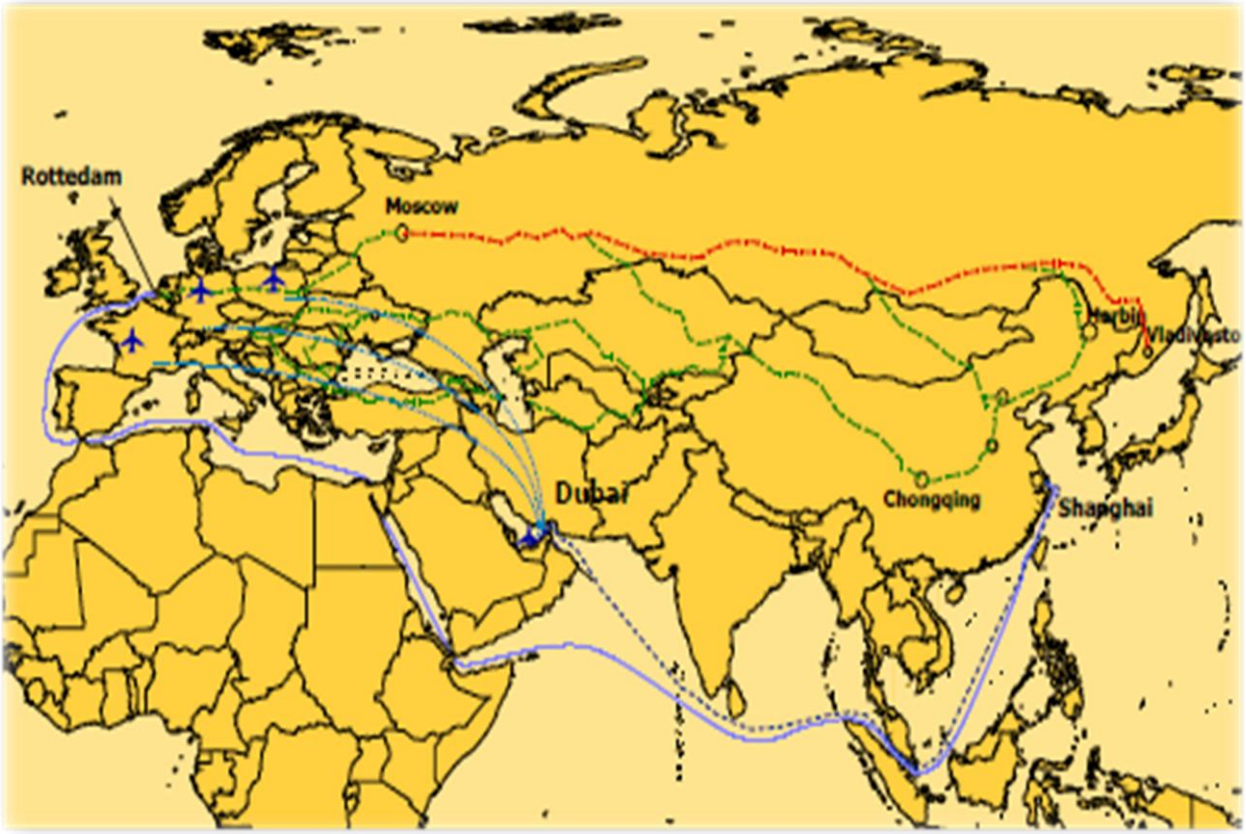
ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

MSc Economics and Business

MSc Urban, Port and Transport Economics

THE IMPACT OF SLOW STEAMING ON SHIPPERS AND ON THEIR SUPPLY CHAINS: A WINDOW OF OPPORTUNITY FOR OTHER TRANSPORT MODES.



CASE STUDY ON CHINA-EUROPE ROUTE

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TITLE

The impact of slow steaming on shippers and on their supply chains: A window of opportunity for the other transport modes. Case Study on China–Europe route

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Η δροσιά γεννιέται μέσ' στα φύλλα
όπως μεσ' στον απέραντο ουρανό
το ξάστερο συναίσθημα.

Οδυσσέας Ελύτης (1984)

The dew is born inside the leaves
just like inside the endless sky
the starry emotion (is).

Odusseas Elutis (1984)

Acknowledgements

This thesis is the final product of my Masters in Economics and Business with specialization in Urban, Port and Transport Economics. 'Slow steaming' is an interesting trend that grasp my interest from the beginning and I enjoyed analyzing the impact on the shippers and their supply chains. Desk research and interviews with experts were conducted enriching my research with practical insights. Despite few pauses, in front of you lies the outcome of several months of intensive research.

During writing this thesis I have experienced difficulties in various levels. Prolonged period for the accomplishment of the interviews was required, in order to meet with the experts. Discipline, hard work and motivation were required for the completion of this master thesis. This period certainly contributed to my personal development and comprehension.

In the meantime and after the completion of the majority of the interviews I had the opportunity to work as an intern at PANTEIA, researching upon the market potential of rail freight between the Netherlands and Russia. During these months a deep knowledge on transport corridors was acquired. However, this internship further stretched the finalization of my master thesis. The last month I worked hard to draw the conclusions of my research and I am proud to present the final result.

First of all, I would like to express my gratitude to my supervisor Dr. B. Kuipers for his supervision and critical feedback. Our meetings and discussions contributed to the final result of this research. I would also like to thank all the experts for their time, willingness and their useful insights into my research. A special thanks goes to Martin van Hees, for his support during our endless conversations. I would also like to express appreciation to my brother, Sotiris Karampampas for helping me in the proofreading process. Last but not least I would like to thank and dedicate this research to my parents for their support; without them I would not be able to live in the Netherlands and finalize my master studies.

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Abstract

This research focused on the effects of slow steaming from a shippers' perspective, and on the alternative strategies that they might implement, in response to speed reductions. Taking into consideration the longer transit times and the increasing unreliable services that shippers face due to the increasingly applied slow steaming practices (Containerization International, 2012; Containerization International, 2013; Nieuwsblad transport, 2012; Review of maritime transport 2010), the potential of a modal shift is questioned. The modal shift concept per se is discussed, and the factors that exert an influence on shippers' transport mode choice decision are identified Parallel to the desk research, interviews with relevant stakeholders conducted providing the research with practical insights. The China-Europe trade route selected for the case study analysis. This research investigated two alternative transport services on the China-Europe route; the Eurasian railway connection and a sea-air combined transport, both emerged from literature studied and interviews. Transport data collected from the ETISplus database analyzed, providing an overview of the freight flows between China and Europe.

Keywords: slow steaming, freight transportation, shippers, modal choice, logistics services, international supply chains, China- Europe route, alternative transport options

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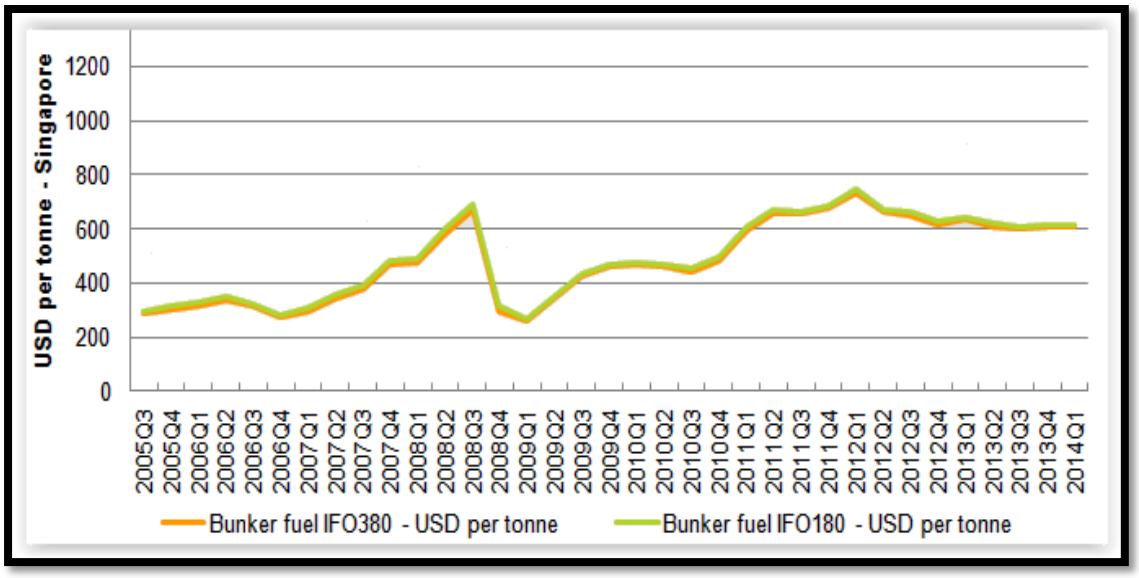
INTRODUCTION

1. Background

High fuel costs, low freight rates and the reduced transportation capacity demand are the main drivers behind the slow steaming practice (Wiesmann, 2010, Psaraftis & Kontovas, 2011). These characteristics of the container shipping market combined with increased operating costs and the global financing crisis have forced the shipping lines to reduce costs. More specifically, in 2007 and beginning of 2008 the increased fuel prices implied higher bunker costs for carriers (Notteboom & Vernimmen, 2009).To illustrate the bunker fuel prices reached $700 per ton in 2008 (figure 1.1). Taking into consideration that bunker costs represent an important part of the total costs for carriers (Notteboom, 2006), shipping liners had to adjust to the current challenges in order to achieve competitive advantage.

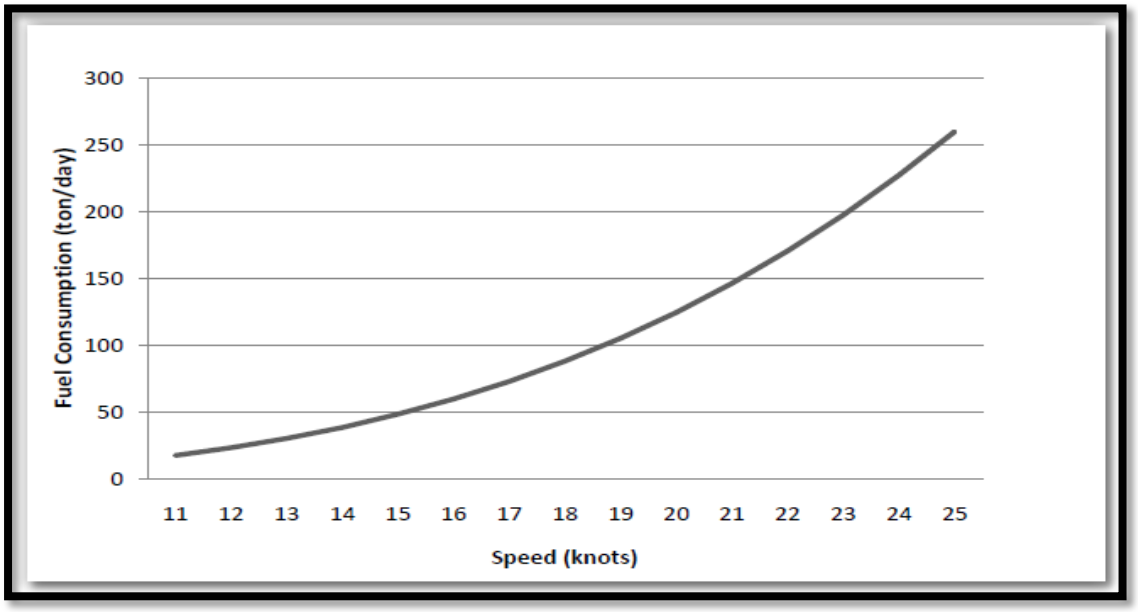
Figure 1.1 Bunker fuel prices



Source: Ministry of Transport (2014)

In fact, since fuel consumption and in turn fuel costs are proportional to the speed of the vessel, it appears that the most feasible way to lessen these costs is by reducing the ships' speed (Cariou, 201; Kolieb & Savitz, 2010; Fagerholt, F. et al., 2010). This practice is called slow steaming. Figure 2 illustrates the fuel consumption at different sailing speeds for 8000-9000 TEU vessels.

