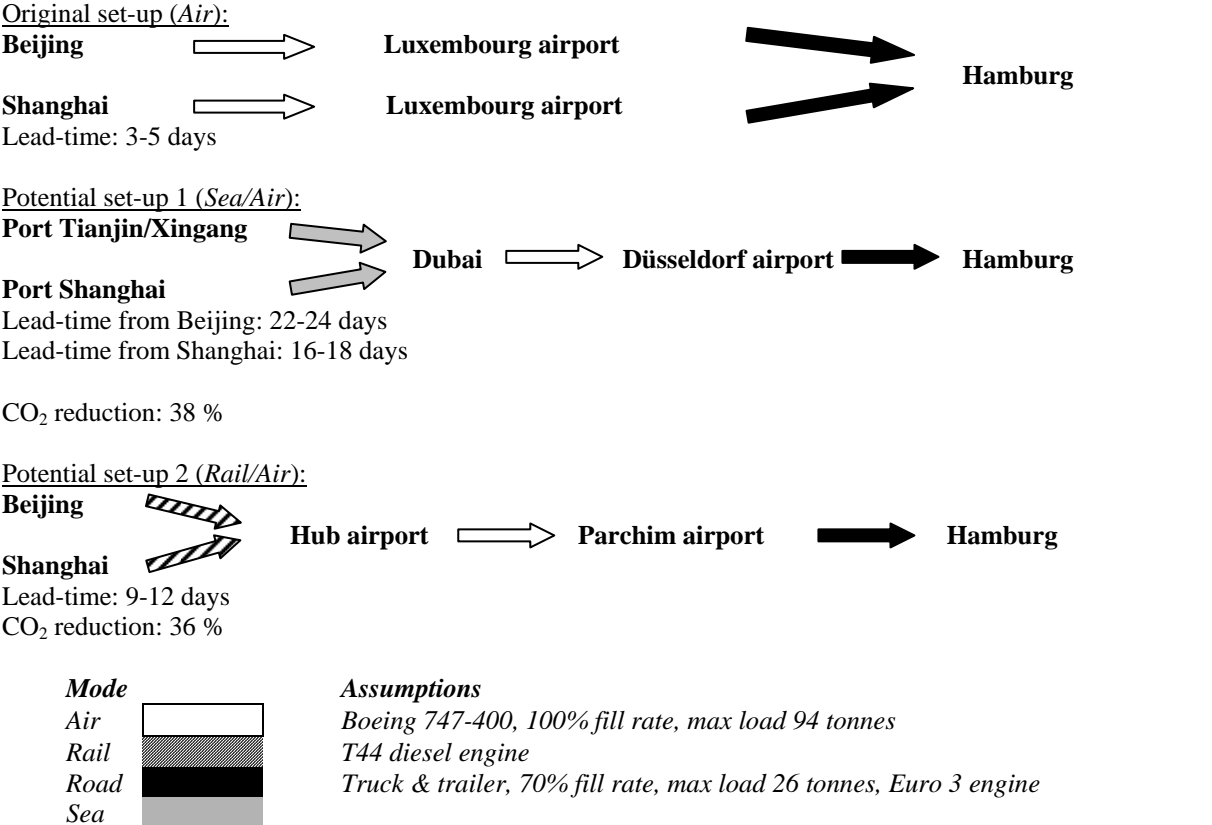


Figure 7.1. Alternative routes for distribution from China to Europe³⁰²

²⁹⁹ European Conference of Ministers of Transport (2005)

³⁰⁰ Axelsson, Peter 2007-11-22

³⁰¹ *ibid*

³⁰² Törmänen, Anna 2007-11-29

For the calculation of the CO₂ emissions, NTM Calc was used. The results were that with potential set-up 1, the CO₂ emissions were reduced by 38 percent and with potential set-up 2, the reduction was 36 percent compared to the original set-up. Test shipments with set-up 2 have been performed and proved to be satisfying. This new set-up is now offered to Panalpina's customers. Panalpina will have a weekly freight operation from URC to Europe. The new offer does not differ much from the original set-up cost wise. Positive aspects with the rail/air set-up compared to the sea/air set-up, is that port congestions are avoided and the lead-time is shorter.³⁰³

Another new potential transport route is to transport the goods north of Asia. This has up to date not been possible since the route has been covered by ice. However, now the temperature is rising and the ice is melting. This has opened up the possibility for a new route for sea freight. Norwegian shippers are looking into this.³⁰⁴

7.6 Findings

One of the major findings is that transport providers experience an increased interest in environmental issues among their customers, especially from Nordic customers. Demands are on environmental policy, certification, emission reports etc. This has also resulted in forwarders initiating the work of transferring these demands onto carriers by setting standards and increasing the collaboration with them. The study further showed that all three forwarders can provide customers with emission data. It was additionally understood that it was the customers' demands that drive the forwarders' environmental work.

In table 7.1 follow a presentation of identified environmental initiatives made by the forwarders and initiatives they recommend shippers to make to facilitate the work for reduced emissions from transport. This information can give guidance not only to areas shippers also can adopt in their work but also to areas they can include in their demands on and collaboration with forwarders. This table will later underlie the analysis of the studied system in order to construct the final recommendations.

Table 7.1. Green initiatives identified in the study of three major freight forwarders

Area	Initiatives	Comments
Green logistics management	Identification and quantifying of the environmental impacts of current and new products and services	
	Set up goals and guidelines for reducing CO ₂ emissions	Schenker Sweden has as goal to reduce its carbon footprint per tonne-km by 50 % until year 2020
	Raise environmental awareness and competence internally	
	Strive to identify potentials and initiate co-operation with customers, suppliers and other players	Promote and participate in research and development Maintain and strengthen dialogues with local, national and international environmental authorities and networks
	Implement management and measurement systems for a systematic approach to environmental issues	
	Report publicly on the environmental work	

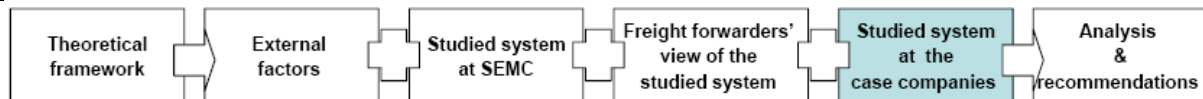
³⁰³ Törmänen, Anna 2007-11-29

³⁰⁴ Axelsson, Peter 2007-11-22

Area	Initiatives	Comments
Logistics structure	Recommends shippers to include the forwarder early in the decision making process in order to make complete logistics investigations that include the environmental factor	All three forwarders can assist with emission data of possible new logistics structures
Mode selection	Investigate new possible transportation routes	Politicians in Europe and Asia support the search for new trade routes
	Increased use of multimodal transportation, mainly sea /air, but also road/rail and rail/air	New possible transportation routes for shipments from China to Europe are illustrated in figure 7.1.
Carrier selection	Better internal communication among customers would make the communication of environmental demands less ambiguous	Today it result in that demands initially considered does not end up in the contract
	Important for shippers to include all demands in the terms from the beginning	Only the most important demands that the company intends to actively follow up should be included in the contract
	Demands should preferably be made in dialogue with the forwarders	Specific demands such as trucks from certain Euro classes or driven by biofuel can for instance effect the fill rate negatively
	Better communication requested between the shipper and forwarder	The forwarder is often the last to learn about a transport The lack of planning complicates the forwarders work
Fill rate	Earlier notice on shipments	Enables increased fill rates due to better planning

8 Case studies

This chapter presents the findings from the multiple case studies. They show how other companies react to the external factors, what areas they work with, how they work and what the result are so far. Single-case analysis of the different cases and later a cross-case analysis are performed in order to present the findings in a systematic way.



8.1 Introduction

The case studies are performed at six companies which all work to reduce the carbon footprint from their logistics operations. The first two cases are SEMC's two owners, Ericsson and Sony. The other ones are Panasonic, Sharp, IKEA and Tetra Pak. For the Case Study Protocol used, see appendix 2.

8.2 Ericsson

The contacts at Ericsson were Jens Malmodin, Research Engineer at the department EMF-Health and Safety, and Johan Jemdahl, Head of Distribution Logistics. Malmodin has worked at Ericsson for 12 years and at his current position for almost a year. His main task is to make environmental calculations such as LCA. Jemdahl has worked almost 12 years at Ericsson. The initial interviews were with Malmodin, first a phone interview and later an interview in person. To get input from the Logistics department this information was complemented with a telephone interview with Jemdahl.

8.2.1 Company presentation

Ericsson provides telecommunications equipment and related services to mobile and fixed network operators to a global market. The company was founded in 1876, and is today world-leading with over 1000 networks in 140 countries utilizing their equipment. A total of 40 percent of all mobile calls are made through Ericsson's systems. The headquarters are located in Stockholm, Sweden.³⁰⁵

8.2.2 Green logistics management

Ericsson divides its influence on the environment in two categories: direct and indirect influence. The major indirect influence that the company has on the environment is the energy consumption of their products during their lifetime. This has also been the area where Ericsson has invested most in the past. The capacity of their telecommunications equipment today is ten times larger than the original ones which have led to products being a lot smaller and weighing less. These are factors that they continue to work to improve even more.³⁰⁶

Malmodin thinks that it is crucial to measure the company's environmental impact, visualize it and communicate it internally. The difficulties that he has encountered during his work have been to collect this type of data or that the data exists, but it is hard to compile the material. He however states that not many resources are needed in order to perform this type of assessment. Measurement is the first step in the environmental work, but it is also important to set goals and to follow up these goals. Within logistics, the environmental work has

³⁰⁵ Ericsson <www.ericsson.com> 2007-10-28

³⁰⁶ Malmodin, Jens 2007-10-24

recently been initiated and to start with they need a baseline with accurate figures on their current emissions. As a first step they are now creating this baseline in order to then set targets and evaluate alternatives for CO₂ mitigation. At the same time they are working for increased internal awareness by having environmental issues on the agenda and evaluating the work.³⁰⁷ Ericsson reports publicly on their environmental work.³⁰⁸ They are also members of NTM³⁰⁹.

8.2.3 Logistics structure

The supply chain strategy at Ericsson has gone from many production sites with regional distribution to fewer production sites with global distribution. Today they have production facilities in Sweden, Italy, USA, China, Brazil and India. The production sites in Sweden, Italy and partly China and Brazil deliver to their regional markets as well as exports. The ones in Sweden and China also supply the other production facilities.³¹⁰ The products are produced to order and lead-times are on average between 14 to 30 days. The set-up today consists of many market unit warehouses worldwide but they do not use a hub system. For the future, Ericsson is working for increased regionalization.³¹¹

8.2.4 Mode selection

The largest direct influence that Ericsson has on the environment is through the transportation of its products, especially from aviation. Around one million shipments are made per year. Ericsson experiences pressure from the customers to provide short lead-times and this has resulted in that almost 60 percent of the shipments were transported by air in 2006. Road transport accounted for 30 percent and the remaining 10 percent were transported by sea. Today the CO₂ emissions caused by Ericsson's transportation are approximately 440 000 tonnes per year, where air transportation accounts for 93 percent of it. They strive to achieve a reduction in emission levels mainly by changing mode from air to sea borne transport as it is believed to have the greatest effect. The goal is to transport only 40 percent by air. Since 2003 the use of sea shipments has increased mainly due to the collaboration between Ericsson and its customers where the lead-times are discussed to see if they are possible to make longer. When customer's expectations about the lead-time can be met with sea shipments, the products have been transported with this mode. Many operators store products themselves and can therefore accept an increase in lead-time. Ericsson has mostly had positive experiences with sea borne transports to date. There have been no significant quality problems and most importantly, the cost has decreased dramatically.³¹² However, on some distances shipments by sea can be difficult due to imbalances in demand and goods may have to be reloaded which increases the transportation times. Ericsson has tried to switch over to sea on several distances previously transported by air such as India to China, China to Sweden and Europe to South Africa, Tanzania, North-, South- and Latin America. The trials have made them aware of which distances are more favourable to ship by sea. This initiative is primarily cost driven but it also has positive impact on the environment. The main obstacle to overcome in order to get even more goods transported by sea is for Ericsson to better plan their projects and to change the supply chain to a more regionalized structure where final configuration happens later in the process.³¹³

³⁰⁷ Jemdahl, Johan 2007-11-20

³⁰⁸ Ericsson, *The Environment & Sustainability* <www.ericsson.com> 2008-01-02

³⁰⁹ NTM <www.ntm.a.se> 2008-01-02

³¹⁰ Malmodin, Jens 2007-10-24

³¹¹ Jemdahl, Johan 2007-11-20

³¹² Malmodin, Jens 2007-10-24

³¹³ Jemdahl, Johan 2007-11-20

Meetings with the operators are held on a regular basis and the trade-off between time and environmental impact from transports is being discussed more and more. A problem is that in the current contracts, delayed deliveries can cause major costs from fines and bad will that can make the environmentally best option very costly. It is crucial that Ericsson works together with the operators in order to avoid this problem and reduce emissions.³¹⁴

Another concern is that providers of sea borne transport do not have the same focus on the customers and their demands on lead-times and delivery accuracy. Aviation is more driven by delivery accuracy and lead-time but instead cost is much higher. Nevertheless, Jemdahl believes that as sea shipments become more common because of the increased environmental concern, the providers will become more aware of the importance of high delivery accuracy. However, due to the size and capacity of the shipping companies, Ericsson is only a small player and can not put that much pressure on them as they can on the airlines. The final concern with sea transport is that the tied-up capital increases, but this is countered with the large decrease in transportation costs.³¹⁵

Finally, Ericsson has revised the option to change to rail transport within Europe. In other geographical areas this is not an option due to the lack of infrastructure and there are still problems even in Europe since there is no standardisation of rails and signal systems between countries. Nevertheless, they have successfully transported goods for instance from Sweden to Kazakhstan, and the emissions have on average been reduced by fifty percent compared to transportation by road on the same distance.³¹⁶

8.2.5 Carrier selection

Ericsson has outsourced their transports, primarily to Panalpina, DHL, UPS and Kuehne + Nagel. The logistics services are also outsourced to a high degree. They have yet not outsourced the customer order flow but all network planning and development, purchasing of services etc. are performed by external parts.³¹⁷ They have specific demands on the forwarders, for example that they shall provide data about the CO₂ emissions, weight and distances. In meetings with the forwarders they present how to calculate the emission levels. The formulas have been taken from ghgprotocol.org.³¹⁸ They have no demands on vehicle standards but some demands on for instance ISO certification. These demands are however not being followed up on.³¹⁹

8.2.6 Fill rate

Ericsson are working to make their products more energy efficient and thereby also to reduce size and shape of their products.³²⁰

8.2.7 Single-case analysis

The findings from the case study at Ericsson are summarized in this subchapter and it prepares for the following cross-case analysis. The characteristics of the Ericsson are described in table 8.1.

³¹⁴ Malmodin, Jens 2007-10-24

³¹⁵ Jemdahl, Johan 2007-11-20

³¹⁶ ibid

³¹⁷ ibid

³¹⁸ Greenhouse Gas Protocol Initiative

³¹⁹ Malmodin, Jens 2007-10-24

³²⁰ ibid

Table 8.1. Characteristics of Ericsson

Factors	Characteristics	Comments
Product	<i>B2b, high value</i>	Most products larger in size than SEMC's products
Lead-time	<i>14-30 days</i>	From order to delivery
Customers	<i>Global</i>	
Production	<i>Global</i>	
Distribution set-up	<i>Market unit warehouses, no hubs</i>	Going towards increased regionalization
Transport mode	<i>Mainly air</i>	60 % by air, 30 % by road and 10 % sea

Table 8.2 shows the identified initiatives in the different areas within the studied system. Positive and negative aspects of the changes made are presented as well as other experiences that they have had.

Table 8.2. Findings from the case study at Ericsson

Area	Initiative	Experiences/Benefits/Difficulties
Green logistics management	Create baseline	
	Set target for emission reduction	
	Work for increased internal awareness	
	Evaluate the environmental work	
	Dialogue with customers concerning the trade-off between time and environmental impact from transports	- Delayed deliveries can cause major costs from fines and bad will that can make the environmentally best option very costly
	Public environmental reporting	+ Not many resources are needed in order to perform the assessment - Can be hard to collect data, or to compile the existing material
	Collaborations and memberships within logistics and environment	o NTM
Logistics structure	Regionalization	+ Enables postponement
	Postponement	
Mode selection	Change of mode from air to sea	+ No significant quality problems + Reduced environmental impact + Significant decrease in cost - Difficult to put demands on the shippers - Longer transportation times - Decreased delivery accuracy o Need to better plan their projects and cooperate with operators
	Change of mode from road to rail from Sweden to Kazakhstan	+ CO ₂ emission reduction to half the levels from trucks
	Improved planning	o Discussions with customers + Enables more environmental modes
Carrier selection	Demand on measuring and reporting CO ₂ emission levels	
Fill rate	Reduce size and shape of products	
Results	No available results of today	

8.3 Sony Corporation

Yoshio Etori, General Manager, Environmental Affairs Europe at Sony Europe GmbH, was the main source of information in the case study at Sony. He has worked at Sony Corporation for 16 years and at his current position for 5 years. He answered the specific logistics related questions in consultancy with Masahiro Yamamoto at Supply Chain Solutions (Europe) B.V. The Sony website and Environmental Reports were also used during the information search.

8.3.1 Company presentation

The Sony Corporation was founded in Japan in 1946. Today they have 163 000 employees worldwide. The sales and operating revenue from March 31 2006 and a year forward was \$70,303 million. Major products are audio, video, televisions, information and communications, semiconductors and electronic components.³²¹

8.3.2 Green logistics management

Sony's definition of environmental impact from logistics includes CO₂ and other pollutants from vehicles, waste from packaging and other logistics tools and finally environmental substance in their products. Their objectives with the environmental work are to make reductions or eliminations in these three areas.³²²

The major motivation for Sony to set up an environmental program is strong concern from the management for the sustainability of Sony's operations. It is a response to growing stakeholder and customer requirements in environmental issues as well as legal requirements. According to Yoshio Etori, the new regulations in Japan have already affected the work for energy reduction in logistics operations. The areas to target globally have been selected by Sony Corporation and there have been frequent discussions internally to identify the best way to control their environmental impact. The results are now included in their global environmental action plan Green Management 2010, a new set of medium-term environmental targets to be achieved by fiscal 2010. The targets will guide Sony in their efforts to prevent global warming and in other environmental areas and they include for instance to ascertain and take measures to reduce CO₂ emissions during transport of products and other materials. Even though the emissions from logistics are lower than from product utilization and production, changes in logistics is believed to have a significant influence.³²³

Currently the greatest challenge is to find a common methodology and platform for discussions globally that will help avoid double work. As legal requirements and conditions vary between regions a large obstacle is to find a balance and harmonization worldwide. As this work is just recently been initiated, Sony has no results to present of the actions so far. Sony focuses as well on the internal education for increased awareness in environmental issues. The environmental impact is considered in logistics decisions by having the logistics department trigger discussion with business groups to find out the most environmentally friendly way to service the market, whilst making sure the business targets are still met. With a uniform method developed, they have as goal to be able to show precise measures of different options in order to get a correct basis for evaluation.³²⁴

³²¹ Sony <www.sony.net> 2007-12-05

³²² Etori, Yoshio 2007-12-03

³²³ ibid

³²⁴ ibid

Sony reports publicly on their environmental work.³²⁵ They publish a sustainability report which includes a specific section on logistics. Much information is however focused on efforts made in Japan. They are also members of collaborations within the environmental area and it has given them positive experiences and good benchmarking opportunities. One of the collaborations is the World Wide Fund (WWF) Climate Savers. This association is however not directly logistics related.³²⁶

8.3.3 Logistics structure

Sony has production sites globally, in Japan, Asia, America and Europe and production is mainly made to stock. They have 3 main hubs and 9 regional/local warehouses in Europe. Lead-time is depending on the country, region or distance but it is usually 24 to 72 hours.³²⁷

8.3.4 Mode selection

Products made in Japan or Asia are transported to Europe by sea or air to warehouses and then by trucks to customer. Within Europe they use mainly trucks and sea/rail for certain destinations.³²⁸

Modal shift from trucks to rail and sea is one of the areas of focus in Sony's environmental work and it is considered to provide large environmental savings. However, they have at this point no details and hard data that supports this. As mentioned earlier, this is something that they are currently working with.³²⁹

8.3.5 Carrier selection

Products are transported to global customers by external transport providers, which ones are used depends on the country or region. When selecting carriers, Sony favours forwarders that have lower CO₂ emission trucks based on Euro standard. Furthermore they are exploring the possibility to use green trucks.³³⁰

8.3.6 Fill rate

Sony sees the opportunity to reduce their carbon footprint by improving the utilization of trucks and thereby reduce the number of trucks needed. One method planned is consolidation with other companies to increase fill rates. Co-transportation by sharing railway containers is also introduced in Japan.³³¹

8.3.7 Single-case analysis

The findings from the case study at Sony are summarized in this subchapter and it prepares for the following cross-case analysis. The characteristics of the Sony are described in table 8.3.

³²⁵ Sony, *Environment* <www.sony.net> 2008-01-22

³²⁶ Etori, Yoshio 2007-12-03

³²⁷ Masahiro, Yamamoto 2007-12-03

³²⁸ ibid

³²⁹ Etori, Yoshio 2007-12-03

³³⁰ Masahiro, Yamamoto 2007-12-03

³³¹ Etori, Yoshio 2007-12-03

Table 8.3. Characteristics of Sony

Factors	Characteristics	Comments
Product	<i>Consumer products, high value</i>	
Lead-time	<i>24-72 hours</i>	From warehouse to customer. Depending on country, region or distance
Customers	<i>Global</i>	
Production	<i>Global</i>	Japan, Europe, America and Asia
Distribution set-up	<i>Hubs and warehouses</i>	
Transport mode	<i>All four modes</i>	Long distance transports by air or sea, short distance transports mainly by truck and sea/rail for some destinations.

Table 8.4 shows the identified initiatives in the different areas within the studied system. Positive and negative aspects of the changes made are presented as well as other experiences that they have had.

Table 8.4. Findings from the case study at Sony

Area	Initiative	Experiences/Benefits/Difficulties
Green logistics management	Global environmental action plan to ascertain and measure CO ₂ emissions from transportation	
	Create common methodology and platform for discussions globally	
	Internal education for increased awareness of environmental issues	
	Include the environmental factor in logistics decisions	○ Discussion with business groups about the most environmentally friendly way to serve the market, whilst still meeting business targets
	Public environmental reporting	
	Collaborations and memberships within logistics and environment	○ WWF Climate Savers (Not directly logistics related) + Good benchmarking opportunities
Logistics structure	An area not targeted for emission reduction activities	
Mode selection	Change of mode from road to rail	+ Considered to provide large environmental savings - No hard data that supports this
	Change of mode from road to sea	+ Considered to provide large environmental savings - No hard data that supports this
Carrier selection	Forwarders with lower CO ₂ emission trucks based on Euro standard are favoured	
Fill rate	Consolidation with other companies	
	Co-transportation by sharing railway containers in Japan	
Results	As of today no hard data showing the results from the efforts made	

8.4 Panasonic

The main source of information at Panasonic was Hajima Tomoyuki, at Corporate Environmental Affairs Division Environmental Planning Group in Japan. Interviews were conducted by e-mail since it was preferred by the interviewee. Additional information was gathered from the website and environmental reports.

8.4.1 Company presentation

Matsushita Electric Industrial Co., Ltd. was founded in 1918 in Japan. It consists of about 650 companies and has 328 000 employees worldwide. Net sales were \$77.19 billion in March 2007, and it is one of the largest electronic product manufacturers in the world. One of their most famous brands is Panasonic. The main product areas are AVC networks, home appliances, components and devices.³³²

8.4.2 Green logistics management

Figure 8.1 illustrates the major projects in green logistics at Panasonic. Their key activities are a modal shift, mainly to rail which reduces the CO₂ emissions with about one-eight compared to trucks, but they also shift to sea transport. In addition they see utilizing natural gas, promoting eco-driving and reducing distances as very important areas.³³³

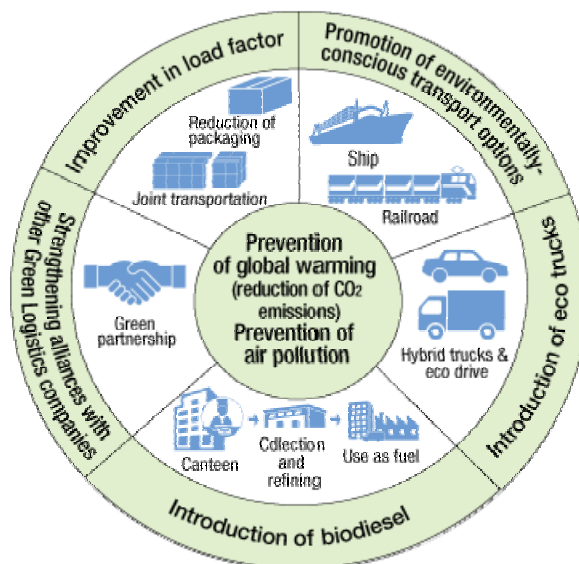


Figure 8.1. Major projects in green logistics at Panasonic³³⁴

At Panasonic they try to develop emission calculations that are as accurate as possible, and they want to use them to get precise figures of the CO₂ emission reduction from a shift to railway transport. Each region has its own way of working with green logistics, but excellent activities are spread to other areas. Modal shift, minimization of transportation distance and biodiesel fuel are some of the activities considered applicable even outside of Japan. In October 2007, a global target on emission reduction from logistics activities was set. The figures are however not yet presented to the public. One of the major obstacles to these initiatives is the lack of infrastructure development in some countries making for instance the

³³² Panasonic <www.panasonic.net> 2007-12-05

³³³ Tomoyuki, Hajima 2007-12-28

³³⁴ Panasonic <www.panasonic.net> 2007-12-05

shift to rail transport very difficult and eco trucks hard to introduce. Another obstacle is the difficulty to obtain accurate data on international logistics activities.³³⁵ Panasonic is a member of the SmartWay partnership.³³⁶

8.4.3 Logistics structure

Panasonic has production sites all over the world. Their set-up includes regional warehouses and their customers are found globally. Some products are finalized and transported as finished packages from sites, while others are shipped in bulk for regional modification.³³⁷ 58 percent of CO₂ emissions from transportation come from international distribution, 15 percent from transports within Japan and 27 percent within countries other than Japan.³³⁸

Panasonic argues that ideally they should promote production to meet customers' demands/orders, not to accumulate products in warehouses as stock. By saving space for stock they need less storage space which in turn means savings in electricity for air conditioning, lighting etc. It would also lead to less waste and as a result reduce CO₂ emissions. The current situation is far from the ideal one, but they have strong intentions to reduce inventories.³³⁹

Products made at one factory are shipped to several markets. When selecting location of production sites, they try to take in mind the best possible place for serving a couple of markets but still other factors may have more priority in this decision. To reduce the distances transported, Panasonic are increasing the direct deliveries to customers. In fiscal year 2008, it will account for 50 percent of all of their deliveries.³⁴⁰

8.4.4 Carrier selection

Mainly external companies are used as forwarders, but Panasonic also have a subsidiary that is in charge of a part of the transportation from manufacturing sites to customers or warehouses. In Japan the demands on transport providers include introduction of eco-trucks, promotion of eco-driving and joint transportation. The interviewee was not aware of the demands in other countries.³⁴¹

8.4.5 Mode selection

Panasonic use all four modes of transport but are working to increase transportation by rail, especially in Japan. Panasonic states that in general they transport by ship but when two or more countries border each other, they use trucks. Nonetheless, they use air transport in many cases because of delivery deadlines. For international transports, 85 percent is transported by air and 15 percent by ship.³⁴²

8.4.6 Fill rate

As shown in figure 8.1, increased load factor is one of the main projects in green logistics at Panasonic. Joint transportation and reduced packaging material are the means they use to increase the fill rate.³⁴³

³³⁵ Tomoyuki, Hajima 2007-12-28

³³⁶ SmartWay Transport Partnership <www.epa.gov/smartway> 2008-01-02

³³⁷ Tomoyuki, Hajima 2007-12-28

³³⁸ Panasonic <www.panasonic.net> 2007-12-05

³³⁹ Tomoyuki, Hajima 2007-12-28

³⁴⁰ ibid

³⁴¹ ibid

³⁴² ibid

³⁴³ Panasonic <www.panasonic.net> 2007-12-05

8.4.7 Single-case analysis

The findings from the case study at Panasonic are summarized in this subchapter and it prepares for the following cross-case analysis. The characteristics of the Panasonic are described in table 8.5.

Table 8.5. Characteristics of Panasonic

Factors	Characteristics	Comments
Product	<i>Consumer products, high value</i>	
Lead-time	<i>N/A</i>	
Customers	<i>Global</i>	
Production	<i>Global</i>	
Distribution set-up	<i>Regional warehouses</i>	Intends to produce more to order
Transport mode	<i>Mainly air</i>	Internationally: 85 % by air, 15 % by ship Japan: 96 % by road

Table 8.6 shows the identified initiatives in the different areas within the studied system. Positive and negative aspects of the changes made are presented as well as other experiences that they have had.

Table 8.6. Findings from the case study at Panasonic

Area	Initiative	Experiences/Benefits/Difficulties
Green logistics management	Develop emission calculations that are as accurate as possible	- Difficult to obtain accurate data on international logistics activities
	Global target for emission reduction	
	Action plan	
	Work for increased internal awareness	
	Public environmental reporting	
	Collaborations and memberships within logistics and environment	o SmartWay
Logistics structure	Postponement	
	More direct deliveries to customers	
	Produce more to order	+ Decreasing the need for warehousing + Savings in electricity + Less waste
Mode selection	Modal shift, mainly from road to rail	+ Reduces the CO ₂ emissions with about one-eighth - The lack of infrastructure development in some countries is an obstacle
Carrier selection	Promote eco trucks	
	Promote eco-driving	
	Purchase of services within the US from members of SmartWay	
Fill rate	Consolidate with other companies	
	Reduce packaging material	
Results	As of today no hard data showing the results from the efforts made	

8.5 Sharp

Information about Sharps environmental work comes from e-mail correspondence with Mark Servidio, VP Logistics & Environmental Supply Chain Planning at Sharp Electronics USA. He has five years experience of working with supply chain issues at Sharp and his main responsibility is to make sure products they receive overseas get to customers in USA and Canada. His objective is to reduce GHG in all areas he can control. Servidio is participating in different events and seminars about green logistics, among them the Green transportation and logistics world summit that will be held in Zurich in February 2008 where he will give a presentation.

8.5.1 Company presentation

Sharp Corporation was founded in Japan in 1912. Today the Sharp Group have 57,200 employees (31,100 in Japan and 26,100 overseas). They manufacture and sell audio-visual communication and information equipment, home appliances and other electronic components. Their product range includes for instance LCD TVs, DVDs, solar panels and phones.³⁴⁴

8.5.2 Green logistics management

The environmental work within logistics at Sharp Electronics USA started in mid 2004. Their main focus is on the SmartWay partnership. This is a volunteer program in which carriers commit to actions that will reduce GHG, like using low sulphur diesel fuel, purchasing diesel filters, implementing no idling policies etc. The shippers promise to use SmartWay carriers to ship their freight. There are three primary components of the program: creating partnerships, reducing all unnecessary engine idling, and increasing the efficiency and use of rail and intermodal operations.³⁴⁵ Servidio considers it to be a win-win situation in that carriers get more business and shippers can contribute to the work to improve the environment. The program helps with emission calculations and demands carriers to present an action plan for environmental improvements. As part of the SmartWay partnership, Sharp Electronics USA have during their three years as a member changed some transports to intermodal shipping where they are shipping trailers on rail. Together with the no idling policy the result so far is a decrease in CO₂ emissions of 917.5 tonnes. According to Servidio, being a member of SmartWay and the work included has not affected other factors such as lead-time, delivery accuracy and cost.³⁴⁶

At Sharp Electronics USA they are also working internally to increase awareness and include the environmental factor in logistics decisions. Sales and customers are educated on the logistics impact on the environment. Sales are trained to discuss with customers how ordering more seldom will help reducing the environmental impact and advertise about how Sharp is working to reduce GHG. The largest obstacle according to Servidio is to make people aware of the environmental impact from supply chains.³⁴⁷

Regarding lead-times, Servidio says customers often want their products yesterday and getting sales is still considered more important than the environment. However, he sees this changing. He also believes that being in the forefront on environmental issues is very important and that the environment is becoming a major selling point in the next five years.

³⁴⁴ Sharp <www.sharp.com> 2007-11-28

³⁴⁵ Sharp USA <www.sharppusa.com> 2007-11-28

³⁴⁶ Servidio, Mark 2007-11-28

³⁴⁷ ibid

Customers are predicted to be more active in their selection of companies from which they purchase products, which will gain them who provide environmentally friendly products.³⁴⁸

The work performed by the Logistics & Environmental Supply Chain Planning department is communicated to the manager of Environmental Affairs who in turn reports to HQ. The work is published in an Environmental & Social Report every year. Nevertheless, the report contains much information only on the work within Japan. Sharp USA has won many awards for their environmental work. In 2006 and 2007 they received the SmartWay Excellence Award. They believe these are important when communicating with customers and consumers.³⁴⁹

8.5.3 Logistics structure

Customers are found worldwide and production sites are located mainly in Far East and Mexico. Products are made-to-stock and transported to regional warehouses as finished packages. In the US, they have four warehouses located in New Jersey, Illinois, California and Memphis. Transports are outsourced and most products are shipped by sea. To USA out of Asian factories, 99 percent of the products are shipped to ports in California and Seattle. From Mexico 50 percent is transported by rail and the remaining 50 percent by truck. Air is only used when they are short of products.³⁵⁰

8.5.4 Mode selection

In Japan there is a new energy conservation law requiring shippers to take further energy saving measures. As a result in Japan, Sharp is shifting from road to rail and sea to achieve the reduction target. Servidio argues that having the home office in Japan, where the work for the environment is well developed, has given them much support and made their work easier.³⁵¹

8.5.5 Carrier selection

As members of SmartWay, Sharp Electronics USA is obligated to purchase at least 50 percent of their transports from carriers that are members of the partnership, but their target is to purchase all services from other members. Today, Sharp allow new carriers into handling their business, but they must become SmartWay certified within 90 days or they discontinue using them. It is likely that the SmartWay partnership will develop and Servidio believes the next step is to target ports and ocean carriers. He is also hoping for a SmartWay partnership in the EU.³⁵²

8.5.6 Fill rate

To increase the fill rate in trucks Sharp has introduced trucks with adjustable height shelves for two-stage loading. Sharp also works to reduce packaging material both to reduce waste and storage space needed. By creating a new packaging design for personal computers in 2004, they were able to reduce the volume of material needed by 20 percent; the storage space required by 50 percent and the time required for packaging set up were reduced as well.³⁵³

³⁴⁸ Servidio, Mark 2007-11-28

³⁴⁹ ibid

³⁵⁰ ibid

³⁵¹ ibid

³⁵² ibid

³⁵³ Sharp <www.sharp.com> 2007-11-28

8.5.7 Single-case analysis

The findings from the case study at Sharp are summarized in this subchapter and it prepares for the following cross-case analysis. The characteristics of the Sharp are described in table 8.7.

Table 8.7. Characteristics of Sharp

Factors	Characteristics	Comments
Product	<i>Consumer products, high value</i>	Audio-visual communication and information equipment, home appliances and other electronic components. Handsets.
Lead-time	<i>Short</i>	
Customers	<i>Global</i>	
Production	<i>Global</i>	Mainly in Far East and Mexico
Distribution set-up	<i>Regional warehouses</i>	
Transport mode	<i>Mainly sea, rail and road</i>	Long distance by sea, short distance by road or by rail. Air is only used for express shipments.

Table 8.8 shows the identified initiatives in the different areas within the studied system. Positive and negative aspects of the changes made are presented as well as other experiences that they have had.

Table 8.8. Findings from the case study at Sharp

Area	Initiative	Experiences/Benefits/Difficulties
Green logistics management	Work for increased internal awareness	○ Sales is educated on the environmental impact from logistics decisions
	Include the environmental factor in logistics decisions	
	Discussions with customers	○ Education on the environmental impact from logistics decisions, e.g. how ordering more seldom can reduce the environmental impact
	Public environmental reporting	
	Collaborations and memberships within logistics and environment	○ SmartWay + Possibility to influence + Helps with emission calculations + Demands carriers to present an action plan for environmental improvements
Logistics structure	An area not targeted for emission reduction activities	○ They have a regionalized distribution set-up
Mode selection	Intermodal shipping, shipping trailers on rail	
	Change from road to rail and sea in Japan	
Carrier selection	Aim to purchase all services from members of SmartWay	
	No idling policy	
Fill rate	Discussions with customers about how ordering affects fill rate	
	Trucks with adjustable height shelves for two-stage loading	
	Reduce packaging material	+ Reduces waste + Reduces storage space
Results	Intermodal shipping and no idling policy has resulted in a reduction of 917.5 tonnes CO ₂ emissions.	○ No negative effects on lead-time, delivery accuracy and cost

8.6 IKEA

The information in this case study was gathered from environmental reports, the IKEA website and through an interview with Jeanette Skjelmose, Social and Environmental Manager for IKEA Transport Global. Skjelmose has worked at IKEA for ten years and at her current position since April 2007.

8.6.1 Company presentation

The IKEA Group is a home furnishing company, it has 90 000 employees and operates in 44 countries. The business idea is to offer well-designed, functional home furnishings to a low price.³⁵⁴

8.6.2 Green logistics management

IKEA's environmental goal is to reduce the carbon footprint by 12 percent per transported m³ from the levels of 2006, by year 2010.³⁵⁵ In order to achieve this, several projects have been initiated. The strategies that IKEA follows to achieve this goal are the following:

- To increase the fill rate
- To influence the suppliers to use more alternative fuels
- Establish CO₂ targets for all suppliers of transport service
- To switch mode from road to rail and from land to sea
- To have CO₂ as one factor when deciding upon where to locate production sites and which suppliers to source from.