Figure 1.2 Fuel consumption at different sailing speeds for 8000-9000 TEU vessels



Source: Elswijk, J. (2011:24)

Slow steaming introduced sailing speeds below twenty knots, significantly less than the standard twenty- five knots speed. Although, Maersk was the first to introduce slow steaming to their Europe- Far-East services, the majority of the shipping liners followed by reducing the speed of their vessels by the end of 2009 (Nieuwsblad transport, 2009) . Later on shipping liners reduced the speed of their vessels even more by sailing at 14 knots (super slow steaming). Cutting fuel costs and absorb surplus capacity are significant effects that shipping liners are benefiting from but shippers, on the other hand, have to accept that the transportation time of their goods will be increased, influencing significantly their supply chain (Lindstad, et al., 2011: 3463, Psaraftis & Kontovas, 2010: 458). In the years before 2008, ocean liner service itself has become much faster (Hummels, 2007), since larger and faster ships have been designed sailing at 25 knots. High speeds meant short transit times, a fact that allowed shippers to operate under just-in-time principles. However, since the increased fuel prices and slow steaming implementation, shippers have to adapt their supply chains to the new slow steaming era.

Although, research on the economic impact of slow steaming is relatively limited, a growing base of academic work has addressed elements of speed reductions, primarily focusing on carriers. It is interesting to see that Runhaar & Kuipers (2002:32) in the paper "Flexibility of Freight Transport" found out that in waterborne transport transit times would increase in an effort to reduce fuel use by slowing down the sailing speeds, six years before the witness of slow steaming in liner shipping industry. To this direction, Notteboom (2006) pointed out the benefits from slowing down on the Trans-Pacific route due to congestion on the US West Coast,

not yet realizing that almost the whole industry would sail at lower speeds only few years later (cited in Elswijk, J. 2011: 8).

In addition, speed reduction practices will require more vessels in order to maintain the same service frequency per liner service. Andersson (2008) investigated a case of a container shipping line, where the speed of the ship reduced from 26 to 23 knots and by adding one more ship in order to maintain the schedule, resulted in 28% reductions on the total costs per container. Other papers (Corbett et al., 2009) put emphasis on the financial benefits for shipping carriers, but most of the articles investigated slow steaming per se as a means to reduce CO2 emissions (Carriou, P. 2010, Psaraftis et al. 2009). Indeed, slow steaming is the most efficient operational measure to reduce emissions (Cariou, 2010, Kokarakis, 2012, Kolieb & Savitz, 2010, Fagerholt, F. et al., 2010); a vessel's speed reduction by 10% would decrease CO2 emissions by at least 10-15% (Corbett et al., 2009).

On the other hand, the consequences of slow steaming to shippers have been relatively under-researched. Thus this thesis will try to counter this research "deficit" on the topic, through the investigation of the impact of slow steaming form a shipper's perspective. In practice it is difficult to quantify the positive or negative impact on shippers given that shippers value time and reliability differently depending as well on the value of their products. In other words how much will slow steaming costs to the shippers depends mainly on the value of their cargo. Shipping for instance, regular t- shirts by sea from China to Europe, is still cost effective regardless slow steaming practices and in turn longer transit times.

This research focuses on shippers' reactions and alternative strategies in response to the speed reductions and extra supply chain costs. Transport and distribution are the major considerations when planning for you international supply chain. Additionally, international supply chains are more difficult to manage than domestic ones (Dornier et al. 1998, Wood et al. 2002), since considerable "geographical distances complicate decisions because of inventory cost tradeoffs due to increased lead-time in the supply chain" (Meixell & Gargeya, 2005: 533). For that reason choosing the right mode of transport is essential in order to guarantee that your product is efficiently and cost- effectively transported to the end destination. In fact, the choice of transport mode directly affects all other elements in the supply chain, but at the same time the logistics framework that the company is embodied in is critical for the mode choice decision.

Many factors appear to exert an influence on the modal decision making process inter alia transport mode criteria, cargo characteristics, logistics costs etc. This is the reason why this research examines emerging transport alternatives in line with shippers' requirements and their cargo characteristics. Research on the specific topic; the link among slow steaming from a shipper's perspective, cargo characteristics, logistical characteristics and the adequate transport mode is missing.

1.1 Problem Statement

The previous section indicated that the increasingly applied practice of slow steaming affects the entire container shipping industry and the supply chain of the products. In particular, by slowing down the vessels which they operate, container shipping companies cut operating/ fuel costs and absorb surplus capacity. Slow steaming simultaneously has a positive effect on the environment; less fuel consumption means less CO2 emissions. This is very important for both shipping carriers and shippers taking into consideration the pressures from the shipping community and society towards a more sustainable and efficient maritime transport. However, slow steaming affects shippers negatively mostly by added inventory costs and disruptions in their production models due to unexpected delays and longer transit times (Efsen & Cerup-Simonsen., 2010, Bergh 2010, Cariou 2011, Ronen 2010). In fact, the longer time a vessel will need to arrive at the port, the longer the shipper gives its invested capital away, which does not pay off at that moment, but costs money.

To illustrate, for shippers and consignees, the additional costs that inventory accrues on the water adds up to almost $170 million per year, based on a price per hour of waiting time, considering factors such as interest, insurance and depreciation costs (Lloyds' list, 2013). This is the main disadvantage for the shippers. In fact when shipping companies decide to slow steam by optimizing their own business case, the impact on the shippers/company and the chain behind the company and on the shareholders of the company will be significant. However, the value of the cargo and in general the cargos' logistical characteristics play a key role on the evaluation of slow steaming impact on shippers. Apparently shippers with higher value cargo will incur higher in- transit inventory costs than shippers of lower value cargo (Maloni et al. 2013).

Nonetheless, supply & demand imbalances coupled with freight rate volatility worsen the situation for shipping companies as well. Some shipping companies have recently reduced capacity in some routes seeking to increase the freight rates at the same time. This results in tighter or even in lack of capacity availability for shippers. These unprecedented levels of freight volatility will further impact shipper- carrier relation.

Although carriers have identified slow steaming as a win for all stakeholders (Barnard, 2010c cited in Maloni et al. 2013: 2), the aforementioned side effects have put pressures on stakeholders and most of them can be seen as threats for many shipping actors (Ferrari et al. 2012). At the same time general trends in sustainability, technology, and internet, as well as the effect of globalization have also a great influence on shippers' supply chain. Shippers have greater and greater logistical needs since they start developing production and/ or distribution activities in an international level, taking advantage of the opportunities presented by globalization (Slack & Fremont, 2009). Moreover, other trends in logistics and supply chain

management in terms of speed flexibility, responsiveness, seamlessness and principles under JIT production come into a collision with slow steaming practices. Yet to what extend shippers/ consignees accept speed reductions and prolonged transit times for their supply chain?

Shippers have to rethink their supply chains and adapt to the new slow steaming era. In fact, advance planning in order to synchronize production and delivery schedules are conducted coupled with increased inventory levels. Moreover, shippers that have taken a total cost approach in supply chain management may opt to ship their cargo by other modalities depending on the logistical characteristics of their products. In this research a discussion on how slow steaming might impact shippers' transport decisions will be presented and potential transport alternative options will be identified.

1.2 Thesis objectives and research questions

The objective of this thesis is threefold;

1. Slow steaming from a shipper's perspective;
    a. analyze the effects of slow steaming on shippers and on the products
    b. understand shippers' reactions and strategies in response to slow steaming implementation
2. Match the different products with the adequate transport mode
3. Understand and evaluate emerging transport options as an alternative strategy by shippers on the Asia-Europe route

The main research question is: *Is slow steaming a window of opportunity for other transport modes?*

The following sub-research questions are derived:

1. What is the impact of slow steaming on shippers?
2. Which are the shippers' reactions in response to slow steaming implementation?
3. What are the effects of slow steaming on the different types of products shipped?
4. Which products may have the potential modal shift to rail or air?
5. Which are the factors that influence the shipper's transportation mode choice decision?
6. Which are the emerging shipping alternatives on the China-Europe route?

1.3 Methodology

Different methods are combined in this thesis in order to answer the main research question. Literature, Interviews, questionnaires, and transport data (ETISplus database) are the methods used in order to give theoretical but also practical insights into the area of research. Literature review evolves the impact of slow steaming on shippers, their supply chains and on the products. Next, the shippers' reactions towards the increasingly applied slow steaming practices are discussed. Literature was also studied in order to identify the factors that exert an influence on shippers' transport mode choice decision. The concept of modal shift per se is discussed and related studies are presented.

Interviews gave more practical insight into the research questions (see below section 1.3.1), and the data collected provide coherence into the findings from literature and interviews. Further in order to determine whether the theoretical approach on the feasibility of a modal shift in question can be practically applied, and to determine whether slow steaming is a window of opportunity for other transport modes, it is considered that a case-study is the appropriate research design for this thesis. The case selected is the trade between China and Europe, mainly due to the fact that the most TEU is traded on this route and it was the first route, wherein Maersk, initially applied slow steaming practices.

Data collected from the ETISplus database, considered to be the appropriate source to use for the analysis required in this thesis. The data collected are discussed into more detail in Transport Data (p. 52). The Research approach and the research design are further discussed into more detail later on this thesis (see p. 50-52).

1.3.1 Interviews

In the final phase of this research, interviews will be conducted with relevant stakeholders, transport operators etc. The interviews will definitely contribute to a deeper understanding of the main research question (explained in section 1.2) but also of the general field of research. The experts will be asked questions as regards the impact of slow steaming on shippers, shippers' reactions and alternative transport opportunities, logistics related decisions, transport demand and supply issues etc. Since there are several ways to conduct an interview, this section describes in detail the interview methodology used in this research.