These were selected since they were believed to provide the greatest influence on the emissions. Skjelmose claims that the goal of a 12 percent reduction already has been achieved, but that they are continuing with the projects for even further reduction.³⁵⁶

At IKEA they do not notice many demands from the customers on environmental issues. Instead Skjelmose claims that the driver of the environmental work at IKEA is a genuine interest and that this is communicated top down in the company.³⁵⁷

IKEA reports on their environmental work to the public by on a yearly basis publish environmental reports. They are involved in several collaborations within environment and logistics. They are a member of SmartWay and Clean Cargo, which is an American organization within sea freight. More than 100 companies are involved, among them several of the large shippers. The aim is for shippers and their customers to collaborate and discuss how to reduce the environmental impact from sea freight. In Sweden they are members of for instance NTM and the Logistics Forum.³⁵⁸ The Logistics Forum is an advisory body to the Swedish government.³⁵⁹ Furthermore they collaborate with the WWF.³⁶⁰

³⁵⁴ IKEA <www.ikea.com> 2007-11-25

³⁵⁵ Skjelmose, Jeanette 2007-11-22

³⁵⁶ ibid

³⁵⁷ ibid

³⁵⁸ ibid

³⁵⁹ Regeringskansliet <www.regeringslogistikforum.se/website/index.asp?pageID=1> 2008-01-02

³⁶⁰ IKEA Group <www.ikea-group.ikea.com/?ID=719> 2008-01-02

8.6.3 Logistics structure

IKEA's ambition is to have production close to the market and the raw material. The most frequently used raw material is wood from the North-East Europe. 80 percent of IKEA's customers are found in Europe and this is also where most of the production is located: 70 percent. The other 20 percent of the customers are almost equally spread between Asia and North America. 22 percent of the production is in Asia and the remaining 8 percent is in North America. IKEA have outsourced the logistics operations to about 300 different external service providers. Today they have 20 000 different transport routes and 32 warehouses globally. Emissions are calculated with data from their transport booking program and default values for emissions from different routes.³⁶¹

To locate the production close to the raw material and to the customer is not always possible. When they are geographically separated the trade-off will be between having short inbound or short outbound logistics. Since inbound logistics can be more volume demanding, as with wood, it is often better to place the production site close to the raw material. When deciding where to locate production sites, IKEA always take CO₂ emission as a factor in the decision making. By calculating the effects on lead-time, cost and CO₂ emissions and they can make an informed decision.³⁶² One example of a change made is the move of the production of a certain product for the North American market from Poland to USA, resulting in a decreased demand of transportation.³⁶³

8.6.4 Mode selection

So far the single most effective initiative has been the shift of mode, especially from land to sea. One example where a modal shift has been performed is from Turkey to warehouses in Spain and Portugal where goods now mainly are transported by sea. IKEA's experience with transporting by sea is positive. Skjelmose says that shippers follow the contracts, with lead-times and delivery accuracy as agreed.³⁶⁴

8.6.5 Carrier selection

All potential transport service providers need to fulfil IKEA's start-up requirements on social and environmental issues. These include demands on truck age, CO₂ emission targets and action plan, compliance with IWAY, The IKEA Way on Distributing Home Furnishing Products, and an annual update of the EPS, Environmental Performance Survey.³⁶⁵ The IWAY is a standard similar to ISO 14001 with the minimum requirements within Social & Working conditions and Environment that IKEA have on it suppliers and service providers. One of the requirements is that they "must work to reduce waste and emissions to air, ground and water."³⁶⁶ Seven regional IKEA offices purchase transport services and they are responsible for upholding the IWAY.³⁶⁷ They conduct audits that cover social and environmental issues related to the transport of products. In the audits they make sure that the IWAY requirements are being fulfilled. IKEA believe in long-term relationships with their

³⁶¹ Skjelmose, Jeanette 2007-11-22

³⁶² ibid

³⁶³ Ekelund (2007)

³⁶⁴ Skjelmose, Jeanette 2007-11-22

³⁶⁵ ibid

³⁶⁶ IKEA Services AB (2007), p.3

³⁶⁷ IKEA (2006)

suppliers and they work together with them to make sure they meet the requirements.³⁶⁸ In the US, all transport providers also need to be members of the SmartWay partnership.³⁶⁹

One of IKEA’s environmental strategies is to promote the use of biofuels. They however believe that it is difficult to achieve great emission reductions with this strategy today.³⁷⁰

8.6.6 Fill rate

One of IKEA’s strategies to reduce the carbon footprint is to increase fill rates. They do it by having discussions with the transport providers about how to optimize the loads. The discussions can be for instance about size and shape of the package or of the product itself or about how to reduce the amount of packaging material. This issue is driven both from an economical and an environmental point-of-view. IKEA has already made initiatives to improve the fill rate by changing the shape of the package for a certain type of lights. This has resulted in a 20 percent increase in load factor.³⁷¹

8.6.7 Single-case analysis

The findings from the case study at IKEA are summarized in this subchapter and it prepares for the following cross-case analysis. The characteristics of IKEA are described in table 8.9.

Table 8.9. Characteristics of IKEA

Factors	Characteristics	Comments
Product	<i>Consumer products</i>	The products varies significantly in volume
Lead-time	<i>Varying</i>	
Customers	<i>Global</i>	Europe, North America, Asia
Production	<i>Global</i>	Europe, North America, Asia. Close to the raw material and/or the market
Distribution set-up	<i>Regional warehouses</i>	32 warehouses
Transport mode	<i>Rail, sea and road</i>	

Table 8.10 shows the identified initiatives in the different areas within the studied system. Positive and negative aspects of the changes made are presented as well as other experiences that they have had.

³⁶⁸ Skjelmose, Jeanette 2007-11-22

³⁶⁹ IKEA (2006)

³⁷⁰ Skjelmose, Jeanette 2007-11-22

³⁷¹ *ibid*

Table 8.10. Findings from the case study at IKEA

Area	Initiative	Experiences/Benefits/Difficulties
Green logistics management	To reduce the carbon footprint by 12 percent per transported m ³ from the levels of 2006, by year 2010	
	Action plan	
	Measure the effects from the efforts made	
	Work for increased internal awareness	
	Include the environmental factor in logistics decisions	
	Public environmental reporting	
	Collaborations and memberships within logistics and environment	<ul style="list-style-type: none"> ○ Environmental Protection Agency (EPA)'s Smart Way Partnership ○ NTM ○ Logistical Forum ○ WWF ○ Clean Cargo + Ability to together with the shippers reduce the environmental impact from sea freight
Logistics structure	To have CO ₂ as a factor when deciding on where to locate production sites and which suppliers to source from	
	To have production close to the market and to the raw material	<ul style="list-style-type: none"> ○ Trade-off between having short inbound or short outbound logistics. In this case to have short inbound logistics is normally preferred since it can be more volume demanding.
Mode selection	Change of mode from road to rail	
	Change of mode from road to sea	<ul style="list-style-type: none"> + Agreed lead-times has been achieved + Agreed delivery accuracy has been achieved
Carrier selection	Fulfilment of IKEA's start-up requirements on social and environmental issues including: <ul style="list-style-type: none"> ○ Truck age ○ CO₂ emission targets and action plan ○ Compliance with IWAY ○ Annual update of the EPS 	
	Promote biofuel	
	In the US all transport providers need to be members of the Environmental Protection Agency (EPA) Smart Way Partnership	
Fill rate	Reduce size and shape of products and packages	
	Reduce packaging material	
Results	The goal of a 12 percent reduction has already been achieved	
	Single most effective emission reduction activity is the change of mode, especially from land to sea	
	Difficult to achieve great effects in emission reduction with the promotion of biofuel	

8.7 Tetra Pak

The main contact at Tetra Pak was Johan Borglin who works with purchasing of transport services at Tetra Laval Group Transport & Travel. Borglin has worked for the Tetra Laval Group for 8 years. He has been active in NTM and held seminars on the subject logistics and the environment. Much information about Tetra Pak's work was found in their environmental reports, on their website and through other sources. Complementing information was added from a telephone interview with Johan Borglin. Even though Tetra Laval Group Transport & Travel purchases transports for all companies in the Tetra Laval Group, the focus was mainly on the largest company, Tetra Pak, when studying for instance the environmental reports.

8.7.1 Company presentation

AB Tetra Pak was established in Lund, Sweden in 1951. After Tetra Pak's acquisition of Alfa Laval the Tetra Laval group was founded in 1993.³⁷² The Tetra Laval Group provides food processing and packaging equipment. They employ 30,361 people and consist of the three independent industry groups: Tetra Pak, DeLaval and Sidel which are all industry leaders within their respective areas of business. Tetra Pak focuses on food processing and packaging, DeLaval produces equipment for dairy farming and Sidel designs, manufactures, assembles, supplies and sells complete packaging lines for liquid foods packaged in glass bottles, plastic and drink cans. Although they work independently they seek for synergies between the groups. Net sales 2006 were €10,562 million.³⁷³

Tetra Laval Group Transport & Travel are responsible for the procurement of transport and travel centrally for all companies in the Tetra Laval Group. They are responsible for the global contracting of transports and have been working on these issues for 20 years. Meanwhile the global presence has increased, the environmental work that started around 15 years back has spread and today all suppliers worldwide meet the same demands.³⁷⁴

8.7.2 Green logistics management

CO₂ is the main focus in Tetra Pak's environmental work and the objective is to reduce CO₂ emission levels in absolute numbers even though the volumes increase. The emissions are calculated from data gathered by the transport provider on how much they transport. Measuring the CO₂ emissions does not only confirm progression, it also makes it easier for Tetra Pak to focus the efforts on the right areas.³⁷⁵ The environmental strategy has always been to involve suppliers and partners in the improvement process. Their environmental commitment is a combination of genuine interest and commercial considerations. Equally important as the environmental savings are the financial benefits. Tetra Pak has always tried to be ahead of demands from their stakeholders and sees the selection of environmentally aware suppliers as an investment since forthcoming regulations, taxes and tariffs will put pressure on the transport sector.³⁷⁶

At Tetra Pak a reduced need for transportation is the main focus area, both from inbound and outbound transport. In order to achieve this they always question themselves how much they transport and why, if there are any available options and how they can achieve shorter distances and transport more by sea.³⁷⁷

³⁷² Tetra Pak <www.tetrapak.com> 2007-11-07

³⁷³ Tetra Laval <www.tetralaval.com> 2007-11-07

³⁷⁴ Borglin, Johan 2007-11-16

³⁷⁵ *ibid*

³⁷⁶ Tetra Pak <www.tetrapak.com> 2007-11-07

³⁷⁷ Borglin, Johan 2007-11-16

Tetra Pak have been collaborating with WWF in discussions with suppliers and customers to get experience and exchange knowledge. They see collaborations as a great way to attain larger understanding of what is working for companies and what is not, but unfortunately they often have more to give others than others can give them.³⁷⁸ Tetra Laval is also a member of the Clean Shipping Project, a development project for sustainable shipment. The project's main objective is to initiate a process towards clean shipping, primarily in western Sweden. One method is to influence purchasers of maritime transports to make stringent environmental and health related demands on the shippers.³⁷⁹ Other participating companies are ABB, Astra Zeneca, H&M, Preem Petroleum, SKF, Stora Enso Logistics, Skanska Sweden and Vattenfall Nordic. The environmental requirements are on fuels used, how the oil is purified and how the waste oil is handled.³⁸⁰ For further description of the demands, see appendix 6.

Tetra Pak is also participating in other projects in the environmental field. In 2006, a European research program was initiated to investigate how the environmental effect from transports can be reduced. The project that is called Impact is running over three years and is supposed to work as a link between the industry and the research community. Tetra Pak figures as a reference company in the study and has as one task to measure the CO₂ emissions from each single transport. This gives them detailed information on the impact from transport and guides the decision of mode of transportation.³⁸¹

8.7.3 Logistics structure

Production is found at around 60 sites worldwide and covers most continents. These sites supply the regional markets but some products are exported globally. Customers are also found all around the world. Air freight is not a common mode of transport for Tetra Pak and it is mainly spare parts that are delivered by this mode. The primary mode used is sea transport as their CO₂ emission levels are lower than road or air.³⁸²

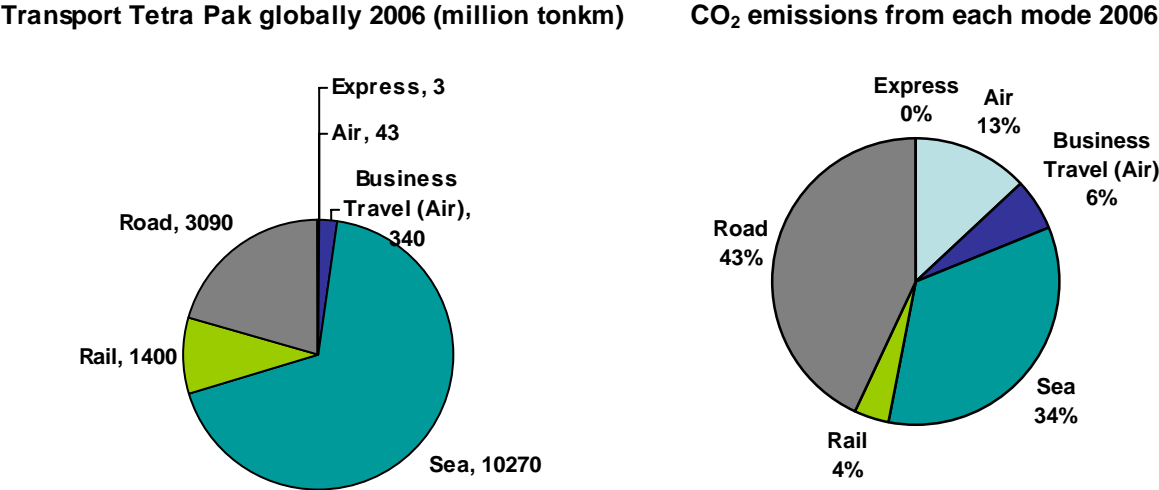


Figure 8.2. Tetra Pak global transports 2006³⁸³

³⁷⁸ Borglin, Johan 2007-11-16
³⁷⁹ Clean Shipping Project <www.cleanshippingproject.se/projektet.html> 2007-12-06
³⁸⁰ Feuk (2007)
³⁸¹ Tetra Pak <www.tetrapak.com> 2007-11-07
³⁸² Borglin, Johan 2007-11-16
³⁸³ Tetra Pak <www.tetrapak.com> 2007-11-07

8.7.4 Mode selection

Since not much of Tetra Laval's products are transported by air, the transition from road to sea is considered the most vital, when it comes to selecting more environmental modes.³⁸⁴

They try to avoid air freight as much as possible. In order to do this they divide orders so that if some items are delayed for instance due to missing spare parts, they are separated from the rest of the order. As a result the items that are ready are not in need of air transport. Additionally, spare parts demanded by customers are grouped according to the urgency. The ones that are not needed instantly can be transported on other more environmental modes, while the most urgent must be delivered by air. In order to understand the available alternatives, they work in close collaboration with the customers to understand their demands. The better they can plan their work the more opportunities they have to select environmental options. When air transport is unavoidable, they work to find the most environmentally friendly option.³⁸⁵

8.7.5 Carrier selection

At Tetra Pak they have been working with environmental issues within transport since mid 1990s. To start with they tried to get information from transport providers on how many trucks they had of different types, with different environmental performance, but they soon discovered that this information was not of interest and could not be used in the decision making. Instead they started to focus on how active the transport providers were in their environmental work and in planning and working for continuous improvements. Being a large customer has made Tetra Pak able to influence the suppliers to a great extent. However, according to Johan Borglin, it is important to understand that putting pressure on the supplier to reduce emission alone is not the way to go. Companies must themselves consider options for reducing the volumes, distances and mode of transportation.³⁸⁶

Tetra Pak is today prominent in the evaluation of their transport suppliers' environmental work and they use a standardized questionnaire with 14 questions given to all present and potential suppliers. It is developed from the one presented by NTM, found in appendix 4. The questions are about the suppliers' work within the environmental field from internal goals and policies to how they work with their subcontractors. Based on these answers they are classified as green, yellow and red depending on how well their environmental work is developed. Green suppliers already have a good environmental work and targets for further development in place. Yellow and red rating means more work is expected but it does not disqualify the supplier from being selected. Instead Tetra Pak sees the potential in contributing to the environment by working together with less environmental aware suppliers and includes conditions that will move them upwards in the ranking. When it comes to the selection of suppliers, the decision is based on a model of cost efficiency including price, quality and the environment. Often, the more environmentally sound supplier also have better processes and business models, which result in a better overall performance. They are therefore in general not more expensive than others.³⁸⁷ To get a total measure, classification is also made on quality, safety and other factors. In total their questionnaires can give the suppliers 100 points. 30 of these are from the environmental questionnaire, 30 are from safety

³⁸⁴ Borglin, Johan 2007-11-16

³⁸⁵ *ibid*

³⁸⁶ *ibid*

³⁸⁷ Tetra Pak <www.tetrapak.com> 2007-11-07

and quality and other aspects such as price, capacity and accessibility cover the final 40 points.³⁸⁸

The ones that are considered for larger volumes and have among the best total results are called for a meeting where the answers are discussed. The supplier is asked to explain their answers and for the issues where their performance does not reach the targets they are asked why this is and when and how they plan to improve these areas. These targets are later followed up on at the next meeting. The rating of the supplier's environmental performance is public and shown to all of the contracted suppliers within the same field. This public comparison is made to trigger the suppliers to better performance and it has given a very good result. The ones that does not perform as well as the competition is motivated to work harder and the ones in the top get an incentive to keep working hard to keep that position. Companies that due to the demands from Tetra Pak have developed their operations are often grateful since it gives them a lead of the competition and an advantage in negotiations with other companies.³⁸⁹

From an international perspective this evaluation is seen as a challenge to make everyone, internally and externally, understand that climate change really is a threat and that actions are needed in order to reduce emission levels. However, generalisations can not be made on the performance in different regions.³⁹⁰

8.7.6 Fill rate

Tetra Pak works with reduced sizes of packages. This is however not an area highly prioritized in the work for reduced emission levels. Packages must additionally still protect the goods from damage because if goods are damaged during delivery, the need for transportation will increase when it is either repaired or replaced.³⁹¹

8.7.7 Single-case analysis

The findings from the case study at Tetra Pak are summarized in this subchapter and it prepares for the following cross-case analysis. The characteristics of Tetra Pak are described in table 8.11.

Table 8.11. Characteristics of Tetra Pak

Factors	Characteristics	Comments
Product	<i>Varying</i>	
Lead-time	<i>Varying</i>	Often longer with the exception of spare parts
Customers	<i>Global</i>	
Production	<i>Global</i>	Tries to reduce transport by producing to regional markets
Distribution set-up	<i>N/A</i>	
Transport mode	<i>Mainly sea</i>	

Table 8.12 shows the identified initiatives in the different areas within the studied system. Positive and negative aspects of the changes made are presented as well as other experiences that they have had.

³⁸⁸ Borglin, Johan 2007-11-16

³⁸⁹ Borglin, Johan 2007-11-16

³⁹⁰ *ibid*

³⁹¹ *ibid*

Table 8.12. Findings from the case study at Tetra Pak

Area	Initiative	Experiences/Benefits/Difficulties
Green logistics management	Reduce emission levels in absolute numbers	
	Reduce the total transport work	○ Question the importance of each transport
	Action plan	
	Work for increased internal awareness	
	Work on a global basis for equal demands	
	Measure the CO ₂ emissions	+ Confirm progression + Enables them to focus the efforts on the right areas
	Close collaborations with partners and suppliers	
	Public environmental reporting	
	Collaborations and memberships within logistics and environment	○ WWF ○ Clean Shipping ○ Increase of experience ○ Exchange of knowledge + Increase of understanding of what works and what does not work
Logistics structure	Regionalization	
Mode selection	Change of mode from road to sea	
	Aim to always select the most environmental mode possible for each product	
	Segmentation of orders to enable most environmental transport for each product	+ The items that are ready are not in need of air transportation
	Grouping of spare parts according to urgency	+ The ones not needed instantly can be transported on a more environmental friendly mode
Carrier selection	14 point questionnaire with questions on the suppliers environmental work and their plans for improvement	○ Not enough to solely have environmental demands on the forwarders. Companies must themselves consider options for reducing the volumes, distances and mode of transportation
	Public supplier rating system on environmental performance	+ Trigger the supplier to better performance
Fill rate	Reduce size of packages	○ Still protecting the goods from damage during transport to reduce take-back and waste
	Question the importance of each transport	○ Understand the urgency of delivery
Results	Well prepared for upcoming laws and regulations	

8.8 Cross-case analysis

In this section the identified initiatives made by the studied companies to reduce their carbon footprint within logistics are compared and discussed. These initiatives are again divided into the areas green logistics management, logistics structure, mode selection, carrier selection and fill rate. Furthermore, the obstacles and positive aspects of the initiatives that were recognized during the interviews are summarized. These tables are not exhaustive and it needs to be emphasised that it is a summary of the initiatives identified in interviews and through observations on websites. This means some companies may be targeting areas even though they are not acknowledged in these tables.

The abbreviations used are:

E - Ericsson

Sh - Sharp

S - Sony

I - IKEA

P - Panasonic

TP - Tetra Pak

8.8.1 Green logistics management

In their green logistics management the case companies focus on areas such as measuring the carbon footprint, setting up targets and a strategy for how to achieve these targets. They also work with communication internally and externally to increase the environmental awareness. A complete list of the identified initiatives is presented in table 8.13.

Table 8.13. Cross-case analysis of initiatives in green logistics management

Initiatives	E	S	P	Sh	I	TP	Obstacles	Positive aspects
Create baseline	X	X	X		*	*	<ul style="list-style-type: none"> Obtain and compile data on international logistics activities Find a common methodology and platform for discussions globally 	<ul style="list-style-type: none"> Not many resources are needed in order to perform the assessment
Set target for emission reduction	X		X		*	*		
Action plan		*	*		*	*		
Measure and evaluate the environmental work	X	X			X	X		<ul style="list-style-type: none"> Confirms progression Identifies the most efficient areas to target
Work for increased internal awareness	X	X	X	X	X	X		
Dialogue with customers	X			X				
Collaboration with partners and suppliers						X		
Include the environmental factor in logistics decisions		X		X	X	X		
Public environmental reporting	X	X	X	X	X	X		
Collaborations and memberships within logistics and environment	X	X	X	X	X	X	See table 8.15	See table 8.15

* Initiatives already completed

Tetra Pak is the case company with the longest experience in green logistics management. Not only do they target all of the areas in the studied system, they have also developed an environmental thinking internally and question the importance of each transport to reduce the

total transport work. In addition they work in collaboration with suppliers and partners in order to together make environmental improvements.

Creating baselines and measuring and evaluating emission levels is considered important for the work in green logistics management as it gives hard data and shows where reductions can be made as well as the progression of the work.

IKEA and Tetra Pak have already set quantitative targets for emission reduction. IKEA's target is to reduce the carbon footprint by 12 percent per transported m³ from the levels of 2006, by year 2010 and Tetra Pak targets a decrease in emission levels in absolute numbers, even if volumes increase.

All companies are members of organizations within logistics and the environment. The experiences are positive and memberships are considered to help the exchange of knowledge and give benchmarking opportunities. A list of the organizations, a brief description of them, which studied companies that are members and other comments are included in table 8.14.

Table 8.14. Organizations within logistics and the environment

Organization	Brief description	Members	Comments
<i>EPA's Smart Way Partnership</i>	Land transports, only within United States	<ul style="list-style-type: none"> • Sharp Electronics Corporation • IKEA Distribution Services (NA) • Panasonic NA Logistics Department 	<ul style="list-style-type: none"> • Helps with emission calculations • Demands carriers to present an action plan for environmental improvements
<i>WWF Climate Savers</i>	Not directly logistics related. Publish a sustainability report which includes a specific section on logistics.	<ul style="list-style-type: none"> • Tetra Pak • Sony 	<ul style="list-style-type: none"> • Good benchmarking opportunities • Overall a positive experience
<i>WWF</i>	A cooperation to reduce IKEA Groups CO ₂ emissions that their operations contribute to. One of the two main areas is to develop sustainable people transportation.	<ul style="list-style-type: none"> • IKEA 	
<i>Clean Cargo Working Group</i>	American organization within sea freight	<ul style="list-style-type: none"> • IKEA 	
<i>NTM</i>	Swedish non-profit organization. Aims to establish a common base of values on how to measure the environmental performance from transportation.	<ul style="list-style-type: none"> • Ericsson • IKEA 	<ul style="list-style-type: none"> • See appendix 4 for NTM's environmental evaluation of freight forwarders
<i>Logistical Forum</i>	Advisory body to the Swedish government	<ul style="list-style-type: none"> • IKEA 	
<i>Clean Shipping project</i>	Sea, Swedish, see appendix 6 for the criteria used	<ul style="list-style-type: none"> • Tetra Pak 	<ul style="list-style-type: none"> • Ability to together with the shippers reduce the environmental impact from sea freight

8.8.2 Logistics structure

Identified activities to reduce the environmental impact within logistics structure are illustrated in table 8.15 below. Sony and Sharp have not targeted these areas for emission reduction efforts.

Table 8.15. Cross-case analysis of initiatives in logistics structure

Initiatives	E	S	P	S h	I	T P	Obstacles	Positive aspects
Regionalization	X					X		
Increase use of direct shipments			X					
Postponement	X		X					
Produce more to order			X					<ul style="list-style-type: none"> • Decreases the need for warehousing • Savings in electricity • Less waste
More direct deliveries to customers			X					
Have CO ₂ as a factor when deciding on where to locate production						X		
Have production close to the market and close to the raw material						X	<ul style="list-style-type: none"> • Sometimes trade-off between short inbound or outbound logistics 	

An interesting observation regarding the initiatives within the logistics structure is that most of the case companies have regionalized distribution-set up and the two companies that do not have this are working for increased regionalization. Ericsson's comment on why they had taken this initiative was that it enables postponement. Postponement is something that both Ericsson and Panasonic are working to increase.

8.8.3 Mode selection

The change of mode is a common target area among the studied companies for emission reduction since it is considered to provide large environmental savings. Table 8.16 provides a cross-case analysis of mode selection at the studied companies.

Table 8.16. Cross-case analysis of initiatives in mode selection

Initiatives	E	S	P	S h	I	T P	Obstacles	Positive aspects
Change of mode from air to sea	X						<ul style="list-style-type: none"> • Longer lead-times • Tied-up capital increases • Difficult to put demands on the shippers • Planning of projects • Better cooperation with customers needed 	<ul style="list-style-type: none"> • No significant quality problems • Significant decrease in cost • Reduced environmental impact
Change of mode from road to rail	X	X	X	X	X		<ul style="list-style-type: none"> • The lack of infrastructure development in some countries 	<ul style="list-style-type: none"> • Considered to provide large environmental savings
Change of mode from road to sea		X		X	X	X		<ul style="list-style-type: none"> • Considered to provide large environmental savings
Intermodal transports				X				

Initiatives	E	S	P	S h	I	T P	Obstacles	Positive aspects
Improved planning to enable more environmental modes	X					X		
Segmentation of orders to enable most environmental transport for each product						X		<ul style="list-style-type: none"> The items that are ready are not in need of air transportation
Grouping of spare parts according to urgency						X		<ul style="list-style-type: none"> The ones not needed instantly can be transported on a more environmental friendly mode

Among the studied companies it is only Ericsson and Panasonic that transports their products mainly by air and Ericsson is striving to reduce the use of this mode. Although Tetra Pak does not transport much by air, they still try to reduce the small part that they do through segmentation of orders by grouping parts according to emergency. They simply always try to select the most environmental friendly mode.

A strong focus among the case companies is to change mode from road to rail. This shift is however mainly initiated in Japan due to their newly introduced strict environmental laws.

8.8.4 Carrier selection

Among the studied companies there are two approaches towards environmental demands on the freight forwarders. The first one is to put specific demands on them, such as increased use of biofuel, green trucks, no idle, promotion of eco-driving etc. The second approach is to demand the forwarder to have CO₂ emission reduction targets and an action plan for achieving them. Table 8.17 illustrates the initiatives made by the studied companies when it comes to carrier selection.

Table 8.17. Cross-case analysis of initiatives in carrier selection

Initiatives	E	S	P	S h	I	T P	Obstacles	Positive aspects
Demands on measuring and reporting CO ₂ emission levels	X							
Demands on CO ₂ emission targets and action plan					X	X		
Promote eco-driving			X					
Promote eco trucks and use of biofuel			X		X		<ul style="list-style-type: none"> Lack of infrastructure in some countries 	
No idling policy				X				
Demand on truck age/ Euro standard		X			X			
Purchase of services within the US from members of SmartWay			X	X	X			
Evaluation of freight forwarders' environmental performance					X	X		
Public supplier rating system on environmental performance						X		<ul style="list-style-type: none"> Trigger the supplier to better performance

8.8.5 Fill rate

Several initiatives are made among the studied companies in order to increase the fill rate as illustrated in table 8.18. The initiatives are made on parcel, pallet and vehicle level. Furthermore initiatives are made to influence the timing of orders which can have a positive effect on the fill rate.

Table 8.18. Cross-case analysis of initiatives for increased fill rate

Initiatives	E	S	P	S h	I	T P	Obstacles	Positive aspects
Discussions with customers about ordering more seldom				X				
Consolidate with other companies		X	X					
Reduce size and shape of products/ packages	X				X	X		
Reduce packaging material			X	X	X	X		<ul style="list-style-type: none"> • Reduces waste • Reduces storage space
Improve truck design for more efficient storage				X				
Question the importance of each transport						X	<ul style="list-style-type: none"> • Understand the importance of each delivery 	

Many of the companies work to reduce the packaging material. However, as mentioned by Tetra Pak, it is crucial that there is enough packaging material to protect the goods from damage, because otherwise the need for take-back and amount of waste will increase.

8.8.6 Results

To conclude, a finding from the case studies was that most of the case companies had only recently started their environmental work within logistics. Many of them are also struggling with getting accurate figures on the emissions levels. These factors have made it difficult for companies to identify clear results and many also found it too early to share any results with the authors.

IKEA and Tetra Pak were the two companies that seemed to have the longest experience with environmental work in logistics and they also had some results to share. IKEA has achieved their goal of a 12 percent emission reduction. The single most effective activity has been the change of mode, especially from land to sea. The initiative with the least effect on the emission levels at IKEA so far is the promotion of biofuel. Tetra Pak states that their environmental work has resulted in them being well prepared for upcoming laws and regulations. Their strict environmental demands on transport providers have also given positive results and motivated the transport providers to improve their environmental performance.

9 Analysis and recommendations

In this chapter the findings from the study are analysed with the aim to answer the problem statements and to fulfil the purpose of the thesis. This includes a presentation of the recommendations to SEMC on how they can work to reduce the carbon footprint from their outbound logistics.



9.1 Trends influencing SEMC's work in logistics and environment

The external factors influencing SEMC's work to reduce the carbon footprint within logistics are competitors' and other companies' activities within the area, the regulations and market incentives as well as the technological development within each mode.

Findings from the case studies indicated that the environmental work within logistics have developed faster in Japan than in many other countries, especially the change of mode from road to rail, due to the country's strict environmental laws. This indicates that regulations, taxations and trade opportunities do influence the businesses and that being aware of the upcoming ones is important. The Kyoto Protocol, together with regional initiatives to prevent further climate change, such as the targets and action plans created by the European Union, underpin individual countries regulations and market incentives. They will therefore most likely bring about stricter environmental regulations worldwide. Additionally the media attention continues to increase the environmental awareness among consumers and other stakeholders. Consequently, SEMC will experience tougher environmental demands in the future. One of the observations made from competitors' environmental work is that the competition will be tough about who will be the leader within sustainability. Samsung even states that they are the industry leader today regarding the reduction of the environmental load.

Investments are made within all four modes in order to reduce the environmental impact. Most investments are made within the air and rail sector. Air because of high fuel costs and high levels of emission, and rail since it is a more environmentally friendly option but lack in infrastructure and harmonized standards. Within the air and road sectors, investments are mainly made in projects for increased energy efficiency and use of renewable fuels. Some investments are made within sea transport, but these are mainly infrastructural. Better technology already exists than is used in the common vessels. Consequently, within sea transport, tougher environmental demands are needed from the customers and international bodies. Within the EU, focus is on increasing the competitiveness and use of the rail and sea transport. Regulations and market incentives will therefore likely favour these two modes the most within the EU. Furthermore they intend to control the predicted growth in air traffic by including the air industry in the EU ETS as well as introducing fuel taxation.

The price of transportation will most likely not be affected much in the short term, but it is hard to predict how much it will be affected in the long term. The upcoming regulations will add to the cost for transportation, especially for land and air. Another factor is the oil price. However, the technological development will improve the energy efficiency and will thereby affect the cost. Consequently, depending on the technological progress and the regulations affecting each mode it is hard to predict how the price for transportation will increase.

Transportation cost will nevertheless most likely be a larger factor to consider when deciding for example logistics structure in the future.

9.2 Activities affecting the emission levels at SEMC

The activities that affect the CO₂ emissions from SEMC's outbound logistics are found on strategic, tactic and operational levels. According to Aronsson and Huge Brodin's framework model³⁹² the decisions concerning the strategic levels are the ones that have the greatest effect and that outline the framework for the tactic and operational decisions. Furthermore, Lumsden³⁹³ argues that the largest potential for environmental savings comes from changes in the logistics structure and purchasing- and distribution patterns.

SEMC can both directly and indirectly affect the amount of emissions. They can influence directly through decisions on e.g. product design, content in package, the package itself, logistics structure and sales- and operations planning. The indirect influence can be through the selection of freight forwarders by incorporating environmental performance as a vendor selection tool and adding terms of environmental considerations in the contract.

According to Swahn³⁹⁴ there are three ways to decrease the emissions from transportation: limitation, increased efficiency and use of new technology. There are several examples on how SEMC can limit their transport work. One option is reducing size and shape of handsets, sales items and the content in the sales item. Furthermore, the transport work needed is limited if customization is made closer to the customer. Parts such as batteries, packaging material and instructions could then be sourced from local suppliers, resulting in drastically reduced transport distances for these items. Also, the location of production determines the need for transportation. A local or regional production significantly reduces the transportation distances compared to global production. This of course given that parts are sourced locally. An example of a decision affecting the efficiency of transports is the utilization of transport resources. This includes fuel saving measures such as eco driving, vehicle maintenance and traffic management, but also utilization of vehicles such as optimization of routes and loads. These are areas to improve mainly in collaboration with forwarders. Some aspects can however be considered internally such as working with sales and operations planning to support high fill rates. This can be achieved by evaluating the promises made to customers about deliveries and the effects these have on the supply chain and emission levels. Finally, introduction of new technology is also strongly dependent on the freight forwarders initiatives. The complete list of the factors driving the emission levels within outbound logistics at SEMC is illustrated in table 9.1.

³⁹² See chapter 4.3.2

³⁹³ See chapter 4.3.2

³⁹⁴ See chapter 4.3.2

Table 9.1. Decisions that determines the environmental impact from SEMC's outbound logistics

Area	Decisions concerning	Comments
Design of handset	Size Shape Design for supply chain	
Design of complete sales item	Content	Packaging material Plastic bags Handset Charger Instructions Headset Cables CD
	Size and shape of parcel	
Production	Location	Local, regional or global
Outbound logistics	Number and location of warehouses and hubs	
	Where activities are performed	For instance regarding postponement and regionalization
	Mode of transport	
	Selection of forwarder and demands on their performance and work for the environment	Routes Vehicle standard Maintenance Driving behaviour Fuel Utilization of fleet, Coordination Fill rate
	Pallet	Size Weight
Sales and operations planning	Size of orders Frequency and timing of transports	Ability to keep high fill rates. Improved planning to avoid emergency deliveries

9.3 The studied system

This section contains an analysis of the findings from the studied system from the perspective of researchers, forwarders, SEMC and the case companies. Together with the previously identified activities that determine the environmental impact from SEMC's outbound logistics, recommendations on how they can reduce the emission levels are explained.

9.3.1 Green logistics management

In Eyefortransport's survey³⁹⁵, a majority of the participating companies worldwide consider green issues important or very important and many of them work with emission reductions. This fact, together with the findings from the case studies and the information from freight forwarders, shows that green logistics management is becoming more common. As SEMC aims to be a leader within sustainability, it is essential that they now set up an organization that makes this possible.

Initiatives in green logistics management that has been identified in this study are summarized in table 9.2. These are compared to the current practices at SEMC to identify gaps and understand SEMC's present performance. If the initiatives are not already in place, the possibility for implementation is determined together with the potential for emission reduction, when this is applicable. Further comments such as the importance of implementation or explanations of the initiatives are also included in the table.

³⁹⁵ See chapter 5.4.2

Table 9.2. SEMC's current practice and potential for identified green initiatives within green logistics management

Initiative	Current practice at SEMC	Potential for SEMC to:		Comments
		implement	reduce emissions	
Create baseline	No – But about to start gathering data	High		Prepares for further work
Set target for emission reduction	No	High		Prepares for further work
Action plan	No	High		Prepares for further work
Measure and evaluate the environmental work	No	High		Controls and manages the work
Public environmental reporting	No - not within logistics	High		Requirement in order for SEMC to profile themselves as a leader within sustainability
Work for increased internal awareness	No - not within logistics	High		Prepares for further work
Include the environmental factor in logistics decisions	No	High		By adding the environmental impact as an additional cost. Sometimes cost and environmental impact go hand in hand but that is not always the case.
Collaboration with partners and suppliers	No	High		By exchanging information and addressing the issue together there are greater possibilities for improvement
Dialogue with customers	No	High		By informing the customer on how e.g. demands on the package, ordering system, lead-times etc. affects the environment and then together discuss possibilities for improvement.
Collaborations and memberships within logistics and environment	No	High		These collaborations can help with emission calculations, evaluation of freight forwarders, benchmarking etc. as well as give marketing opportunities
Carbon offsetting and trading	No	High	Low	This is mainly a marketing opportunity, SEMC should focus mainly on reducing the CO ₂ emissions from their own operations

As can be seen in the above table, SEMC has many initiatives they need to implement in order to organize the work for green logistics management. The case studies showed clearly that initial green logistics initiatives are to create a baseline by calculating the current emission levels and to set targets for emission reduction. Some companies are performing the emission calculation themselves and others let their freight forwarders provide this data. Among the three forwarders interviewed in this study, all could provide emission data. Emission calculators are also available through organizations such as SmartWay and NTM. Measurement does not only give the opportunity to confirm progression, it also makes it easier for the company to understand the best areas to target for reductions. In order for this to be achieved, key performance indicators need to be determined. These must be selected to give comparable measures so that the true improvements are shown.

Creating a baseline does bring some obstacles such as finding a common methodology and platform for discussions globally, as well as to obtain and compile data. However, it is most likely not the calculations that will be the largest obstacle, but the change of routines and

mindsets. It is therefore important that the internal awareness of the issue increases which is something all of the studied companies work with. Case companies also show plans for how to reduce emissions, including what areas to target and how to manage and evaluate the work.