Interviews may be conducted in person (face-to-face) or over the phone. The interviewer, in case of face-to-face interviews, may ask complex questions opposed to short and simple questions in case of a telephone interview. According to Bryman and Bell (2007), an important disadvantage of face-to-face interviews is that interviewees' replies are sometimes affected by characteristics of the interviewer

(age, social status, gender, or style of interviewing). These characteristics of the interviewer may influence not only the amount of the information the interviewees are willing to reveal, but also the validity of the information they reveal. On the other hand, the remoteness of the telephone interview removes this potential source of bias to a significant extent (Bryman and Bell, 2007). Another disadvantage of face-to-face interviews is the fact that it is time consuming; travelling between the interviewees, factor which depends on how geographically dispersed is the sample. Since major objective of the interviews is to gain insight and to look deeply into the research topics, face-to-face interviews can be distinguished as the most adequate interview research method despite the aforementioned disadvantages.

According to Harrell and Brandley (2009), different kind of interviews can be distinguished based on the level of control the interviewer may have over the interaction with the interviewee. Amongst other (group interview, intensive interview), major types of interview are the structured, the semi-structured and the unstructured interview. In a semi-structured interview the questions are frequently somewhat more general in their frame of reference than the questions found on a structured interview (Bryman and Bell, 2007). More specifically the interviewer is able to vary the sequence of the questions but also he has the freedom and autonomy to ask further questions depending on the replies of the interviewee. Question wording and explanations given can be changed (Robson, C. 2002). For this research semi- structured interviews were conducted.

First approach

The ideal scenario was to interview various stakeholders, logistics managers and mainly air/ rail operators in order to find evidence on a potential modal shift, but this proved to be more of a challenge. In fact more than 100 emails were sent, 80 experts were contacted mainly via email and from different domains (transport operators, logistics service providers, transport authority domain etc), located in various countries; the Netherlands, Germany, Belgium, Greece, Russia, United Arab Emirates (Dubai), Qatar and China. This would have formed the basis of the sample, but instead a "snowball" sample technique was used (Bryman and Bell, 2007). Therefore, I started from initial contacts, relevant with the research topic, and then I was introduced to other potential interviewees. However, due to the limited amount of responses and after request from few contacts, a questionnaire with open questions was prepared and sent via email. The questionnaire meant to be an alternative to the interviews, since the availability of the experts was rather limited. In total 11 questionnaires were sent, however to my surprise only 2 questionnaires were sent back. Table 1.1 includes more information.

Table 1.1 Response Rates

Type of Company	*Contact*			
	Interview- Response (N/%)		*Questionnaire- Response* (N/%)	
Transport operator:	31	1	-	-
SEA	2	1 (50%)		
AIR	13	0	4	0
RAIL	10	0		
MULTIMODAL	6	0	1	0
LSP	26	1 (3.8 %)	4	0
Distribution center	2	0	-	-
Container terminal Operator	1		1	1
Authority	5	1 (20%)		
Other	15	4	1	1
Total	80	7 (8.75%)	11	2 (18.1%)

In total 7 in-depth interviews were conducted for this research, 6 during the months October- December, 2013 and one final interview took place by the end of April 2014. An interview questionnaire was prepared in advance including open questions. Logistics managers and transport operators (mainly rail and air operators) were interviewed, regarded as the most appropriate interviewees. For this research both face-to-face and telephone semi-structured interviews were conducted. Few telephone interviews executed mostly due to interviewees' limited availability.

This research uses the same general frame of questions for all interviewees, with few adjustments where it was necessary, depending on the interviewee. Both face-to-face and telephone interviews were recorded, therefore the reliability of the evidence that was used from the interviews on this thesis is established. Besides, the report of each interview was written and sent to each interviewee requesting the confirmation on the validity of the report. The full interviews can be found in the Appendix 9. The figure below presents all the interviewees by company, function and kind of interview.

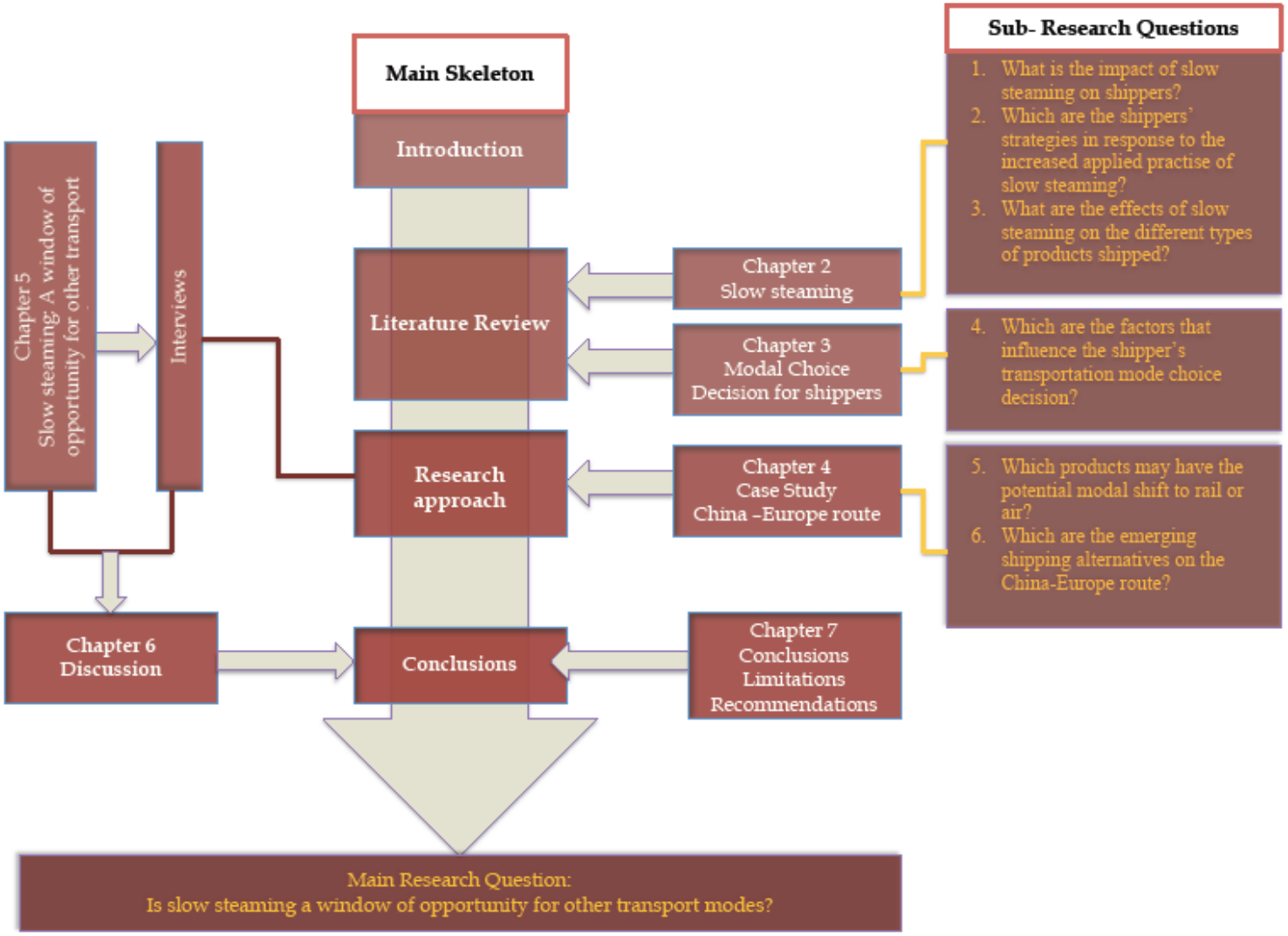
Table 1.2 List of interviewees

Name	*Company*	*Function*	*Interview*
Joest van Doesburg	EVO & ESC	Secretary of the Council of Air Shippers & Air Freight Policy Manager	Face-to-face
_____	KombiConsult	Consultant	Telephone
Ben Radstaak	ACN	Manager Director	Telephone
Irina Birman	TRWC BV	Director	Face-to-face
Arnaud Burgess	PANTEIA	Strategic Research Manager	Face-to-face
Chris Schuchard	M.O.L.	Manager Director	Face-to-face
Enno Osinga	Schiphol Group	Senior Vise President Cargo	Face-to-face

1.4 Outline of the thesis

The remainder of the thesis is structured as follows. In chapter 2 the literature review is presented. First the impact of slow steaming on shippers, on their supply chain and on the products will be discussed. The actions taken by shippers in response to the increased applied practice of slow steaming are identified. At the end of chapter 2 the conceptual framework is presented. In chapter 3 an extensive literature on the factors that exert an influence on shipper's transport mode choice decision will be presented. The concept and the principles of a modal shift are identified. The research approach- framework and the case studies on the China- Europe route will be presented in chapter 4. In this chapter the analysis of the alternative shipping routes will take place. This chapter provides as well a freight volume analysis on a European level but also on the corridor connections with Russia and China. Interviews with experts will be conducted providing the research with practical insights. According to the interviews, chapter 5 discusses issues related to slow steaming practices, effects on the products, modal shift opportunities, and initiatives and transport developments along the studied region. Chapter 6 presents the discussion and finally chapter 7 draws the conclusions. This chapter also includes limitations and recommendations for further research.

Figure 1.3 Schematic Overview of the Thesis Outline



Literature Review

The literature review consists of existing theory and research and contains not only published work (articles, academic journals, and books), but also unpublished papers and dissertations regarding the field of research, which contain information, ideas, data and evidence. The main goal of the literature review is to demonstrate understanding and argumentation in relevance to the topic of research. Moreover, using former literature on the related topic is a means of developing an argument about the significance of the research and where it leads (Bryman & Bell, 2007). Beyond that, the literature review will constitute the basis on which the conceptual framework, the research approach will be built and justify the research questions. Section 2.1 establishes the role of a shipper as an actor in the supply chain. The impact of slow steaming on shippers, on the different type of products and shippers' reactions in response to the speed reductions will be discussed in section 2.2. Section 2.3 presents the conceptual framework. Section 2.4 identifies and analyzes the main factors influencing the modal choice decision of shippers.

2. Slow steaming

Literature was studied as regards the increased applied practice of slow steaming and the effects of speed reductions on shippers and on their products, which are presented in this section. Before we proceed with this, the role of a shipper is being identified.