Ericsson and Panasonic are currently working with creation of baselines, which reflects that their environmental work has just recently begun. Finding companies with long experience of work for CO₂ emission reduction from logistics was difficult and shows that this is a relatively new area for many. This does however not mean that achievements have not been made, only that they find it too early to communicate the results externally. IKEA and Tetra Pak have longer experience and could present some results. They also seem to have introduced an environmental thinking among employees and include the environmental factor in logistics decisions. Generally, the Nordic companies are considered to be in the forefront regarding green logistics.

According to Lumsden's framework³⁹⁶, changes in logistics structure and purchasing- and distribution patterns have the largest potential for environmental savings. He states that although they have the greatest potential, they are not the most prioritized areas for companies to target. However, when global companies were asked about their planned green transportation and logistics initiatives by Eyefortransport, strategic warehouse and DC placement was one of the most common answers as well as using more environmentally friendly logistics providers. Logistics structure initiatives were as well indicated in the case studies such as working for increased regionalization to reduce the transport distances.

Just as Lumsden states, the more operational activities showed to be most common also in this study. Time management of orders to determine the flows through discussions with sales and customers, better planning and segmentation of products are some examples. Sharp for instance have a dialogue with their customers about how ordering more seldom reduces the environmental impact. Ericsson is striving to better plan their projects and discusses lead-times with customers in order to enable a more environmentally friendly mode and increase fill rate. An obstacle to introducing more environmental practices is the time factor. Customers are today used to short lead-times and they may not reflect over the positive effect earlier notice could have on the environmental impact. With more time between order and delivery, it is easier to plan for the most environmental option, to increase fill rate and to select the most environmental mode of transport. If the dialogue with sales, customers and transport providers improves, these can better optimize their work to reduce the environmental impact. The dialogue with customers can as well enable segmentation of products according to urgency. Perhaps not all of the products in the order need to be delivered as soon.

Control of transport resources, includes initiatives such as selecting more environmentally friendly transport modes, optimize the transportation routes and increase the fill rate which most case companies worked with. Different from what Lumsden has stated, case companies have considered change in mode as one of the most efficient way of reducing the emission levels. However, as presented in Aronsson and Huge Brodin's funnel framework³⁹⁷, decisions on higher strategic levels limit the options on lower levels and to be able to change mode structural changes may as well be needed.

³⁹⁶ See chapter 4.3.2

³⁹⁷ See chapter 4.3.2

Other findings of interest from observations of case companies and competitors websites were that they all reported publicly on their environmental work. Since SEMC wants to be a leader in sustainability and to use this as a marketing opportunity, they should report on their environmental work, also in logistics, in their environmental report and on their website. The information published must however be carefully selected not to present initiatives that can not be defended, as this can affect the credibility. Consequently, it is of importance to have a careful evaluation of the environmental work.

The case studies have shown that being a member of organizations within logistics and environment can be helpful. As mentioned before, it can be difficult to perform emission calculations and some organizations can help with this, for instance NTM and SmartWay. All six studied companies were members of different organizations³⁹⁸ and they all had only positive things to say about it. General comments were that these memberships provided good benchmarking opportunities. The Clean Shipping project and SmartWay also help making demands on the freight forwarders. Being a member of such organization would also be good for SEMC’s environmental image. Recommended organizations are NTM, where Ericsson already is a member, and the SmartWay partnership in USA which is well known and have Sharp, IKEA and Panasonic as members. Finally the WWF Climate Savers could be of interest where Sony and Tetra Pak are members.

9.3.2 Logistics structure

Changes in logistics structure is said to bring the largest possibilities for emission reduction as it can reduce the overall logistics significantly. Opportunities for improvements include location of warehouses, production sites and suppliers. Green initiatives regarding the logistics structure that have been identified in the study are summarized and compared to the current practice at SEMC in table 9.3.

Table 9.3. SEMC’s current practice and potential for identified green initiatives within logistics structure

Initiative	Current practice at SEMC	Potential for SEMC to:		Comments
		implement	reduce emissions	
Regional warehouses	No	Medium	Medium	Enables more environmental friendly modes, reduction of lead-times etc.
Production site close to the market	No	Low	High	Would significantly reduce the transport work needed but is however not compatible with SEMC’s current strategy
Regional customization centres	No	High	High	Enables more environmental friendly modes, local sourcing, reduction of lead-times etc.
Produce to order	Yes			
Direct shipments	Yes			Shortening of routes reduces the transport work
Vehicle re-routing to reduce miles	Some work initiated	High	Medium	Should always be considered, possibility to improve by collaboration with forwarder
Include the forwarder early in the decision making process in order to make complete logistics investigations	No	High	Medium	The forwarders knowledge of routes is a valuable asset when selecting the most environmental route.

³⁹⁸ See table 8.14

SEMC uses direct shipments of their products which in a way is positive as it keeps down the transport distances. However, a direct shipment set-up together with demands on short lead-times put tough demands on the transportation time and makes air transportation difficult for SEMC to avoid. Furthermore, this set-up makes it more difficult to keep high fill rates since shipments need to be made more frequently and consequently in lower volumes. Panasonic is nevertheless working to increase direct shipments. To be able to keep high fill rates, they consolidate goods with other companies. They also claim that by saving on storage space they save as well on the emissions from building and running the warehouses. Additionally, with more warehouses the risk for products to become obsolete increases which means goods are transported unnecessarily. To conclude, the optimal logistics structure when it comes to environmental impact depends on the case. The theory states that high volumes are needed to benefit from centralized warehouses and that it is a favourable set-up if customers are located close to each other.

As has been shown in Aronsson and Huge Brodin’s framework model³⁹⁹, the selection of logistics structure limits opportunities on lower strategic levels. Since the current set-up at SEMC limits for instance the possibilities to use other modes than air, changes in logistics structure would increase the potential for emission reduction drastically. Options for a new structure are setting up warehouses, returning to the previous set-up with regional customization centres or setting up new production sites closer to markets. With warehouses, the complete set-up with customization to order must change. It is accordingly not considered to be the best option.

If regional customization centres were introduced again it would be possible to postpone the customization because of the reduced transportation time of finished products to customers. Accordingly the lead-times from order to delivery could be reduced as well. The set-up is presented in figure 9.1 and would apart from reducing lead-times make it possible for unmodified handsets to be transported by other modes than air to the centre. This could reduce emission levels significantly since large vessels emit 10 grams CO₂ per tonne-km compared to 500 grams for air transport.

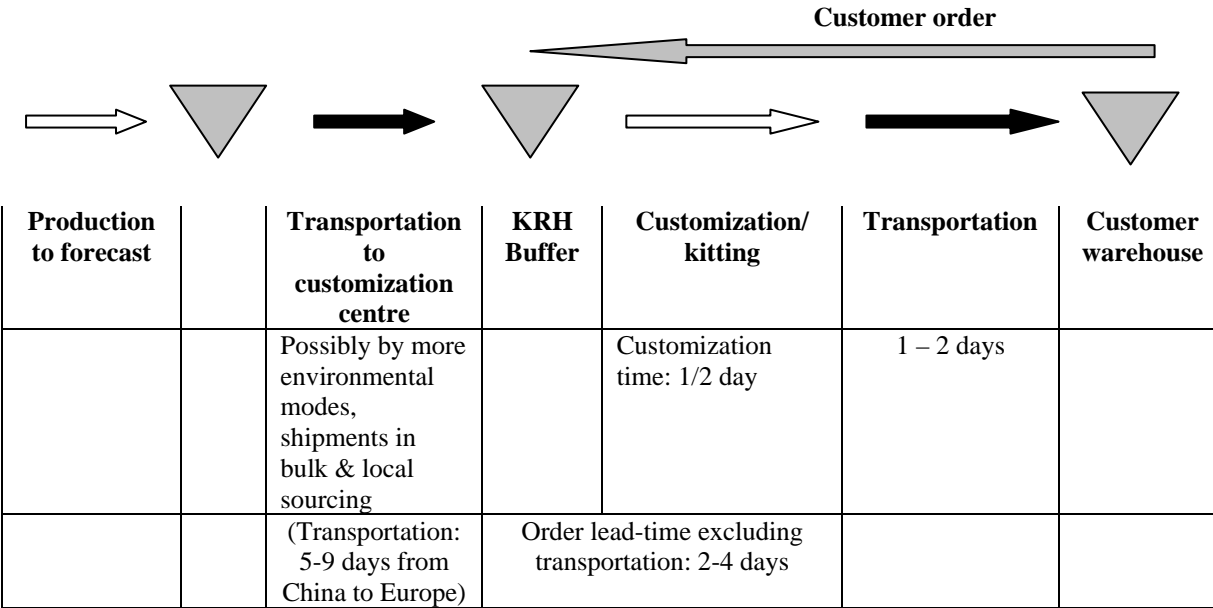


Figure 9.1. Alternative logistics set-up with regional customization centre

³⁹⁹ See chapter 4.3.2

With a customization centre, the shipments could also be made in bulk, resulting in a significant decrease in volumes and in freight cost. When SEMC earlier made shipments in bulk, 2000 phones could be transported in the same pallet as 240 sales items are transported today. Furthermore, this new set-up would enable sourcing of e.g. packaging material and battery from suppliers close to the customization centre, which would reduce the transportation of these items significantly. Since SEMC transports a large share of the products from China to Europe, a customization centre in Europe would have the largest potential.

To fully take advantage of the customization centres, SEMC must make the KRH unit as standardized as possible and take after the concepts design for customization and design for localization as described in the theoretical framework. This was not the case in the former customization centres which was the reason they were closed down. By making a design in a generic model that is easily customized they increase flexibility, make the inventory control less complex and are able to more easily respond to fluctuations in demand.

The case studies also indicate that companies are locating sites closer to the customers to thereby reduce the transports. When making such decision, the inbound transportation should as well be taken into consideration so the transport work in total is reduced. Moving the production from Asia might not be an option for SEMC, at least not in the short term. The environmental factor should nevertheless be taken into consideration when selecting new production sites or deciding which production sites to serve which markets. Emission calculations can be a useful tool for selecting the best set-up as it gives hard data on what option to favour. Freight forwarders can help in the process of evaluating potential new logistics structures. This study shows that all the forwarders interviewed are willing to provide help with this. The earlier they get involved, the greater impact they can make. As it is them who have the knowledge of routes and freight opportunities, they are a useful source of information.

9.3.3 Mode selection

The environmental impact from the four modes differs significantly, see figure 9.2. Air transportation emits much higher levels of CO₂ than other modes. Since SEMC transports almost all products by air today, it is obvious that here lie great possibilities for emission reductions.

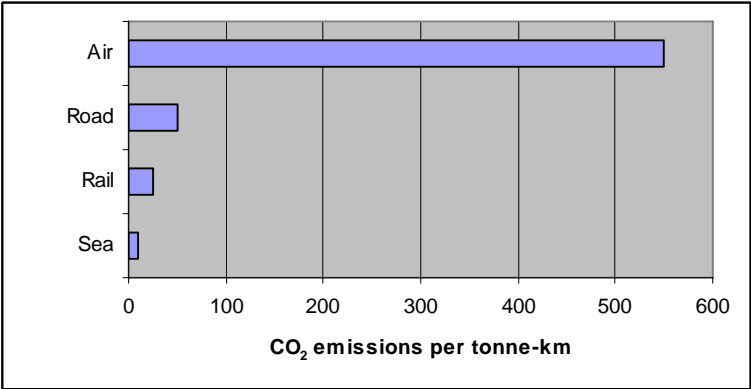


Figure 9.2. CO₂ emissions per tonne-km from the different modes of transport⁴⁰⁰

⁴⁰⁰ Swahn, Magnus 2007-12-03

Findings from the case studies and the analysis of external factors indicated that mode selection is a major area targeted for emission reduction initiatives among companies. It is also considered one of the most efficient initiatives for emission reduction. According to the Eyefortransport's survey⁴⁰¹, the shift from air to other modes of transportation is one of the most important green issues in the companies' overall strategy, especially within Europe. Other trends among the companies are to initiate the shift from road to rail and from road to sea. The EU also promotes these shifts as explained when discussing the external factors. In order for SEMC to be proactive concerning new regulations and be able to achieve great emission reductions, they should consider other options than air transportation. Table 9.4 contains a summary of the identified green initiatives within mode selection and the potential for implementing them at SEMC.

Table 9.4. SEMC's current practice and potential for identified green initiatives within mode selection

Initiative	Current practice at SEMC	Potential for SEMC to:		Comments
		implement	reduce emissions	
Change of mode from air to sea	Yes	Medium	High	They have recently initiated such a change for entry-level phones on a certain route. However, there is great potential for further changes. Furthermore this must be complemented with structural changes in order for SEMC to fulfil the demands on lead-times.
Change of mode from road to rail	No	Medium	Medium	As the rail systems differ between countries within Europe today, this will be difficult to implement today. However, investments are made to improve rail transport whereby the development should be monitored.
Change of mode from road to sea	No	Low	Medium	Does not fit SEMC's current logistics set-up
Intermodal transports	No	High	High	Intermodal transports are an option to SEMC since the lead-times are shorter than transport solely by sea and the carbon footprint is significantly reduced compared to air transport.
Improved planning of projects to enable more environmental modes	No	High	Medium	Facilitated by an increased awareness internally and communication with customers
Segmentation to enable most environmental transport for each product	No	Medium	Low	Not the most important initiative initially but for the continuous work within green logistics. Facilitated by better communication with customers.
Grouping of spare parts according to urgency	No			Not included in the limitations of the study

With a customization centre, the possibility to transport by sea would increase drastically, especially for lower value components. A standard amount of higher value goods could as well be shipped by sea on regular departures and be complemented with air transport to cover the variations in demand.

⁴⁰¹ See chapter 5.4.2

Findings from the interviews with the freight forwarders indicated that new transportation routes are being explored, both within China, from China to EU and within the EU. A new transportation route of interest to SEMC is shipping by rail to the north-west of China and from there by air to Europe. This route would result in only a small increase in transportation time, to 9-12 days. Nevertheless, CO₂ emissions from this new route would be reduced by 36 percent compared to transporting products by air from Beijing and Shanghai to Europe. The experience with this new route so far has been merely positive. Another option for multimodal transportation that is rather common today is shipping goods by sea from China to Dubai, and then transport by air to the final destination. The transportation time for this set-up is 22-24 days from Beijing and 16-18 days from Shanghai. The reduction in CO₂ emissions compared to air transport is 38 percent. These two options for multimodal transportation should definitively be considered at SEMC since they can make a significant impact on the carbon footprint.

If the current logistics structure is kept at SEMC, there are not many possibilities to change mode of transport and still keep the same lead-time requirements, even if the planning improves. Among the case companies, Ericsson and Panasonic transport their products mainly by air today. Ericsson is however initiating a change of mode from air to sea. The experiences so far have been mainly positive with no major quality problems. Ericsson's experience is that the customer sometimes does not need the product right away and can therefore accept a longer lead-time. Most of SEMC's shipments go to customers' centralized warehouses today. If the customers make orders earlier and are willing to except a longer lead-time if the environmental impact can be reduced, it would be possible to plan for more environmental transportation even with the current set-up. Furthermore, SEMC can make more of the shipments to VMI or VMR, an ordering system that can make it easier to get sufficient time to plan for a more environmentally friendly mode.

SEMC transports their products by road from hubs and within regions. As the congestions on the roads increases and bodies of regulation make initiatives to reduce road transport, SEMC should, as their parent companies' Sony and Ericsson and other case companies already do, act proactive and look into possibilities of changing mode.

Finally, in the selection of mode for a certain route, SEMC should take the environmental factor into consideration. This can be made by calculating and comparing the emissions from different modes. By doing this, the environmental impact can be visualized and influence the decisions makers. A further step towards always selecting the most environmentally mode is through segmentation of products, for instance by separating the delayed products in an order from the ones completed on time. This reduces the need of faster and less environmentally friendly modes as the ones completed on time can be shipped by for instance sea. This is however not considered one of the most important initiatives for SEMC initially.

9.3.4 Carrier selection

SEMC has outsourced its transports to freight forwarders. Nevertheless, even if it is the forwarders that perform the transport, it is the shipper who in the end is responsible for the impact it has. Therefore, it is not enough to solely make environmental demands on the forwarders. To achieve the greatest reductions, efforts need to come from both parts, some of them preferable in collaboration. Discussions with forwarders indicated that their network design is already optimized since it has a great effect on their costs. As a result, they see the greatest potential for environmental saving if they are included at an early stage in the

shippers’ decision making process. Then the forwarder can bring their expertise in structural decisions as well.

Identified green initiatives within carrier selection are compared to the current practice at SEMC and are summarized in table 9.5. The potential for implementation and emission reduction are also discussed.

Table 9.5. SEMC’s current practice and potential for identified green initiatives within carrier selection

Initiative	Current practice at SEMC	Potential for SEMC to:		Comments
		implement	reduce emissions	
Collect data on CO ₂ emission levels from forwarders	Yes			Emission data is a prerequisite for further work within green logistics
Incorporate environmental factor in selection and demands on forwarders	Yes- but only to a small extent	High		Demands are preferable developed in collaboration with the forwarders and stated in the contract. Demands can be either general, such as CO ₂ emission targets and action plan, or more specific such as e.g. truck age/Euro standard, biofuel, eco-trucks or eco-driving.
Purchase of services within the US from members of SmartWay	No	High		The forwarders have already committed to emission reductions and evaluation of their performance
Evaluation of freight forwarders’ environmental performance	No	High		Necessary in order to make sure that the forwarder’s follow the demands stated in the contract
Public supplier rating system on environmental performance	No	High		Not the most important initiative initially

Findings from the interviews with the three major freight forwarders showed unambiguously that it is demands from customers that drive their environmental work. A large customer can have an important impact on the improvement of the forwarders’ environmental work. Consequently, it is still important that SEMC includes environmental demands in the selection of forwarders and includes these in the contracts.

Among the studied companies there are two approaches towards environmental demands on the freight forwarders. The first one is having specific demands, such as increased use of biofuel, green trucks, no idle policy, promotion of eco-driving etc. However, specific demands can have negative effects since it can make it harder for the forwarders to optimize their transports. If a customer demands forwarders to ship their goods on green trucks, it may be difficult to keep a high fill rate. An additional obstacle with having demands on eco trucks and use of biofuel is the lack of infrastructure development in some countries.

The second approach is to make demands on long-term development and demand the forwarder to have CO₂ emission reduction targets and an action plan for achieving them. This approach is found at IKEA and Tetra Pak and is by them considered more effective than the first one. It gives the forwarders possibility to focus their efforts where they see the largest potential for improvements in the long term. It also requires continuous improvements. However, this approach requires more resources since it is harder to follow up on these demands. Tetra Pak and IKEA both perform audits at their suppliers’ sites. Tetra Pak also practises a public rating system where they rate the suppliers’ environmental performance on a scale of three.

Examples of environmental demands that can guide shippers in their selection and evaluation of freight forwarders is provided by the networks NTM⁴⁰² and QIII⁴⁰³. These demands have been developed through discussions with both shippers and freight forwarders. Forwarders prefer to discuss the environmental demands together with the shipper, in this way they can together agree on the optimal initiatives for emission reduction. Examples of demands to promote are environmental policy and targets, action plan for increased fill rate, environmental management systems, demands on subcontractors, education in eco driving and fleet standard and age.

Since the demands stated in the contract are the ones acted on, it is crucial that these are the most important ones and that the shipper intends to follow up on them. Findings from the discussions with forwarders indicated that they often see a lack of communication between the various functions within a company. The ones with the final responsibility for purchasing the services often prioritise other factors than the environment. Consequently, many of the original environmental demands do not end up in the final contract. Just as stated by Björklund⁴⁰⁴, shippers should increase the information exchange and strive to apply a more uniform level of ambition throughout the process.

The case companies and the freight forwarders both stated that it is important to follow up on the demands in the contract. If they are not being measured and evaluated, the forwarders will most likely not take action. Consequently, it is crucial that SEMC follow up on the environmental demands. In order for this to be possible, changes in the internal conditions need to be made and new measures and follow-up routines need to be created.

The freight forwarders that are members of the SmartWay partnership in the US have already committed to emission reductions and evaluation of their performance. This makes the work easier for shippers purchasing transports from members of this type of organization. However, SmartWay only exists in the US, but comments were made that a similar organization was wished for outside the US as well.

9.3.5 Fill rate

The fill rate is strongly dependent on decisions about product size and shape, logistics structure but also on the sales and order management. As explained by Swahn⁴⁰⁵, fill rate can be worked with on different levels, in each parcel, pallet, vehicle or in the infrastructure.

Identified green initiatives within fill rate and the current practice and potential for implementation at SEMC are summarized in table 9.6. Further comments such as the importance of implementation or explanations of the initiatives are also included in the table.

⁴⁰² See appendix 4

⁴⁰³ See appendix 5

⁴⁰⁴ See chapter 4.3.2

⁴⁰⁵ See chapter 4.3.2

Table 9.6. SEMC's current practice and potential for identified green initiatives within fill rate

Initiative	Current practice at SEMC	Potential for SEMC to:		Comments
		implement	reduce emissions	
Sales and order planning for regular and controlled flows	Some work initiated	High	Medium	Ordering patterns to enable high fill rates
Consolidate with other companies	No	Low	Low	SEMC uses large forwarders that do consolidate goods
Reduce size and shape of products	No	High	Medium	Includes the complete content in the sales item, except packaging material
Reduce size and shape of packages	Some work initiated	High	Medium	Still, more can be done and potential new solutions should be discussed with customers
Improve truck design for more efficient storage	No	Low	Low	Since SEMC do not own their own vehicles, this would not be a prioritized initial initiative for them
Improve planning and communication between shipper and forwarder	Some work initiated	High	High	The planning and communication should be improved even further. By noticing the forwarder on an early stage, they have a greater chance to plan the transportation and thereby increase the fill rate. Let forwarder monitor and report fill rate in order to identify possibilities for improvement
Question the importance of each transport	No	Medium	Medium	This would increase the fill rate and at the same time reduce the total transport work. Facilitated by understanding the urgency of each transport

On parcel level improvements can be made by reducing packaging material and size of packages. The case studies have shown that all the companies except from Sony have made initiatives in this area. Sharp did by changing packages for computers reduce the volume by 50 percent. Due to high transport costs, SEMC are also working with their packages, to reduce size and weight as well as optimizing the ability to load them on pallets. Weight has an effect on the fuel consumption but to reduce the total need for transport, much focus need to be on size. To be able to reduce the size even more the content should be questioned to see if it can be rationalized. For SEMC this could involve eliminating manuals and replace them with information submitted electronically. Other examples are providing software online and eliminating plastic bags for cables and charger. In cooperation with customers, these and other solutions should be tested to reduce size and weight of packages. To realize these changes, supply need to increase their strength in making demands on product development. With customization centres, the possibility to improve the fill rate would increase significantly. Shipments in bulk to the customization centre could increase the fill rate drastically.

Fill rate in pallets can be optimized by having the customers order volumes that fill an even number of pallets. To make customers order in full pallet quantities, a fee could be added if ordering in odd or small quantities. Alternatively, an environmental discount could be given for full pallet order sizes.

Initiatives to increase the fill rate in vehicles have been made by companies such as Sony and Panasonic through consolidation of goods with other companies. However, transporting with global freight forwarders as SEMC does also provides great possibilities for consolidation.

As stated earlier, it would be favourable if the communication and cooperation between shippers and forwarders were improved. Earlier notice on an order enables better planning and in turn increases their possibility to increase the fill rate. Also, the demands on forwarders could as well include monitoring of capacity and fill rate. This information can show possibilities for improvement, but also encourages forwarders to increase fill rates. Another option for SEMC to work with fill rate in vehicles is by influencing the timing of orders. The suggestion to send only one shipment once a week to the same destination will not only increase control in the order process; it will also make the planning of transports easier. Consequently, it can have a positive effect on the fill rate. Additionally, the work with CPFR for increased exchange of information between customers and SEMC also makes the planning easier by creating better understanding of future demands. Including the environmental factor in these discussions give potential to bring further opportunities for emission reductions. To understand the urgency of the delivery and question the importance of each transport, are additional means for keeping high fill rates and thereby reducing the total transport work.

9.4 Recommendations to SEMC

This section presents suggestions to how SEMC can introduce green logistics management and initiatives recommended for reducing the carbon footprint in order to fulfil the purpose of the thesis. The recommendations are based on the discussions in the previous analysis and the rating made of the identified initiatives. This rating is summarised in table 9.7.

Table 9.7. Potential for the identified initiatives at SEMC

Possibility to implement at SEMC	<i>High</i>	<ul style="list-style-type: none"> • Carbon offsetting and trading 	<ul style="list-style-type: none"> • Vehicle re-routing to reduce miles • Include the forwarder early in the decision making process in order to make complete logistics investigations that include the environmental factor • Sales and order planning for regular and controlled flows • Improved planning of projects to enable more environmental modes • Reduce size and shape of products • Reduce size and shape of packages 	<ul style="list-style-type: none"> • Introduce green logistics management • Regional customization centres • Intermodal transports • Incorporate environmental factor in selection and demands on forwarders • Improve planning and communication between shipper and forwarder
	<i>Medium</i>	<ul style="list-style-type: none"> • Segmentation to enable most environmental transport for each product 	<ul style="list-style-type: none"> • Regional warehouses • Change of mode from road to rail • Question the importance of each transport 	<ul style="list-style-type: none"> • Change of mode from air to sea
	<i>Low</i>	<ul style="list-style-type: none"> • Consolidate with other companies • Truck design for more efficient storage 	<ul style="list-style-type: none"> • Change of mode from road to sea 	<ul style="list-style-type: none"> • Production site close to the market
	<i>Low</i>		<i>Medium</i>	<i>High</i>
			Potential for emission reduction	

The initiatives that achieved the highest rating, found in the white cells in table 9.7, are used in the recommendations to SEMC. The suggested process for taking action against climate change is presented in figure 9.3.

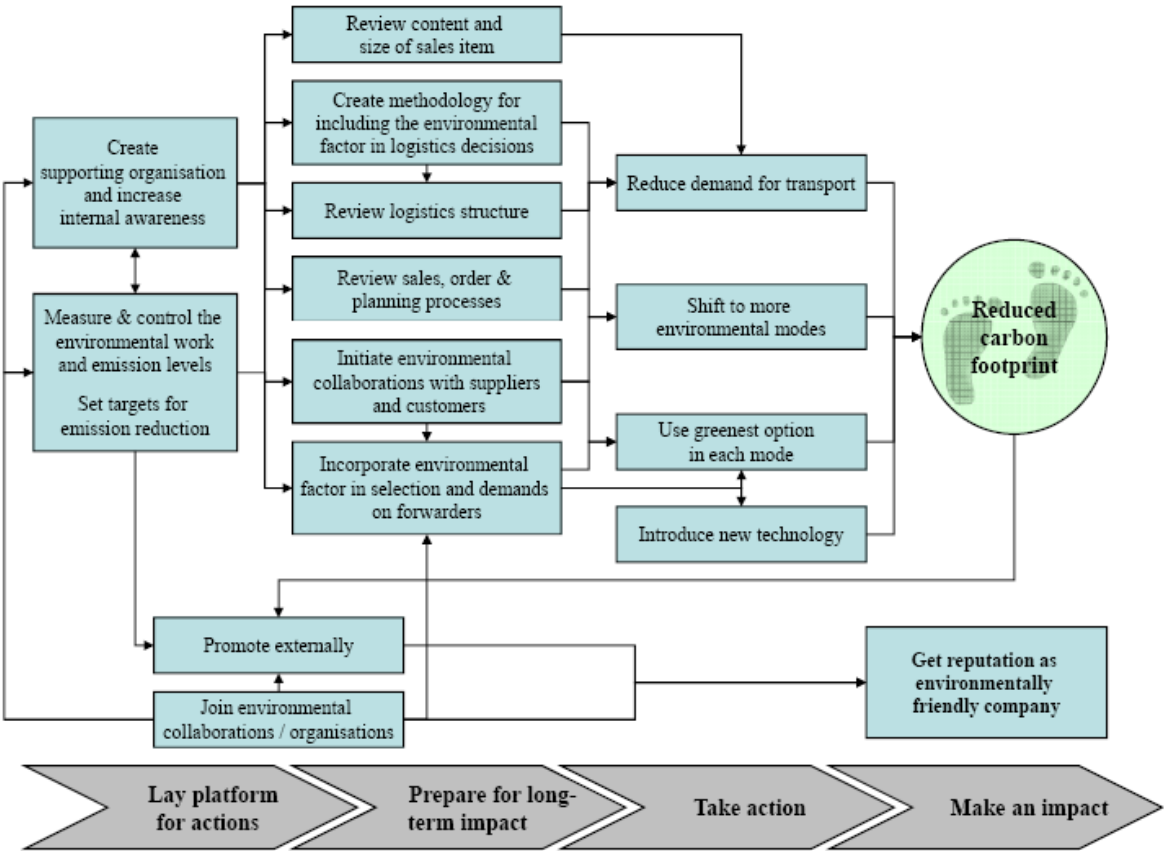


Figure 9.3. Recommendation to SEMC on how to reduce the carbon footprint from outbound logistics

Increased awareness internally can be seen as a facilitator for implementing further recommendations. A baseline should be created by on a regular basis demand CO₂ emission reports on SEMC’s operations from freight forwarders or by own calculations. Research of other companies’ emission reduction targets shows figures for emission reduction between 4 and 12 percent in relative numbers. Tetra Pak on the other hand has as target to reduce emissions in absolute numbers.

Reducing the total need for transport is both cost effective and can provide great reductions in emission levels. It can be achieved by reducing size of sales items, by reviewing the sales and order process or through better communication with sales and forwarders to make sure deliveries are sent in full pallets. Reducing transport can also be made by reducing the distances goods have to be transported through structural changes.

Structural changes give, if it is combined with modal shifts, new packaging solutions and local sourcing, large possibilities for emission savings. To enable modal shifts at SEMC, a new logistics structure is a prerequisite if lead-times to customers shall remain short. This change is consequently very complex. Due to the environmental savings it brings it is however an initiative strongly recommended.

Becoming a member of organizations can guide the work, provide benchmarking opportunities and help in selection of forwarders. Important to consider, even though it is not illustrated in the figure, is a regular follow-up on the progression of the work.

The recommendations are also presented more in depth in table 9.8 together with the prerequisites for implementing them, potential benefits and other comments. They are again divided into the areas green logistics management, logistics structure, mode selection, carrier selection and fill rate.

Table 9.8. Recommendations for reduced carbon footprint within outbound logistics at SEMC

Green logistics management			
Stage in process	Initiative	Prerequisites	Benefits / Comments
Lay platform for actions	<i>Work for increased internal awareness</i>	Commitment from management	Education and communication about how logistical decisions effect the carbon footprint
	<i>Create baseline</i>	Emission data	Collect data on CO ₂ emission levels from forwarders or by own calculations
	<i>Select key performance indicators</i>		Must be selected to give comparable measures so that the true improvements are shown
	<i>Set target for emission reduction</i>	Baseline	
	<i>Construct action plan on how to achieve the target</i>		
	<i>Measure and evaluate the work</i>	Emission data Key performance indicators	
Prepare for long-term impact	<i>Promote the environmental work within logistics externally</i>	Careful evaluation of the environmental work	Marketing opportunity
	<i>Join organizations within logistics and environment</i>	Fulfilment of requirements for being a member	Join e.g. SmartWay and NTM These collaborations can help with e.g. emission calculations, evaluation of freight forwarders, benchmarking and give marketing opportunities
	<i>Include the environmental factor in logistics decisions</i>	Emission data Internal awareness System for rating the environmental impact	
	<i>Collaborate with partners and suppliers</i>	Internal awareness Interest from both parts	By exchanging information and addressing the issue together there are greater possibilities for improvement
	<i>Initiate dialogue with customers</i>	Internal awareness Education of sales	By informing the customer on how e.g. demands on the package, ordering system, lead-times etc. affects the environment and then together discuss possibilities for improvement.
	<i>Segmentation of products (high vs. low value, urgency, stage in product life cycle etc.)</i>	Internal awareness	By segmentation of products the products with less urgency could be transported by a more environmental friendly mode.

Logistics structure			
Stage in process	Initiative	Prerequisites	Benefits / Comments
Prepare for long-term impact	<i>Introduce regionalized customization centres</i>	Standardized KRH	Enables more environmental friendly modes, reduction of lead-times, local sourcing etc. The possibility of segmentation of e.g. low value components such as the battery from high value components increases with postponement.
	<i>Re-route vehicles to reduce miles</i>	In collaboration with forwarders	Reduces the total transport work
	<i>Include the forwarder early in the decision making process in order to make complete logistics investigations that include the environmental factor</i>		The forwarders knowledge of routes and opportunities are a valuable asset
Mode selection			
Stage in process	Initiative	Prerequisites	Benefits / Comments
Take action	<i>Use intermodal transports such as rail/air or sea/air</i>	Structural changes give more opportunities for this shift Can also be facilitated by better planning that enables a longer transportation time or discussion with customers about deliveries Segmentation of products and, if the set-up of a customization centre, the components of the sales item	Significant reduction of carbon footprint
	<i>Change mode to sea</i>	Structural changes give more opportunities for this shift Can also be facilitated by better planning that enables a longer transportation time or discussion with customers about deliveries Segmentation of products and, if the set-up of a customization centre, the components of the sales item	Drastic reduction of carbon footprint The low-value products, such as entry level handsets can be transported by sea. The low-value components are most suitable to be transported by sea to the customization centre. However, there could also be a steady flow of all the components shipped by sea and then to cover the fluctuations some components could be transported by faster modes of transportation
	<i>Change mode to rail</i>		Would enable avoiding congestions and a significant reduction of carbon footprint

Carrier selection			
Stage in process	Initiative	Prerequisites	Benefits / Comments
Prepare for long-term impact	<i>Incorporate environmental factor in selection and demands on forwarders</i>		Demands are preferable developed in collaboration with the forwarders and stated in the contract. Demands can be either general, such as CO ₂ emission targets and action plan, or more specific such as e.g. truck age/Euro standard, biofuel, eco-trucks or eco-driving.
	<i>Evaluate the freight forwarders' environmental performance on a regular basis</i>	Demands on the forwarders stated in the contract	Necessary in order to make sure that the forwarder's follow the demands. Public rating can give forwarders an incentive to improve further
Fill rate			
Stage in process	Initiative	Prerequisites	Benefits / Comments
Prepare for long-term impact	<i>Demand that the forwarder monitor and report the fill rate</i>		Identifies possibilities for improvement
Take action	<i>Improve planning and communication between shipper and forwarder</i>	Increased internal awareness	By noticing the forwarder on an early stage, they have a greater chance to plan the transportation and thereby increase the fill rate.
	<i>Improve sales and order planning for regular and controlled flows</i>	Knowledge of the order flow	E.g. shipment once a week to the same destination Increases the control in the order process and makes planning of transports easier.
	<i>Eliminate manuals in sales item</i>	Alternative way to access manual, e.g. download it on the internet	Reduces the total transport work
	<i>Eliminate software in sales item</i>	Alternative way to access software, e.g. download it on the internet	Reduces the total transport work
	<i>Reduce size and shape of packages</i>		Reduces total transport work Potential new packaging solutions should be discussed with customers
	<i>Ship in bulk</i>	Regionalized customization centres	
	<i>Question the importance of each transport</i>	An understanding of the urgency of each transport Internal awareness	This would increase the fill rate and at the same time reduce the total transport work.

10 Conclusion

This chapter concludes the findings of this thesis. In order to remind the reader of the purpose of the thesis, this will initially be repeated and the level of fulfilment will be discussed. Finally recommendations on further studies will be provided.

10.1 Purpose and partial objective of the thesis

The purpose of this thesis was to provide SEMC with recommendations of possible means to reduce the carbon footprint from their outbound logistics. A partial objective was to analyse the trends in the external environment that might influence their work within logistics and environment.

The broad theoretical framework has set the foundation for an extensive analysis of the external environment. Trends have been identified through interviews with researchers and freight forwarders, through observations on companies' and organizations' websites and through case studies. By performing this careful analysis, the authors believe that they have fulfilled the partial objective to identify the trends that are likely to influence or can guide SEMC's work within green logistics. The studied system at SEMC has also been mapped and understood in order to detect potential for improvement. Together with the theoretical framework and the rest of the empirical analysis, this enabled the authors to construct valid recommendations on means to reduce the carbon footprint from outbound logistics. Thereby the purpose of the thesis has been fulfilled. To further prove their applicability, the recommendations were discussed in a workshop at SEMC.

10.2 Conclusion

In this section the problem statements are answered. The first problem statement was:

A. What trends within the external environment influence SEMC's work within logistics and the environment?

The concern for climate change has increased and national as well as supranational institutions such as the EU are making investments and form regulations to promote more environmental practices. The by the UN assigned Kyoto Protocol is one of the initiatives requiring countries to take actions towards preventing further climate change. Consequently, the world is experiencing increasingly stricter regulations on activities adding to the emission levels, especially those of carbon dioxide. The concern for environmental issues has also increased among other companies and among the transport providers.

A distinct trend within the external environment is the shift towards rail and sea transport. This shift is also promoted by the European Union to thereby reduce the congestion on roads and control the growth in air traffic. Investments are made in the development of infrastructure and to increase energy efficiency. Within the rail sector investments are also made for standardisation among countries within Europe. These initiatives are likely to improve the performance of these modes. Heavy investments to improve energy efficiency, introduce alternative fuels and improve utilization of resources are also made within the road and air sectors. This makes it difficult to predict how much the price for transportation will increase in the future. Due to the stricter regulations, transportation cost will nevertheless most likely be a larger factor to consider when selecting for example logistics structure.

B. What activities affect the emission levels within outbound logistics at SEMC?

The major drivers of the emission levels in SEMC's outbound logistics are the direct shipment set-up combined with short lead-times and global production, resulting in large volumes being transported by air on long distances. Air transportation has been identified as the mode with the significantly most negative impact on the environment.

SEMC can both directly and indirectly affect the emission levels. They can influence directly through decisions on e.g. product design, content in package, the package itself, logistics structure and sales- and operations planning. The indirect influence can be through the selection of freight forwarders, by incorporating environmental performance as a vendor selection tool and adding terms regarding environmental considerations in the contract.

C. What are the currently studied and used methods for reduction of carbon dioxide emissions?

Green logistics management is becoming more and more common, and it is a prerequisite for creating an internal awareness and initiate actions for reduction of the carbon footprint. Examples of initiatives within green logistics management are the creation of a baseline, to set targets for emission reduction and an action plan for achieving them. Furthermore, memberships of organizations within logistics and the environment are common in order to share experiences and best-practises. This and other initiatives are reported publicly in order for companies to profile themselves as green.