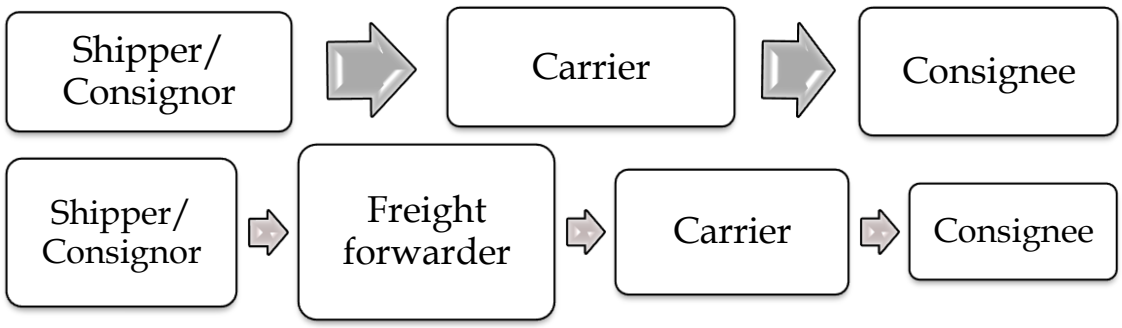
2.1 Shippers/Consignees

In order to gain better insight in the effects of slow steaming on shippers and further understand their strategies, we need beforehand to understand the role of a shipper. Amongst others, Fries & Patterson (2008), classify shippers as the agents that their shipment needs to be delivered, and receivers or consignees as the agents that receive the shipment. Even though somebody can differentiate shippers and consignees, since both actors are on the same level as regards the organizational structure of a transport chain (Fries & Patterson, 2008:4) in this research they are considered together, in line with the European Shippers' Council. According to this, a shipper is 'a person or a company that represents the owner of the goods being transported by any transport mode, whether consignors (tradition meaning of shipper) or consignee" (ESC, 2014). A shipper could be anybody that would like to ship his products to the consignee. The latter is 'a person or a company to whom the products are being shipped', for instance a retailer or a manufacturer. The shipper– as owner of the goods- has ultimate responsibility for the goods in their control or in

transit and compliance with the relevant national and international rules of trade and commerce. Tongzon (2002) refers to three kinds of shippers; a) those with long term contracts with shipping lines, b) those that outsource logistics to forwarders, and c) independent shippers, who make transport choices themselves. In the first category, shippers are committed to a particular carrier, which is responsible for the transportation services. In broad the shipper will pay a freight rate to the shipping line to take care of the maritime transportation, either directly or indirectly (involvement of freight forwarder or broker).

However, the last decades, in line with the emerging international supply chains and increasing transport demand, the definition of shipper has changed (European Shippers' Council). Despite the transport mode choice for each link in the supply chain, a shipper used to make various decisions, such as the size of the production evolving the related inventory levels, the amount of cargo to be shipped, the amount of cargo to be ordered at each demand point, and the number of transshipment points to use in the transport network (Benjamin J. 1990). Nowadays, shippers may not negotiate with shipping companies, but contract freight forwarders or third party logistics providers to manage their freight shipments. According to De Langen (2004), a freight forwarder is one of the most important intermediary functions in the port, who specializes in managing transport and logistics chains. Freight forwarders seek for lower transport costs and this is the reason why transport firms may prefer direct contracts with the shippers. In fact freight forwarders are taking over the role of shipping companies often offering door-to-door services.

Figure 2.1 Relation among shipper- freight forwarder- carrier



The range of services and the requirements of shippers from freight forwarders are becoming wider and more complex, and so are the related business contracts and practices. Presently shippers are increasingly contracting with freight forwarders for their procurement needs by establishing logistics outsourcing relationships and rely on freight forwarders to handle much of their international logistics activities.

2.2 The impact of slow steaming on shippers and on their logistics

Academic work on the topic of slow steaming in the liner shipping industry, and especially the consequences of the vessels' speed reductions on shippers (as mentioned above) has been relatively underdeveloped. Van Elswijk (2011) was first to analyze and calculate the economic consequences of slow steaming not only for shipping companies, but also for shippers in terms of efficiency, effectiveness, equity and sustainability. Van Elswijk concluded that equity- effects are present when slow steaming is implemented. According to his calculations, for every decrease in speed, shippers face extra costs while shipping companies save millions of dollars. This is confirmed by Streng (2012). Streng conducted a macro economic analysis on the effects of slow steaming on a supply chain level. He analyzed four roundtrip routes and found that while carriers can achieve significant benefits by slowing down to sailing speeds below the design speed, shippers/ consignees face substantial costs. In fact according to his research, when speeds are slowing down to 15 knots, slow steaming implies additional costs to shippers and consignees- about $90million on the Loop 6 (operator of this roundtrip is OOCL). Streng's analysis concluded that the combination of both net effects for carriers and for shippers show mainly a negative net effect on a supply chain level. However, on two routes only, slowing slightly below the design speed - sailing at 21 knots for the FAL1 route and at 23 knots on the Loop 6 - could lead to a positive net effect on a supply chain level.

As it seems intuitively obvious, lengthy shipping times impose inventory- holding and depreciation costs on shippers (Hummels et al. 2012). Consequently, slow steaming means even longer transit times, and longer transit times increase inventory tied up (Psaraftis & Kontovas, 2010). Since the amount of in-transit inventory is directly proportional to time in-transit, increasing transit time by one day increases the shipper's in-transit inventory by one day too (World Economic Forum 2012, Efsen et al., 2010, Bergh 2010, Cariou 2011, Ronen 2010). In fact, as it was first noted by Baumol and Vinod (1970: 415), "*freight in transit can be considered to be an inventory on wheels*".

Taking into consideration the importance of holding inventories, a definition of inventories and inventory-holding costs will be given.

> "*Inventories exist at every phase of the supply chain as either raw material, semi-finished or finished goods. Inventory holding costs include both the capital cost of the goods while in transit, as well as the need to hold larger buffer-stock inventories at the final destination to accommodate variation in arrival time (*Hummels et al., 2012: 1*). Since holding of inventories can cost anywhere between 20- 40% of their value, their efficient management is critical in supply chain operations" (*Shukla, 2009: 40).

Accordingly as noted by Dynamar (2010), high inventory costs should be at least offset by improved schedule integrity. Comparing different sources a variance is found on the impact of slow steaming in terms of delivery and time reliability. In fact, Ronen (2011) claimed that the increased transit time provides the operator more

flexibility in order to reduce schedule reliability. Notteboom & Vernimmen (2009) argued that high bunker costs, and the incentive to lower vessel speeds, increasing at the same time the time buffers, would partly solve schedule integrity issues. At the same time, many carriers promised that by slowing down the speed of their vessels, schedule reliability would be improved; the slow speed allows the vessels to continuously adjust speed in order to meet the berth window. The reality differs. Reliability has decreased as slow steaming has become more prevalent (Review of maritime transport, 2010, Nieuwsblad Transport, 2012). 28 million containers arrive late each year and this disrupts shippers' production schedules or retailing plans, which depends on cargo being available on time (Containerization International, 2013). Moreover, *slow steaming increases volatility on time- definite schedules; slower and slower delivery increases the unknowns with more ships and longer supply chain* (Containerization International, 2012).

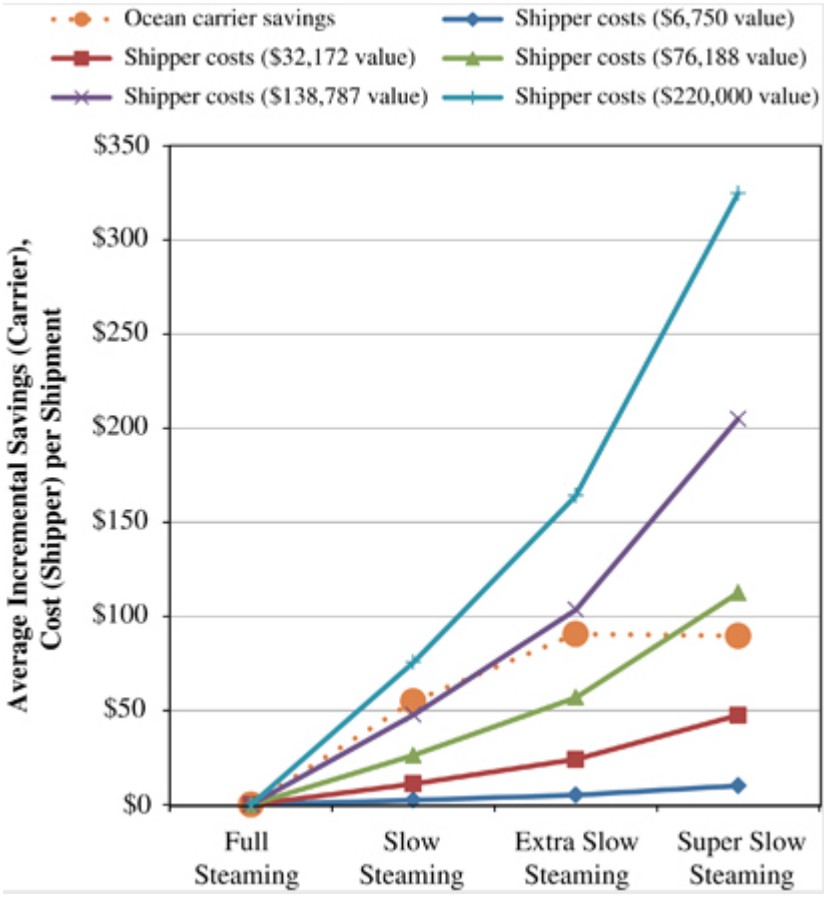
Another issue caused by longer lead times is that the supply chain has become less responsive to market volatilities and changes in demand. Bergh (2010) found that if a company plans to serve 98% of the demand with standard deviation in demand 15%, the safety stock will need to be increased by 10%, when speed is being reduced from 25 to 19 knots. Although demand is not exclusively predictable, longer transit times extend the forecast horizon, which in turn decrease the forecast accuracy. In the aforementioned cases shippers will need to carry extra stock and add more safety stocks respectively, in order to avoid lost sales and disrupted production processes (Maloni et al., 2013). Thus, a subsequently larger amount of products will need to be stored either in warehouses or distribution centers. In that case, most likely, shippers will have to enlarge their storage capacity to ensure that they have ample inventory on stock, which incur more costs for the shippers.

Some of the literature has studied the impact of slow steaming from supply chain perspective, so the cost model includes logistics-related costs. For example, Eefsen & Cerup-Simonsen (2008) considered the economic impact of speed reduction of containerships and included the inventory cost. In addition, Psaraftis & Kontovas (2010), calculated the in-transit inventory costs of high value ($30, 000/ton), industrial products (ex. Machinery, boilers), and they proved that in- transit inventory and other operational costs offset the positive difference in fuel costs. However, according to their study, speed reduction is more attractive if the average CIF[1] price of the cargo is lower. Thus, taking into consideration that in-transit inventory costs are proportional to the value of the cargo, shippers with higher-value cargo will incur higher in-transit inventory costs than shippers of lower value cargo. Comparable Maloni et al. (2013) demonstrated same conclusions. More specifically, seeking to quantify costs and benefits of slow steaming on carriers and shippers, they examined container flows on the Asia – North America trade lane. According to their

[1] (CIF) Cost, insurance and freight is a common term that may be encountered in international trading when ocean transport is used. When a price is quoted CIF, it means that the selling price includes the cost of the goods, the freight or transport costs and also the cost of marine insurance.

findings, ocean carriers solely enjoy the economic benefits of slower vessel speeds at the expense of shipper pipeline inventory costs (Ibid: 162). The figure below illustrates the results of the study on equity efficiency matters. Savings and costs for carriers and shippers respectively are presented for different vessel speeds and cargo values. This figure additionally reveals that shippers with high value cargo will be affected the most by slow steaming practices.