Changes in logistics structure are considered to bring the largest possibilities for emission reduction as they can reduce the overall logistics significantly. Initiatives identified in the study are to regionalize both warehouses and/or production to reduce the total transport work. Furthermore, a more regionalized structure enables postponement and the use of more environmental friendly modes. The shift of mode is a strong focus area among the studied companies for emission reduction. The shifts from air to other more environmentally friendly modes are seen as providing the largest potential for reducing the carbon footprint, especially the shift from air to sea since a large container vessel only emits approximately 10 grams CO₂ per tonne-km compared to 500-600 grams for an aircraft. Another common shift is the shift from road to rail. Apart from changes in logistics structure, initiatives to improve the sales- and order planning process, dialogue with customers about the environmental impact from the logistics decisions, segmentation of orders etc. were identified in order to enable a more environmental mode.

Further initiatives identified were to incorporate environmental demands when selecting forwarders and to work for an increased fill rate. Findings from the study indicated that most companies only recently have initiated emission reduction activities and therefore not many results from the efforts can be seen today.

D. With help from the findings in previous statements, what are the potential means for SEMC to reduce the CO₂ emissions from the outbound logistics of finished products?

Since the major drivers of emission levels at SEMC today are the direct shipment set-up with global production and air transports, structural changes would give the largest possibilities for reduced carbon footprint. SEMC is therefore strongly recommended to set-up customization centres closer to the customers. The suggested new logistics structure is illustrated in figure 10.1. This new set-up would enable shipments with more environmentally friendly modes of transport to the centre and make shipments in bulk possible. With local sourcing the total

transport work would also be reduced. Altogether, this would reduce the carbon footprint significantly and at the same time reduce the lead-time from order to customer which is in accordance with SEMC’s current strategy.

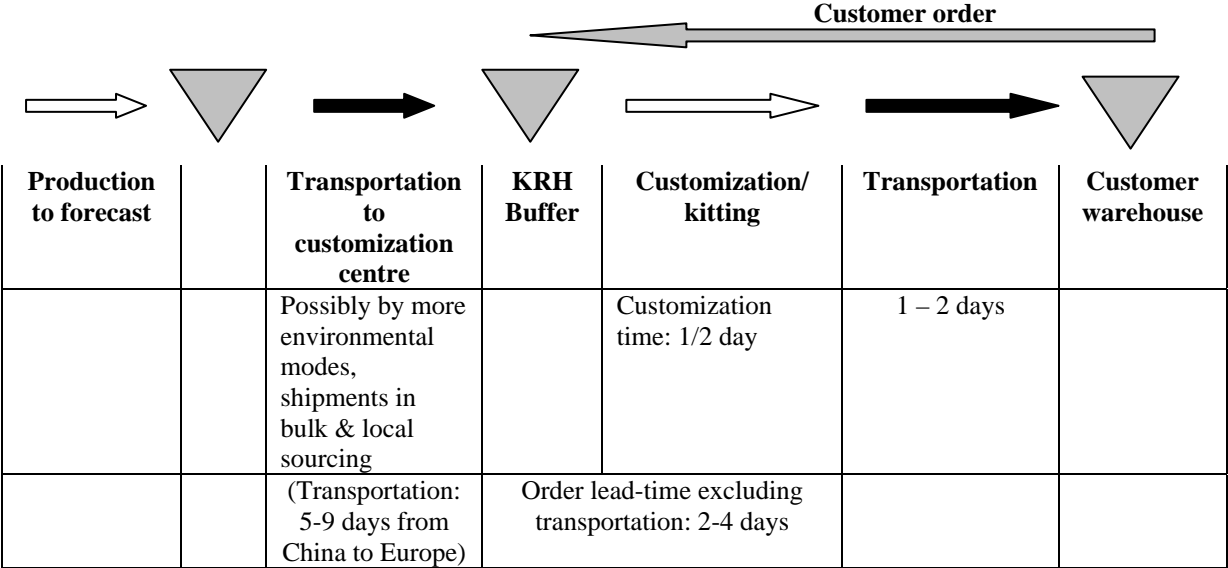


Figure 10.1. Alternative logistics set-up with regional customization centre

Targeting minor drivers of emission levels can however bring large effects when adding these activities together. In order to bring about the changes needed, green logistics management need to be introduced at SEMC. The recommended initiatives to reduce SEMC’s carbon footprint within outbound logistics are illustrated in figure 10.2 below. For a more in-depth description see table 9.8.

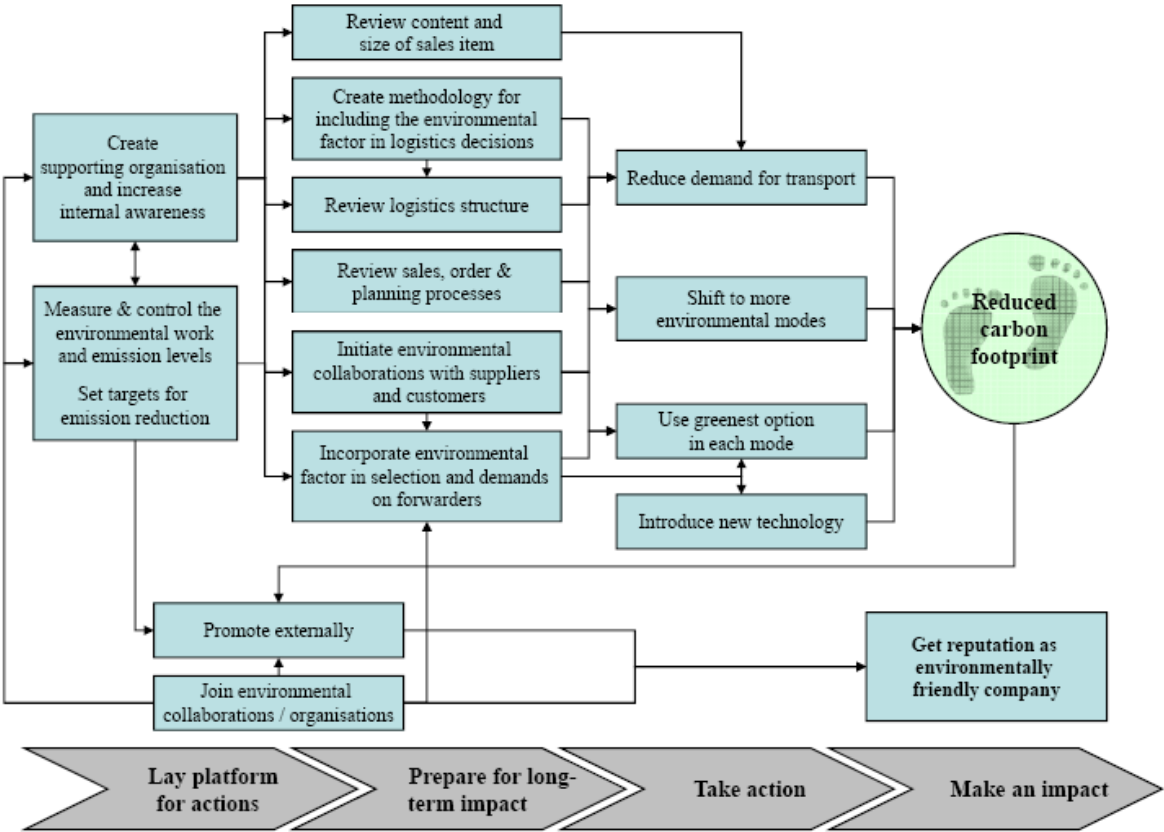


Figure 10.2. Recommendation to SEMC on how to reduce the carbon footprint from outbound logistics

10.3 Comments on the conclusion

Green logistics is a broad area and the authors decided to explore most parts of it even though the time was limited. As a result, the recommendations are general and not analysed in detail. Instead, the recommendations are meant to act as guidelines for initiatives to be further developed by the Supply Chain Greenhouse Project. The recommendations are specific for SEMC and are not applicable to other companies without modifications. However, the findings from the analysis of the external factors and the case studies could be of general interest and used by other companies initiating activities to reduce their carbon footprint within logistics.

To give SEMC an idea of how they are performing against the competition, a case study would preferable have been performed at a competitor. However, none of the competitors contacted were willing to participate. Nevertheless, the companies are expressing their concern for climate change and are either taking actions, or are likely to plan actions in the near future. The general perception is that this creates good publicity and that it often goes hand in hand with reductions in cost.

It was initially believed that the case studies would provide more results, in qualitative as well as quantitative terms. However, since hard data was difficult to obtain, it complicated the ability to determine which activities had the best opportunities to bring cost effective improvements. It also made it difficult to find interrelations between case companies' characteristics and results to use for predicting the full effects of changes at SEMC. Therefore green logistics theory has been used when creating the recommendations. Furthermore, the lack of results is a finding itself as it shows that companies have recently started to address this issue.

10.4 Recommendations for further studies at SEMC

The thesis has focused on the outbound logistics, but in the Supply Chain Greenhouse Project, the focus will be on the whole supply chain and include also the inbound logistics as well as the end of life recycling, see figure 10.3. These areas are left to SEMC for further studies.

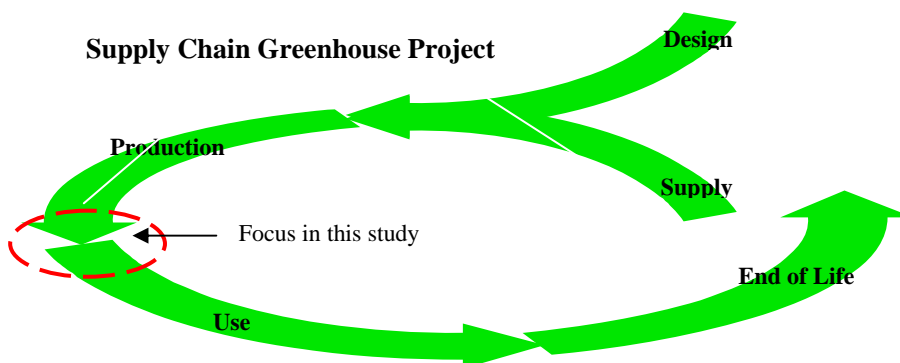


Figure 10.3. Supply Chain Greenhouse Project⁴⁰⁶

The recommendations provided in this study only serve as guidelines and some of them are in need of further studies. All the target areas mentioned for preparation for long-term impact needs to be further reviewed. One of these further studies is on how to include the environmental factor in logistics decisions, to be used for instance when reviewing new

⁴⁰⁶ SEMC internal information 2007-12-05

logistics set-ups. This can be by adding a cost for the CO₂ emissions that is included in the decision making. Another study could be to monitor the current order sizes and see how they affect the fill rate. This data can give support in the review of the sales and order process. It can also be complemented by a review of the current fill rates in the transports of SEMC's products. As stated, SEMC are recommended to make more general environmental demands on forwarders but the areas evaluated can as well be more specific. Selecting which ones to be included and creating an evaluation form for the selection of forwarders is therefore an area to continue working with. This together with increased collaborations with forwarders and customers will make SEMC prepared to take action against climate change.

Finally, the technological development and regulations within logistics and environment should be under observation in order to identify upcoming opportunities and thereby be able to act proactively. The development of new transportation routes is of specific interest. The upcoming investments in infrastructure especially within the sea and rail may in the future create further possibilities for use of a mode with lower environmental impact.

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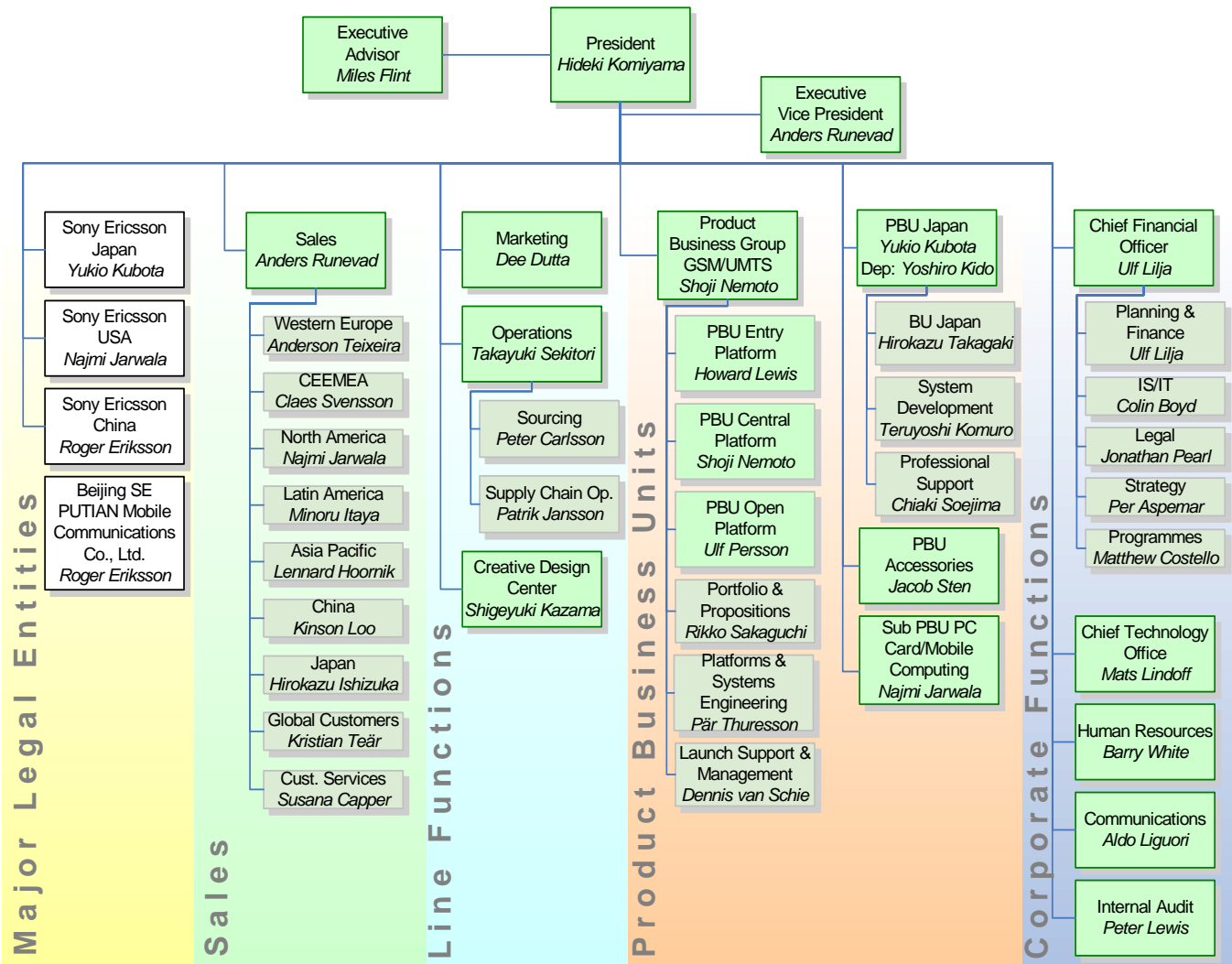
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Appendixes

Appendix 1 – SEMC’s organizational chart



Appendix 2 - Case Study Protocol

Statement of Purpose

The purpose of this study is to investigate what the underlying factors are that drives the company's environmental work, how they work with logistics and the environment, which measures they have taken to reduce the carbon footprint from transportation as well as what the effects have been.

The underlying factors that drive the change could be pressure from stakeholders or customers as well as regulations, taxes or corporate strategy. Measures could be everything from restructure of the distribution set-up and warehouses to the selection and demand on the freight forwarder, improved consolidation, packaging etc. The results we are interested in are mostly which effects the changes have had on the carbon footprint together with other factors such as lead-time, cost and reputation, but we are also interested in obstacles and problems that the changes have brought.

To be able to generalize about the results with regards to Sony Ericsson, it is important that we get an understanding about the studied company's demands on the distribution, such as where and how they produce their products together with the demands on for example lead-time to customer.

The lead-times on Sony Ericsson's products are short and most products are transported by air, globally and in their final packages. We are therefore particularly interested in understanding how you work with products similar to these, for instance the possibility to change modes.

Interview questions

Personal facts:

Name:

Company:

Division:

Job Title:

Main Responsibilities:

Years in Position:

Years with Company:

Environmental work within logistics

1. What are your objectives with the work for greening the logistics?
2. How do you work to make your distribution more environmentally friendly? (Distribution set-up, selection of mode, selection and demands on transport providers, consolidation, how products are packaged during transport, etc.)

3. Why did you decide to focus on those areas?
4. Were other options discussed?
5. What are the results of the changes so far?
6. What have been the major obstacles and risks? What is it that you have had to change in the organization and set-up to make the changes possible?
7. How have the changes affected other factors such as cost, lead-time, security, flexibility and delivery accuracy?
8. How is the environmental impact measured? CO₂ emissions in particular?
9. How is the environmental impact considered in logistics decisions?
10. How is the environmental work within the company evaluated?
11. Have you gained any public recognition from your environmental work, such as for example awards?
12. Are you members of any organization or network within the area?
13. If so, what are your experiences with this?

Underlying factors to the environmental work

1. How is your work affected by the increased attention on the climate change?
2. What are your stakeholders' demands on your work for the environment?
3. How are your decisions within logistics affected by laws and economical instruments of control?
4. What future trends that can have an effect on your work for reducing the environmental impact can you identify? For instance technological development in the transport sector, laws, regulations, taxes as well as customer demands.