Figure 2.2 Carriers savings & shippers costs per shipment at different vessel speeds and value cargo, $ US

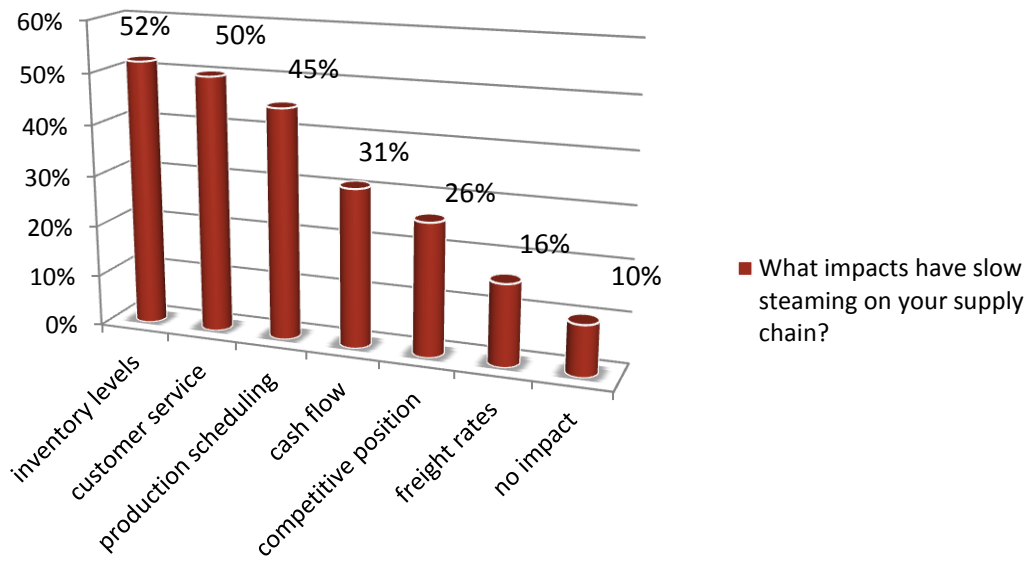


Source: Maloni et al. (2013: 163)

Furthermore, the extent to which slow steaming impacts the shippers, depends not only on the commodity transported but also on the business they are involved in. Some business supply chains are willing to operate with as little stock as possible in order to minimize their capital costs (Svensson, 2002). Other companies plan for "just-in-time" shipments reducing significantly their inventory capacity, whereas others need to buffer their stocks in case of unforeseen delays (Bergh, 2010).

Most of the aforementioned consequences of slow steaming practice have been pointed out as well on a survey conducted by Centrx, BDP International and St. Joseph's University. 290 individuals/executives who make or influence transportation decisions representing chemicals, retail & consumer products participated. According to the results, respondents cited inventory levels as the most affected aspect in their business followed by customer service, production scheduling, cash flow, competitive position, and freight rates. The figure below illustrates the results.

Figure 2.3 The impact of slow steaming on shippers and their supply chain



Source: survey conducted by BDP International, Centrx and St. Joseph's University

To sum up, slow steaming and in turn longer lead times concern shippers and affect significantly either directly or indirectly their supply chain costs, and in particular interest, depreciation and insurance costs (Streng, 2012). Moreover shippers face unreliable services and delays, which sequentially impact their production operations and exert an influence on their supply chain decision making. Nevertheless, it can be complicated to determine the overall impact of slow steaming on an individual shipper and this depends on numerous factors such as the type of the product, logistics characteristics and shipper requirements. These factors will be determined and discussed further in this research.

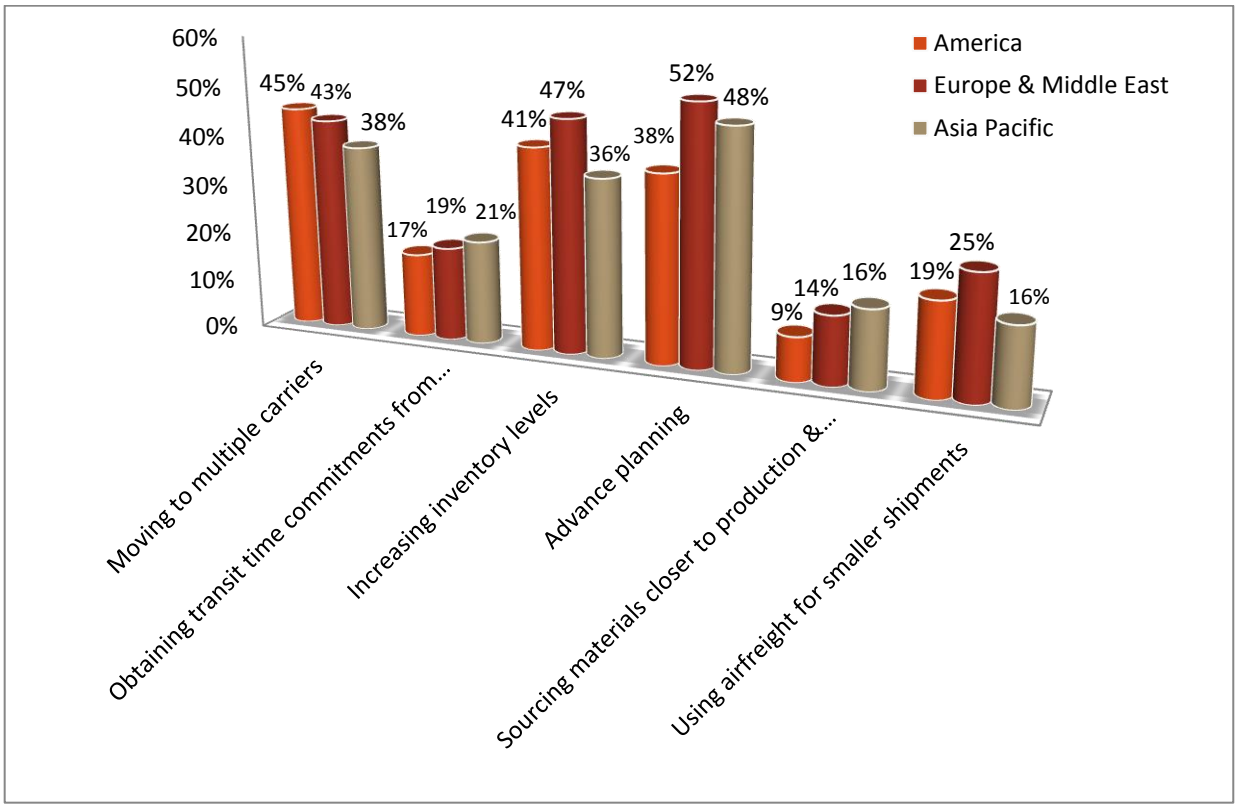
2.2.1 Shippers' reactions towards slow steaming implementation

Section 2.2 presented the impact of slow steaming on shippers and their supply chains. The question then becomes which are the shippers' reactions? This paragraph attempts to give insight on plausible strategies and alternatives that shippers using waterborne transport have implemented in response to the speed reductions.

Few empirical studies have been conducted regarding shippers' reactions and alternative strategies in response to slow steaming implementation. As we already mentioned in section 2.2 survey by Centrx, BDP International and ST. Joseph's University demonstrated the impact of slow steaming and illustrated the reactions taken by shippers. Figure 2.4 presents the results of the study. According to the findings, companies have achieved advanced planning in order to synchronize delivery and production schedules. In fact, it has been perceived that slow steaming disrupts manufacturing processes as some deliveries will not be made on schedule. Moreover, already mentioned before, shippers increased their inventory levels to offset costs and time delays. Few shippers started to be more selective and demanding towards carriers since the freight rates were driven up coupled with less reliable services. Therefore, shippers opt for multiple carriers in the same trade lanes to facilitate the best combination among rates and lead times. Furthermore, a small percentage of the participants required and obtained transit time commitments from carriers. However, the feasibility of such measures depends upon the power the shipper possesses towards the carrier. A small amount of shippers as we see in the figure 2.4, chose to source materials either closer to production or consumption levels taking into consideration that increased geographic distances incur mainly higher transport costs.

In addition, 16-25% of shippers responded to increased transit times by using airfreight especially for smaller shipments. This depends not only on shippers' individual preferences but also on the criticality of the cargo. These shippers are willing to use more expensive transport mode, valuing shipping time and reliability, rather than freight rates.

Figure 2.4 Actions taken by shippers



Source: Survey by Centrx, BDP International & St. Joseph's University *"Managing your international supply chain"*

Empirical evidence further demonstrates the main expected effects of a (hypothesized) increased congestion and the implicit consequences on transit times, delivery reliability, and in turn higher indirect transport costs (Runhaar, 2002). Inter alia, a loss of customers, a decentralization of production or stocks and adaptations in the planning/scheduling of production and distribution respectively, are some of the expected effects (Ibid). At this point, since a hypothesized increased congestion and speed reductions have analogous consequences, namely longer transit times and higher indirect transport costs, similar reactions are expected from shippers.

2.3 The impact of slow steaming on products

In this section, some assumptions have been made, in order to better understand what effects slow steaming practices might have on the products. First assumption is that sea transport is perceived as the transport mode that best fits in the logistics concepts of the product within shipper's supply chain, and second assumption is that the products are capable of being containerized. Therefore, the following discussion takes place, under the assumption that the following products are transported by container ships, which might be the case for some examples given below.

Different products have different time sensitivities (De Langen, 1999) and speed requirements. The effects for the products can be summarized into the effects on (1) the physical appearance of the product, and overall on (2) the value of the product. In fact, "a*n extra day at sea creates opportunity costs linked to fixed capital and could lower the economic value of the goods concerned*" (Notteboom, T.E., 2006:27). Besides, longer transit times or unexpected delays may impact the shelf- life cycle of the products that applies to perishable goods such as food, pharmaceutical drugs, chemicals, and fashion clothes. Perishable goods worsen in quality over time and become less valuable over time. Pharmaceutical products for instance that might have a limited life cycle will be impacted by slow steaming practices, since the products might arrive late in the shelves of the stores. In that case these medicines can no longer be sold. However, in the case of pharmaceutical products that have very long life and expiration date, the consequences will be rather limited. The self-life is only related to the physical characteristics of the product and not on the shelf-life in the market. The theory of a product life cycle was first introduced in the 1950s to explain the expected life cycle of a typical product from design to obsolescence (Wood, L. 1990, Kumar, S. & William, A.K., 2005) in the range of marketing management, but this is not considered part of the scope of the research.

Shelf life is a function of time but also of temperature. Perishable goods such as food, medications lose their nutritional value over time when exposed to temperature. Therefore a perishable food will have a given shelf life at a given temperature. This applies to the cold supply chain, a temperature-controlled supply chain. In fact with a certain temperature you can extend the shelf life of perishable food such as seafood, meat, frozen food, dairy products etc. Therefore products that are temperature controlled- cool cargo - will not be affected by longer transit times. Flowers belong to this category. Interesting articles (Nieuwsblad Transport, 2013) and research conducted have shown that the shelf life of the flowers can be prolonged under a certain temperature.

In the electronics industry, products such as personal computers, laptops and phones have a technological obsolescence of roughly one percent a week (Kuipers, 1999). This element is the key attribute that shippers need to consider regarding their transportation decisions. Shipping a PC from Asia to Europe by sea container, would

take you from ten to twelve weeks total throughput time, including distributing it to the retailer. So the computer will be obsolescent 10-12% at the moment arriving at the retailer. In that case the value of the product is worsening in proportion with the longer transit times. Besides, fashion clothes are products that are very sensitive to time reliability (Kuipers et al., 2006), for that reason the clothes are going to lose value very fast.

In general longer transit times and unexpected delays influence the physical appearance/condition and/or the value of perishable and short life-cycle products (food, medicines, electronics, and flowers). In fact the consequences might be substantial. To what extend these consequences are substantial for the products, depends on the specific product shipped, on the distance, the specific speed of the vessel etc. Further research is required for a deeper understanding on these elements.

2.4 Conclusions and Conceptual framework

2.4.1 Conclusions

Chapter 2 identified the effects of slow steaming on shippers and stretched issues related to shippers' logistics. This section investigated the first sub-research question: *What is the impact of slow steaming on shippers?* Shippers and consignees face longer waiting times for their products, which could lead to substantial costs. More specifically, lengthy shipping times impose inventory and depreciation costs on shippers. Moreover, the key role of the value of the product on the assessment of the impact of slow steaming on shippers was underlined. In fact, in-transit inventory costs are proportional to the value of the cargo, which means that shippers with higher value cargo will incur higher in- transit inventory costs, than shippers of lower value cargo (World Economic Forum 2012; Efsen et al., 2010; Bergh 2010; Cariou 2011; Ronen 2010). Although, it was perceived that longer transit times would provide the operator more flexibility in order to improve schedule reliability (Dynamar, 2010; Ronen, 2010)- fact that was promised by the shipping carriers as well - shippers have witnessed the opposite. Actually, shippers face increasingly unreliable services that lead to disruptions on shipper's supply chain. Another issue caused by longer transit times is that the supply chain has become less responsive to market volatilities and changes in demand.

The second sub- research question investigated in the previous chapter is*: "Which are the shippers' reactions in response to slow steaming implementation?"* Few surveys have been conducted on shippers' reactions and alternative strategies in response to the additional costs that they face, which presented in section 2.2.1. Among the different logistics strategies, slow steaming might have an effect on shippers' transport modal choice decision. This is not associated with all shippers, but depends, as mentioned above, on various factors, including shipper's product characteristics, but also the logistics concepts that the company is embodied in. In fact, the product

characteristics in principle determine the quality of the transport service required (Runhaar & Kuipers, 1999).

Finally, the sub- research question*: "What are the effects of slow steaming on the different products shipped?"* is being investigated in section 2.3, under the assumption that sea transport fits the products logistics characteristics within shippers' supply chain. The effects on the products are diverse, since different products have different time sensitivities. The consequences for the products can be summarized, in the effects on the physical appearance of the product and on the value of the product. Short shelf life and perishable products (food, pharmaceuticals, flowers, consumer electronics etc.) fit in this category of time sensitive products that in fact will be influenced the most by the increasingly applied slow steaming practices.

The aforementioned theoretical effects of slow steaming are summarized and presented in the table below. This represents an important tool in shaping the conceptual framework, which functions as the connection between chapter 2 (slow steaming) and chapter 3 (modal choice decision of shippers & principles of modal shift)

Table 2.1 The effects of slow steaming

Who	What	Which
Shippers	• Extra costs (inventory & depreciation costs) • Unreliable services • Disruptions on the supply chain • Supply chain less responsive to market volatilities • Supply chain carbon footprint reduction	• Owners of middle & high value cargo • Producing under JIT production
Products	• Effects on the physical appearance/ condition • Effects on the value	• Short life-cycle products & Perishable products (food, pharmaceuticals, consumer electronics, flowers, fashion clothes)

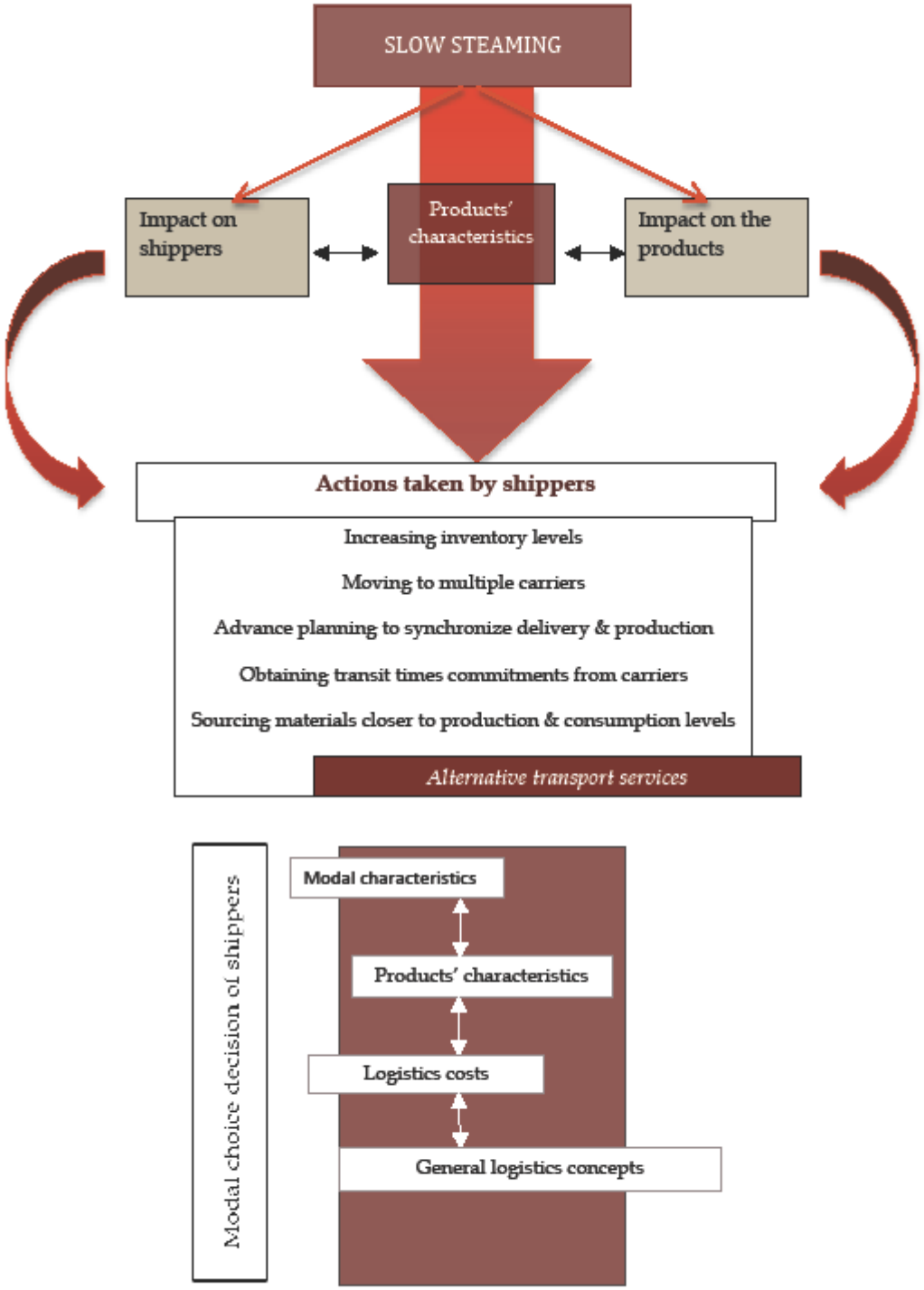
2.4.2 Conceptual framework

Combining the most important aspects presented in chapter 2, a conceptual framework is designed (Figure 2.6). In this scheme the main skeleton of the literature review is provided. Shippers and products face negative effects due to the increasingly applied practices of slow steaming. The characteristics of the products and especially the value of the cargo are the key determinants of the impact of slow steaming on both shippers and products. Consequently, shippers had to rethink and take actions in response to longer transit times and unreliable services. Amongst the various logistics decisions, transportation decisions are discussed and special emphasis is given on a modal shift potential.

Therefore, to be able to answer the main research question, academic literature has been studied in order to identify the factors that influence shippers' modal choice decision (chapter 3). Decisions involve various interrelations between the factors and tradeoffs which are identified in section 3.5. Next literature on a potential modal shift will be presented and the role of transaction costs will be identified.

Related studies have almost exclusively considered transportation decisions and a potential modal shift, arguing that economic and costs factors are the major decisive criteria (Behar & Venables, 2010; Rodrigue et al. 2013). A common pitfall of these studies is the lack of detailed understanding of a wider context of logistics decisions making process. According to Bolis & Maggi (2001), shipper's transport choice, and in general shipper's behavior should be conceived as a complex decision, which considers transport mode choice as only a part of a firms logistics strategy. To what extent logistics characteristics affect transport mode choice, and to what extent transportation decisions are embedded in the wider concept of logistics will be discussed as well.

Figure 2.6 Conceptual framework



3. Modal choice decision of shippers

In order to answer the main research question "if slow steaming is a window of opportunity for other transport modes", and to determine the magnitude of a possible modal shift, it is useful to have insight on the factors that exert an influence on the modal choice decision of shippers. In fact, in this section the question "which are the factors that influence the shippers' transportation mode choice decision" will be answered. Shippers/consignees make their transportation decisions based on a variety of factors including transport mode characteristics, product characteristics, total costs etc. Different studies have been conducted focusing on the decision-making procedure of actors involved in the freight modal choice. Of interest, Fries & Patterson (2008) raise the question if shippers do choose a transport mode explicitly or the mode choice is simply a characteristic of different carriers or logistics service providers, choosing among a variety of transport services (transit time, reliability). Based on their findings, although the transport mode by which freight is shipped is important to the shipper, for further research especially for SP survey, they recommend to also include a mode choice as an attribute of a logistics service provider offer. On the other hand, a great amount of literature considers mode choice as relevant for shippers (Jiang et al. 1999, Maggi et al. 2005). As mentioned above there are several ways to arrange freight transportation from shipper to consignee and since the role of the freight forwarder is case specific, in this research, a general overview on the mode choice decision process is provided.