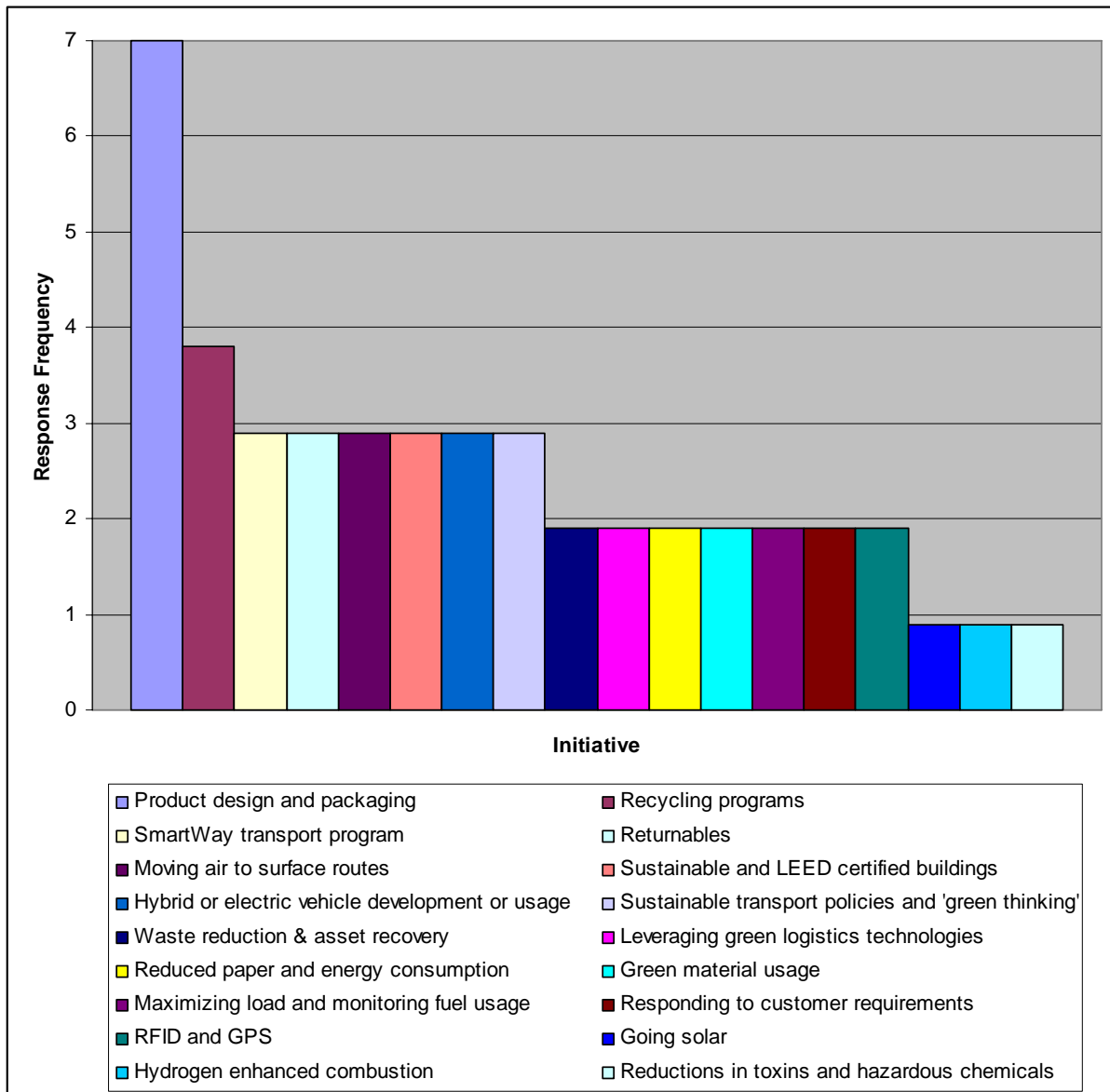
Future

1. What are your expectations on the development within the transportation field?
2. How will you keep working for further improvements?

Production and Distribution

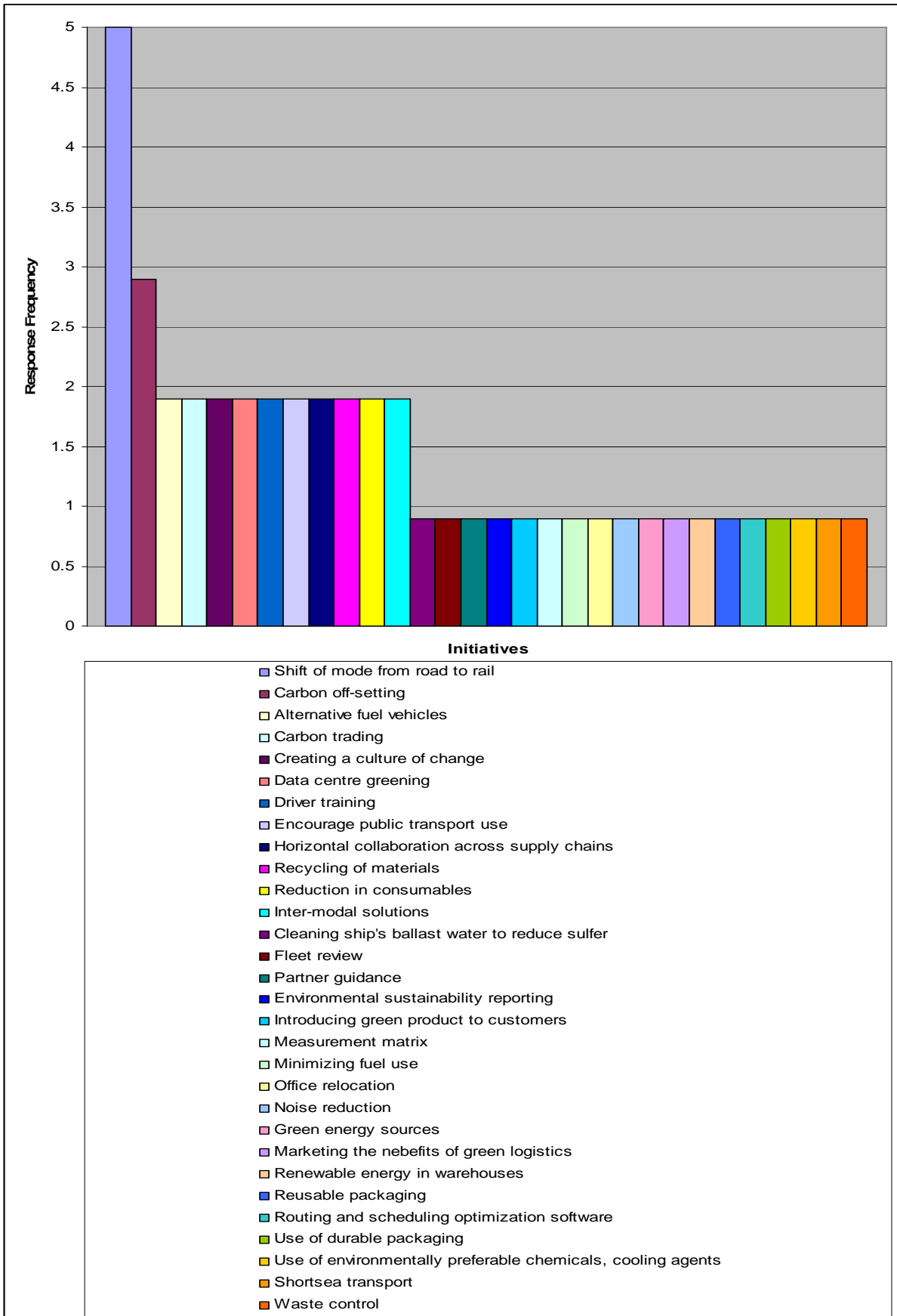
1. Where is your production located?
2. Are products mainly made to stock or to order?
3. Where are your customers located?
4. Do you use a forwarder for the transport services, if yes which are the most used?
5. Which transport modes do you use?
6. What is the logistics structure? Where are warehouses located?
7. What are the lead-time demands?

Appendix 3 – Findings from Eyefortransport’s survey



Specific current or planned green transportation and logistics initiatives in US⁴⁰⁷

⁴⁰⁷ Eyefortransport (2007), p.26



Specific current or planned green transportation and logistics initiatives in Europe⁴⁰⁸

⁴⁰⁸ Eyefortransport (2007), p.26

Appendix 4 – Network for Transport and Environment - NTM

NTM's environmental evaluation of freight forwarders⁴⁰⁹



Företaget

Datum:

Företag

Organisationsnummer

Telefonnummer

Adress

Postnummer, Ort

Telefaxnummer

Miljöansvarig

E-postadress

Direkttelefon

Logistik- /reseansvarig

E-postadress

Direkttelefon

Vilken funktion i ledningen ansvarar för bevakning och uppföljning av miljöfrågor:

Denna enkät finns uppdaterad på vår hemsida under följande länk:

Miljöpåverkan

1. Är miljöpåverkan av företagets verksamhet identifierade?

JA NEJ

Om "ja" ange de tre mest betydande aspekterna:

- a)
- b)
- c)

2. Finns en skriftlig handlingsplan för reduktion av företagets miljöpåverkan?

JA NEJ

3. Redovisning av energi- och emissionsdata, för de tjänster som tillhandahålls, kan lämnas på begäran.

Kundenspecifikt

Generellt

Inte alls

4. Har företaget specificerat mätbara miljömål som följs upp?

JA NEJ

Om "ja" ange exempel på de viktigaste målen:

- a)
- b)
- c)

⁴⁰⁹ NTM, Miljöutvärdering av leverantörer <www.ntm.a.se/index.asp> 2008-01-02

5. Har berörd personal utbildats i grundläggande miljökunskap? JA NEJ
Om "ja", hur stor andel av berörd personal?
 1-25 % 25-50 % 50-75 % 75-100 %

6. Har personalen utbildats antingen i
a - bränslebesparande körsätt **eller**
b - energibesparande åtgärder JA NEJ
Om "ja", hur stor andel av berörd personal?
 1-25 % 25-50 % 50-75 % 75-100 %

Miljöledning

7. Finns en miljöpolicy fastställd av ledningen? Om "ja", bifoga denna JA NEJ

8. Publicerar företaget regelbundet en miljöredovisning? JA NEJ

9. Har ni rutiner för att följa upp att lagar och förordningar följs? JA NEJ

10. Finns plan för nödlägesberedskap? JA NEJ

11. Tillämpar Ni miljöledningssystem? JA NEJ
Om svar "ja", hur stor del av er verksamhet, i förhållande till antal anställda %

Är systemet tredjepartscertifierat? JA NEJ

Om "ja" enligt vilken standard (bifoga certifikat eller motsvarande):

ISO 14001 EMAS Annan, nämligen

12. Accepterar Ni att ta emot en representant från vårt företag för presentation eller revision av ert miljöarbete? JA NEJ
Om svar "nej", motivera:

13. Utvärderar ni era underleverantörer på ett liknande sätt som detta? JA NEJ
Ge exempel på era största leverantörer:
a)
b)
c)

14. Ställer ni miljökrav på era underleverantörer? JA NEJ
Om "ja" ge exempel på dessa krav:
a)
b)
c)



Flygtransporter

Idébruttolista för miljö och trafiksäkerhet

Verksamhetsledning

- Se idébruttolista för verksamhetsledning

Investeringsstrategi

- Investeringsstrategi i nya flygplan?

Certifikat

- Finns det specifika miljöcertifikat inom flygsektorn som flygbolaget innehar?
- Finns det specifika miljöcertifikat inom flygsektorn som flygplanen har?

Energianvändning

- Tillämpas pilotträning för bränsleeffektiv flygteknik? (utbildning och uppföljning)
- Effektiviserad samverkan med trafikledning på marken och i luften?

Emissioner

- Används standardiserat flygbränsle av bästa tillgängliga miljöklass?
- Förekommer tester med andra alternativa flygbränslen?
- Hur arbetar företaget aktivt med att reducera emissioner?
- Metoder eller procedurer för reduktion av emissioner?
- Eftermonterad reningsutrustning?

Buller

- Hur arbetar företaget aktivt med att reducera bullerbelastningen?
- Metoder eller procedurer för reduktion av emissioner?
- Eftermonterad utrustning för bullerreduktion?
- Effektiviserad samverkan med trafikledning på marken och i luften?

⁴¹⁰ NTM, *Idébruttolista för flyg* <www.ntm.a.se/index.asp> 2008-01-02

Utrustning

- Avisningsmedel och insamling, exempelvis via krav och val av produkter, metoder och/eller flygplatser
- Dumpning av bränsle, exempelvis via klara regelverk för hur detta ska gå till när så erfordras

Service och underhåll

- Vilket typ av däck används?
- Används däck utan HA-oljor?
- Är er serviceleverantör certifierad enligt ISO 14000. Om inte, beskriv hur ni arbetar med miljöfrågor kopplat till service och underhåll.

Avveckling och skrotning

- Hur skrotas och hanteras farligt avfall från uttjänta flygplan?
- Finns policy och relaterade program/aktiviteter för skrotning av flygplanen?
- Är er leverantör av avvecklingstjänsten certifierad enligt ISO 14000/EMAS

Trafiksäkerhet

- Finns system för att säkerställa att arbetstids och vilotidsregler efterlevs?
- Hur säkerställs rätt vikter och placering i flygplan
- Hur sker lastsäkring i flygplan

Egna kommentarer och förslag

- Ange andra relevanta policys och program för miljö och säkerhet
- Utarbetar företaget en redovisning som behandlar miljö och hållbar utveckling?
- Har kunder tillgång till information om miljöbelastning vid flygtransporter?

Appendix 5 – QIII

QIII's environmental evaluation regarding freight forwarders' CO₂ emissions⁴¹¹

MILJÖ

Utsläpp till luft

- 3.1.1 Har leverantören en miljöpolicy som anger företagets långsiktiga miljömål? Ja Nej
- 3.1.2 Redovisar leverantören kvartalsvis drivmedelsåtgången och emissioner per tonkilometer och fordon? Ja Nej
- 3.1.3 Har leverantören en plan med kvartalsvisa mål för att minska drivmedelsåtgången per tonkilometer där resultatet, som redovisas kvartalsvis, också omfattar andel förnyelsebart respektive fossilt bränsle som används? Ja Nej
- 3.1.4 Har leverantören en plan för att minska beroendet av fossila bränslen? Ja Nej
- 3.1.5 Är max 5 % av leverantörens fordonsflotta äldre än tio år? Ja Nej
- 3.1.6 Har leverantören en handlingsplan för att öka fyllnadsgraden där resultatet redovisas kvartalsvis? Ja Nej
- 3.1.7 Utförs minst 30 % av transportererna av fordon som är Euro II-klassade eller bättre? Ja Nej
- 3.1.8 Har minst 50 % av leverantörens fordon katalysator och partikelfilter monterade? Ja Nej
- 3.1.9 Dokumenteras transporternas energiåtgång kvartalsvis och redovisas i (kWh/tonkm) samt beräknas utifrån bränslets energiinnehåll (kWh/l)? Ja Nej

Effektivare bränsleanvändning

- 3.2.1 Har minst 50 % av leverantörens förare genomgått utbildning i sparsamt körsätt, med motsvarande omfattning och innehåll som i ECO-drivingutbildningen? Ja Nej
- 3.2.2 Åskådliggör leverantören resultaten av drivmedelsåtgången för förarna minst en gång per kvartal? Ja Nej
- 3.2.3 Har leverantörens samtliga förare har genomgått utbildning i sparsamt körsätt med motsvarande omfattning och innehåll som i ECO-drivingutbildningen? Ja Nej
- 3.2.4 Upprätthåller leverantören kunskapen om sparsamt körsätt genom repetitiva informationer/ utbildningar eller incitamentprogram? Ja Nej
- 3.2.5 Har leverantören en individuell uppföljning som innebär att föraren får information varje månad om hur dennes körsätt påverkar bränsleförbrukningen? Ja Nej
- 3.2.6 Har minst 20 % av leverantörens fordon stödsystem som indikerar hur körsättet påverkar fordonets bränsleförbrukning? Ja Nej

⁴¹¹ QIII, *Leverantörsförfrågan* <www.q3.se/> 2008-01-11

Appendix 6 – Clean Shipping project

Clean Shipping project's criteria⁴¹²

Clean Shipping Criteria

<u>NO_x</u>	<u>Period*</u>	<u>2007-2009</u>	<u>2010-2012</u>	<u>2013- 2015**</u>
Engines from 1985-2000		-20% ¹	-40% ¹	-80% ¹
Engines after 1 st Jan. 2000 ²		-20%K ³	-40%K ³	-80%K ³
New engines ⁴		-40%K ³	-40%K ³	-80%K ³

The NO_x reductions may not increase the CO₂ emissions.

Engines applies to diesel engines with a power output of more than 130 kW

¹ From original emission level to at least below the "IMO-curve" (IMO 1997).

² New or modified according to MARPOL Annex VI (IMO 1997).

³ K= "IMO curve" (see appendix 1)

⁴ Engines from 2008

* A received certification during one period is valid until the following period expires, unless regulations stipulate otherwise

** Italics refers to preliminary levels

<u>SO_x and PM</u>	<u>Period</u>	<u>2007-2009</u>	<u>2010-2012</u>	<u>2013-2015</u>
Fuel quality – main engines		1% m/m S ¹	0.5% S ²	0.5% S
or alternatively		1% S (distillate fuel) ³		0.5% S (distillate fuel)
Fuel quality – auxiliary engines at berth		0.2% S ⁴	0.1% S ^{4, 5}	0.1% S ^{4, 5}
or alternatively		Shore-side electricity at berth; prepared for, installed and used when offered		

¹ If an exhaust gas cleaning system is installed the SO_x emission shall not exceed 2 g SO₂/kWh and the PM emission shall not exceed 5 g/kWh. It shall furthermore be thoroughly documented that the effluent to water is not harmful to the ecosystems.

² Applies only to SECAs

³ The fuel specification must follow at least DMB according to ISO 8217:2005(E). This alternative excludes the NO_x demands above, up to 2013

⁴ Applies also to boilers.

⁵ At berth and within 12 nautical miles of the port limit.

<u>CO₂</u>	<u>Period</u>	<u>2007-2009</u>	<u>2010-2015</u>
		Report MEPC index (MEPC 2005)	<i>Better combustion technique</i>
		Report on transport planning	<i>Better ship/hull design</i>
		Report on speed planning	<i>More efficient propulsion</i>
			<i>Biofuel/Biofuel addition</i>
			<i>Other renewable sources of energy</i>

⁴¹² Clean Shipping Project <www.cleanshippingproject.se/projektet.html> 2007-12-06

<u>Antifouling</u>	<u>Period</u>	<u>2007-2009</u>	<u>2010-2015</u>
Type of coating		No TBT coatings (2007) No CDP coatings	No toxic components

Bilge water

Water discharge overboard < 5 ppm oil
All surfactants led to the bilge water must be approved by the producer of bilge water cleaning equipment

Fuel handling on board

Information and protective equipment All personnel handling fuel shall be informed about health risks and have ready access to adequate protective equipment

Fuel control

ISO 8217:2005 (ISO 2005) Documentation of no exceedances during any bunkering operation for at least three years. If any exceedance has occurred, legal action or a warning alert should have been initiated.

Stern tube oil

Products/ oil components Biodegradable according to OECD standards. Low toxic additives (Ahlbom, Duus 2003) or alternatively Water lubrication

External hydraulic fluids

Products/ fluid components Environmentally adapted according to the Swedish Standard SS 155414 (revised during 2007 to SS 155434). (SP 2007a)

External lubricant grease

Products/ grease components Environmentally adapted according to the Swedish Standard SS 155470 (SP 2007b)

Boiler/cooling water treatment

Products/ components May not be classified as dangerous to the environment, carcinogenic, mutagenic or toxic to reproduction¹. Boiler water treatment may additionally not be classified as sensitizing or toxic.

¹ An exception can be made for the environmentally toxic substance nitrite as it is not bioaccumulating or persistent.

Cleaning agents

Products/ components May not be classified as dangerous to the environment, toxic, carcinogenic, mutagenic or toxic to reproduction. Organic solvents avoided. May not interfere with bilge water cleaning.

Refrigerants

Products/ components The refrigerant shall be a natural refrigerant like NH₃ or CO₂, or alternatively a HFC complying with GWP < 3500 and ODP = 0 (Montreal 1987)

Areas of concern

Ballast water treatment

Products development Observe the development of new “non-toxic” techniques for example the so-called “PureBallast System”, which is the first Ballast Water Management System making use of active substances which has received final approval from IMO (IMO 2007).

Fire extinguishing

Substances used in fixed fire fighting systems should comply with GWP <1650 and ODP = 0. Water jet/fog based fire fighting equipment is a good alternative.

New coatings above water level

Products/ components Waterborne or high solid anticorrosion coatings are preferred. No lead or chromium (VI) pigments should be used. Isocyanates should be avoided. Important is to create a good shield already in the construction phase.

Crew education

Environmental awareness education In order to deal with the sea in a responsible way it is important to understand how the sea works, what the vulnerabilities are and how our activities affect the sea. An aim for every ship should be to have its crew educated in these questions. A good example of such an education is the Marine Awareness Courses given by the ProSea Marine Education Foundation (www.prosea.info)