Baumol & Vinod (1970) intended to explain the shippers' modal choice decision using an inventory theoretic approach. They concluded that the optimal choice of mode involves trade-off among freight rates, speed and variance in speed, and en-route lossage. McGinnis (1990) conducted a study among shippers in the USA; according to it six factors were identified that exert an influence on shipper's transport decision i.e. freight rates, transit time, reliability, loss and damage, shipper market considerations, and carrier considerations. In other studies, reliability was shown to be one of the most important determinants for the transport mode choice (Fowkes et al. 2004; Murphy, Daley 1997; Muilerman, 2001: 156). Research conducted later by Bolis & Maggi (2003) aimed to determine freight transport and logistics service choice of shippers. They interviewed 22 firms in Italy and in Switzerland by performing adaptive stated preference experiments. According to their findings, the logistics context where a firm is operating in is relevant to the transport mode choice. The most important decision factors are reliability, price, speed and safety. Frequency and flexibility follow especially for firms operating under JIT principles, for firms whereby the product is a final product and for firms serving directly the consumer market.

Besides, Lammers et al (2006) found that 95% of the transport mode choice is determined by the product characteristics. More recently, Gursoy, (2010) developed an analytical model to determine the best possible shipping alternative among rail-road-sea transportation for Turkey. After a short poll about the factors affecting the

shipping mode choice, he included in his model the first four criteria that determined to affect mode choice decisions. According to his research shipping price, shipping time, reliability and accessibility are the primary decisive criteria.

Modal choice can be made based on economic and cost factors. In particular direct and indirect logistics costs are the major elements for the shipper before choosing a transport mode. However, the presence of other criteria cannot be denied; mode characteristics (reliability, capacity, frequency) in relation to the products logistical and physical characteristics (value density, packaging density, perishability) are as well of great importance. Transport decisions are also dependent on the general logistics concepts that the company is embedded in, inter alia frequency of shipment, amount and location of the plants and warehouses etc. At the same time the choice of a transport mode has an impact on a whole series of costs in the supply chain besides transportations costs (Blauwens et al. 2007).

The major factors mentioned above that influence shippers' transport modal choice decision are listed in the table below and are further analyzed in sections 3.1- 3.5. These factors will be inspected in the remainder of this thesis.

Table 3.1 Factors that affect freight modal choice

Category		Factor
Transport mode characteristics		Reliability
		Transit time
		Capacity
		Safety/ security
		Equipment availability
		Customer Service & Handling quality
Products' characteristics		Physical appearance/size
		Value density
		Packaging density
		Perishability
		Shelf- life
Logistics costs	Direct costs	Transportation costs
	Indirect costs	Inventory costs
		Insurance costs
		Depreciation costs
		Order & handling costs
General logistics concepts		Shipment frequency
		Frequency of distribution
		Location of plants/ warehouses
Additional factors		Sustainability
		Accessibility

3.1 Transport mode characteristics

As seems intuitively obvious, different transport modes have quite different characteristics. Shippers consider these characteristics and carefully select the transport mode that matches their requirements. For instance shippers require on time reliable shipments, since unexpected delays impact their inventory and ordering costs. In general, shippers of high value products place higher value on the quality attribute of freight service than shippers with low value products do (Oum, 1979). According to Blauwens et al. (2006) each transport mode is characterized by four different logistics characteristics; transportation costs, loading capacity, average lead- time and variance in lead- time (delivery reliability). These characteristics are explained below.

- *Transit time.* Transit time is a critical factor for shippers, since offering shorter transit times is a competitive advantage, especially for time sensitive products. In the maritime segment, transit time can be defined as the number of sailing days on a port-to-port basis (Notteboom, T.E., 2006). In a wider logistics approach the transit time is the total time that it takes for the goods to be transported (door-to-door basis). In this research we are not exclusively focusing on deep-sea shipping but we consider as well rail and air shipping. Therefore, for this research transit time is 'the total time required for the goods to be shipped from the origin to the end destination'.

- *Reliability.* According to studies (Harrigan & Venables, 2006) reliability of transit time or schedule reliability has shown to be one of the major criteria for transport decisions. Especially shippers operating just-in-time logistics value reliability first. Reliability can be defined as the variance of transit time. Delays for instance due to bad weather conditions are responsible for unreliable shipments. In this research reliability has to do more with predictability and certainty in transit times. Especially in intermodal shipments, precisely scheduled intermodal transfers are a key element to an efficient and seamless intermodal freight transportation service. This could include dwell times at terminals, pre- and end-haul to the port of (un)loading in relevance to sea shipping.

- *Capacity.* Capacity in general refers to the maximum volume of cargo that can be contained. The maximum amount of traffic that a particular transport mode can use. Containership ship capacity is measured in twenty-foot equivalent units (TEU). Typical loads are either 20-foot or 40-foot.

- *Safety/ Security.* Safety can be in general achieved by avoiding any form of danger and risk responsible for damage or loss of the products. Each transport mode is may exposed to different dangers, for instance the risk of piracy in deep sea shipping. Safety can be related as well to special handling of the product, named q*uality handling*. Different products depending on their physical appearance or perishability require different handling services. For instance fresh vegetables, meat, and fish need to be maintained fresh in refrigerators and cold temperatures. This depends on the *availability of the equipment* that each transport mode and specific service can offer.

Table 3.2 Main transport mode characteristics

Criteria	Road transport	Rail transport	Sea transport	Air transport
Speed- transit time	High/moderate	Moderate	Slow	Very high
Cost per ton/km	Medium	Low/medium	Low	High
Advantages	Fast, Direct delivery , Flexible	Economical, Large loading capacity	Economical, Large loading capacity,	Fast, Reliable, small capacity
Disadvantages	Congestion, negative externalities	Infrastructure restrictions	Not flexible, risk of piracy	Expensive/ Restricted loading capacity
Other considerations	Short/Medium distance	Green transport	International trade/ no time constraints	Small shipments/ time constraint

3.2 Products' characteristics

Another important factor that affects shippers' modal choice decision, already mentioned above, is the logistical characteristics of the products, since shippers may benefit more by transporting their goods via one specific mode over another one. Therefore, the logistical characteristics of either raw materials or intermediate or final products are (Fessard, 1977, Goor et al., 1989, Tavaszzy et al., 1998, Runhaar & Kuipers, B., 1999):

- The *physical appearance* of a product or its physical condition. Three forms can be distinguished; waste substance, liquid or gaseous substance. Which type of transportation to use, the method of storage, safety concerns, and the (un) loading facilities are facts that will be determined by the physical condition of the product.

- V*alue density* of a product is the value of this product in the smallest shipment unit possible. Shippers of high value density products tend to use fast and reliable modes of transport such as air freight.

- The p*acking density* represents the number of packaged units per unit of volume (m3). The smaller the box, the greater the packaging density and the greater will be the relative proportion of the charge on the goods to be handled. Packaging density is inextricably linked with physical appearance and value density, since high value goods are most likely coupled with higher demands in packaging than low value goods. Certain products may require a certain type of handling, packaging or transport due to special characteristics (overweight/ dangerous materials). These categories of products are mostly shipped with one specific transport mode and it is very much unlikely that a modal shift will take place.

- *Perishability* is defined as the period in which a product is technically or economically usable. More specifically, perishable products are those that worsen in quality over time and become less valuable over time.

- *Shelf–life* is defined as the time expressed in a unit of time, during which the physical properties of the product at the time of sale should have remain present. The shelf- life is relative to the physical characteristics of the product, which means that by the end of its shelf-life time is becoming unsalable. It is obvious that shorter shelf- life requires speed and low inventories. Besides, speed and distance must guarantee that the product will reach their customer within their shelf-life. The terms perishability and shelf- life are usually used interchangeably.

- ***The*** *volume-weight ratio* of the smallest shipment unit. Especially in international freight flows, this ratio determines shippers' freight mode decision between air or

sea freight. For that reason the volume-weight ratio is an important factor. The volume is expressed in cubic meters and the weight in kilograms or tomes.

3.3 Logistics Costs

One of the most important criteria for the choice of transport is the transport costs and in addition the direct and indirect logistics costs (Runhaar & Heijden, 2005). Shippers have to pay direct transport costs on commercial carriers or freight forwarders or own-account transport fleets (Runhaar, 2002: 3), but at the same time they bear variety of indirect logistics costs inter alia inventory costs, and depreciation costs. Studies have demonstrated that "the relative importance of indirect transport costs vis-à-vis the direct transport costs has increased" (Runhaar & Heijden, 2005: 37). However, for shippers of low-valued products, direct transport costs are more important, thus these shippers opt for comparably cheap and slow transport modes (Runhaar, 2002:3). More specifically shippers bear:

- *Inventory costs.* "Inventory- holding costs include both the capital costs of the goods while in transit, as well as the need to hold larger buffer- stock inventories at the final destination to accommodate variation in arrival time" (Hummels & Schaur, 2012: 1). Inventories exist at every phase of the supply chain as either raw materials or semi-finished products or finished products. Some companies keep larger stocks or inventories in order to accommodate the transit time variations due to delays or supply disruptions. However, other companies by relying on JIT production with more frequent shipments do not have stocks, minimizing at the same their cost of inventory significantly (Benjamin, J. 1990). Shippers need to finance their products in- transit or in-transit inventories. Obviously, in case of delays or longer transit times shippers incur higher in-transit inventory costs. Inventory costs are inextricably linked to the transportation decisions, since '*the best choice of mode can be found by trading- off the transport cost of the particular mode with the indirect inventory costs' (*Ganeshan & Harrison, 1995). Thus inventory costs or in-transit inventory costs are key components that influence shippers' modal choice.

- *Depreciation costs.* While the goods are in-transit, technical or economical depreciation of the goods arise, applies to consumer electronics. These are extra costs that shippers need to consider.

- *Insurance costs.* Shippers need to insure their products while in-transit in order to avoid any risks involved such as damage or loss. To this direction, in case shippers have not insure their products then *loss and damage costs* should be considered, including costs for damaged inventory or delayed shipments. These costs can vary significantly by carrier and mode.

3.4 Additional factors & general logistics concepts

Additional factors such as the accessibility to the transport modes and sustainability also influence shippers' modal choice.

Accessibility can be defined as the ease of reaching a specific transport service. First of all some shippers may not have access to a specific transport mode by any means, so their transport choices are limited. Depending on the existence of terminals near the origin and destination regions, other transport modes might be an attractive alternative rather than sea transport (Tavasszy & Meijeren, 2011).

Sustainability includes GHG emissions, fuel consumption, energy consumption, and pollution emissions. The last years the greening of the supply chain as an emerging trend has influenced to a great extent many companies (International Transport Forum 2009, Stuart Emmett & Vivek Sood, 2010). The impact of such trends on shippers' decisions however, it is still uncertain and depends on each individual shipper, but it might induce shippers to use more environmentally friendly transport modes (rail/sea transport). In fact, a stated-preference survey found that GHG emissions were identified as one of the five potentially relevant factors that influence shippers' transport mode choice decisions (Fries & Patterson 2008). In the future, it is expected that shippers will increasingly put more emphasis on sustainability and the reduction of carbon footprint.

Logistics concepts and in generally strategies that the company is involved in are of great importance regarding transportation and modal decision. Amongst others *shipment frequency* is inextricably related to the inventory that the company keeps on hand. When a company is involved in JIT production for instance, inventory costs are significantly minimized and shipment frequency has increased. In that case, therefore, shipment frequency and inventory costs are inversely proportional. Companies that are delaying the activities of manufacturing are involved in 'time postponement' strategy, as it is called, in order to efficiently manage demand fluctuations and at the same time to avoid any risk of uncertainty regarding their logistics operations. Shippers make use of these strategies opt for fast and frequent services.

3.5 Interrelations between the factors

In sections 3.1- 3.4 the factors that might exert an influence on the shippers' modal choice decision process have been analyzed. These factors are related to each other and make transportation decisions more complex. This section will give an overview of the interrelations between these factors and of related trade-offs.

According to Runhaar & Kuipers (1999), in their research with title "The role of transport costs in goods transport", the product's characteristics in principle

determine the quality of the transport service demanded. In other words, the price a shipper is willing to pay depends on the ratio between the total costs and the quality of the service or the benefits that the transport service can offer. In fact, shippers with high value products might choose for fast reliable transport services (air transport). Even if shippers choose for this transport modality, they still have to consider the availability of inventory and consumer demand, which might influence their initial transport decision. This is another trade-off among transport costs, product characteristics and frequency of shipment cited in Runhaar & Kuipers (2009). The frequency of shipment and consumer demand are relatively interconnected, since high demand for a specific product means high frequency of shipment. "How many toys should we ship from our assembly-factory in China to Europe" and "how much stock do we need?" are questions that a toys manufacture company ask themselves when they face demand uncertainty. In fact, Hummels & Schaur (2010) demonstrated that in the presence of higher demand uncertainty, a greater share of shipments is taking place via air transport. Bekes et al. (2014) via an inventory management model showed that firms respond to demand uncertainty by reducing the number of their shipments and increasing the value for a given value exported in a year.

Tseng, Taylor & Yue (2005) highlighted the role of transportation in logistics and put emphasis on the trade-off between transportation and inventory, key element of logistics. In fact "a decrease of inventory size at shippers leads usually to a higher frequency of smaller shipments and in turn to higher transport costs" (Runhaar & Kuipers, 1999: 12). Moreover, Blumenfeld at al. (1985) put emphasis and analyzes trade- offs that exist between transport, inventory and production set-up costs in order to determine optimal shipping strategies (routes & shipment sizes). From the aforementioned becomes clear that transport decisions involve more than one trade-off and shippers need to reconsider all these factors before make any decisions.

3.6 Principles of modal shift

Wolff et al. (2010:) identified a modal shift as "the principle of shifting freight from road based transport to other transport modes". From other studies the same shift pattern has been also shown. For example, a study from EVO & Arcadis Heidemij Advies, & Buck Consultants International (2000), intended to promote a shift from shipper's choice of road transport to alternatives such as short sea, rail and inland waterway transport. 100 companies/ shippers were examined, having chances for success for a modal shift of part of their goods flow. During this project four types of modal shifts were specified, which were considered necessary for the optimal implementation of the project:

- Modal shift by means of adaptation to the way the transport is organized
- Modal shift by means of change of the shipping unit
- Modal shift coupled with a change in the supply chain (relocation of stocks)

- Modal shift by means of subsidy upon request

Worth mentioning finding is the fact that shippers were not aware of the opportunities that the other modalities can offer, which in practice means that many companies have not examine alternatives to road transport and have not considered a modal shift. In total 80 per cent of the companies created a positive recommendation wherein at least one flow of goods would shift from road to other modalities, rail, sea, inland transport (Ibid).

These modal shift concepts fit in a wider approach of actions or incentives taken by government/municipality in a national level. Such modal shifts are considered necessary from a policy and societal perspective; shifting cargo away from the congested roads would lead to: an increase in the accessibility of logistic and economic centers and to a reduction of the negative externalities caused by road transport (Kamp & Scheltjens 2002). In general extensive literature (Kim & Nickolson, 2013, Woodburn, 2003), involving the concepts of modal shift, seeks to promote more environmentally sustainable transportation modes, such as rail and sea transport, rather than road transport. Kim and Nickolson (2013) developed mode choice models in order to identify the constraints on shifting freight in New Zealand from road to rail and coastal shipping. They found that NZ shippers ranked transport time as the most significant constraint on transporting goods by rail, whereas accessibility and load size where the major constraints upon using coastal shipping. Moreover, the logistics characteristics of the firm (transshipment facilities, location of warehouses) appear to constraint the potential shift of flows from road to coastal shipping.

The growing interest on the concept of modal shift and the growing academic work on the subject can be mainly explained due to the large growth of volumes transported by trucks witnessed the last decades, accountable for unpleasant externalities. To this respect, study by TNO & TU Delft University (2011) explores the potential of alternative modes of transport in line with one of the main targets of European Transport Policy, namely, that 30% of road transport freight transport over 300 km should shift to other modalities. The theoretical potential was determined from the perspective of both the supply and the demand side of freight flows. Five factors on the demand side were identified as limitations towards the modal shift; the accessibility of transport modes, transport distance, product characteristics, size of shipment, and speed (Tavasszy & Meijeren, 2011). On the supply side, the rail capacity was characterized insufficient. In fact an increase in rail capacity would be possible if the whole network would exclusively absorb freight flows (CE, 2011 cited in Tavasszy & Meijeren, 2011). The authors created a mode choice model, in which generalized costs are articulated in terms of time, price and value of time, and they are subscripted by mode of transport and the kind of product. In line with this, the shippers will choose the alternative transport mode that has the lowest generalized costs. Among the outcomes of the model, a change in transport time or in costs results in modes attracting different types of goods, which leads to a different modal

split. However, according to their findings the feasibility of the target for modal split by the European Commission is quite low and the ambitions for shifting flows in the segment of 300 km is very high (Tavasszy & Meijeren, 2011). Overall the study concluded that feasibility of this modal shift target was constrained by economic, technological, institutional and infrastructure factors.

In this research a more general approach of the modal shift concept is perceived, adopted by Rodrigue et al. 2013. According to the book "The Geography of Transport Systems" a modal shift takes place when one mode has a comparative advantage over another transport mode. A comparative advantage can take several forms such as costs, capacity, flexibility, reliability etc. *A modal shift involves the growth in the demand of a transport mode at the expense of another, even though a modal shift can actually inclusively involve a growth in both of the concerned modes* (Rodrigue, J.P.et al. 2013). Of interest, according to the same authors, a modal shift takes place over three phases:

- Inertia phase,
- Modal shift phase, and
- Maturity phase

Initially a modal shift is a slow and difficult process to be achieved, due to accumulated investments and assets in the existing mode of use. In general inertia implies that the modal shift is much less significant than expected leading to underperformance (Rodrigue et al. 2013). Moreover, companies might have longer contracts with transport operators, which limit their modal shift potential, even though the comparative advantage of the other mode is significant. During the inertia phase few companies will take the risk to shift their freight flows to another transport mode, either due to high transport costs on the existing mode or when the government supports the shift with subsidies. At the same time, in the presence of perceived competition, additional efforts will be made to more effectively use the assets of the existing mode, known as modal rationalization. During the next phase the new transport mode develops from the underperformance situation to over performance. From the moment the potential is being realized, this phase represents a fast transition from the existing mode to the other transport mode. By the end of this phase the new mode gets increasingly congested and the previous mode loses traffic. At the point when the market potential - new equilibrium in modal share - is reached then the modal shift has reached the maturity phase. Modal rationalization and ways to use more effectively modal assets are the major focus of this phase.

Modal shift in freight transport management implies concerns that first may conflict with the production system and with the location of the consumer market (Soares & Akabana. 2011). To this respect a modal shift should be considered in a wider logistics approach since the logistics concepts that a corporation is involved in determine the transportation decisions and might limit the available alternative options. In fact, a study by Kim & Nickolson (2013) found that shippers' modal shift constraints vary according to the firm's logistical characteristics. Moreover, a modal

shift can be constrained from a supply chain management perspective, since a modal shift is likely to lead in a change on the load unit, the frequency, and the time performance of freight flows (Rodrigue et al. 2013). These changes will imply adjustments to the existing supply chain.

In practice, a shift from the existing mode to another transport mode involves a switch in the supply chain structure and selection of new actors (suppliers, logistics service providers etc.). Verduijn (2004) developed a framework for presenting the factors that determine the need for switching and the easiness of switching. Switching for new technology, switching for alternative component and materials, switching for costs, switching for quality and performance, and switching for capacity/ availability are the main motives behind the need of actors switching in supply chain networks (Ibid). The easiness of switching in supply networks and the easiness of selecting actors is affected by: the uncertainty about the needs and requirements, the availability of actors and market structure and last the availability of the adequate information about actors and capabilities of assessment of actors (Ibid, 2004:296).

Therefore, negotiations of new contracts and transactions and management of new expertise (Rodrigue et al. 2013) are procedures that corporations need to undertake. Obviously, such procedures will involve costs to the company which need to be compensated by the benefits offered by the other transport mode. If not, from a monetary perspective the feasibility of the modal shift is very low, since the transaction costs influence shippers' transport mode choice decision. The next section specifies the role of transaction costs on a potential modal shift and in general in the choice of mode of transport.

3.6.1 The role of transaction costs and bounded rationality on a modal shift

Freight rates, quality of the service (transit time, reliability), the cargo logistics characteristics, the logistics concepts that the company is embedded in (demand side perspective) and the availability of capacity (supply side perspective) are the major criteria that determine the feasibility of a modal shift (Kim & Nickolson, 2013; Tavaszzy & Meijeren , 2011) , as demonstrated in the previous section.

However, even though the competitive advantage of the other transport mode, and in turn the efficiency in their logistics systems might be significant, they still have to "cope with the transaction costs of complex forms of cooperation with other supply chain partners" (Ruijgrok & Tavasszy, 2007: 13). Besides, Labegalini and Martins (2007) considered the role of the transaction costs in logistics decision and on the choice of transport mode in Brazil, trying to gain a deeper understanding of logistics planning in the Brazilian companies. According to the study the transaction costs

inhibit shippers' preferences for coastal transport, a fact which explains also the high share of cargo transported by road transport in Brazil (60%) (Ibid).

In order to gain a deeper understanding on the role of transaction costs on modal shift, initially a definition of transactions costs is given and the main characteristics of the transaction cost theory are presented. Researchers who invoke the concept of transaction costs cite the definition by Williamson (1989). According to his book "The Economic institution of Capitalism", (Ibid), identifies transactions costs into ex ante and ex post costs. The ex ante are the costs incurred in negotiating agreements and vary among the different products or services. "The ex post costs include the setup and running costs of the governance structure to which monitoring is assigned and to which disputes are referred and settled" (mal-adaptation costs, haggling costs and bonding costs) *(*Williamson, 1985:388*)*. The transaction cost theory has its origin in the 1930s, formed as a theory among economic challenges in the scope of law, organization and economy (Williamson, 1989). As stated in (Ibid) the Transaction Cost Economics is part of the New Institutional Economics (NIE), which argues that the economic actors are interrelated with each other. In institutional economics, the institutional environment is the set of fundamental political, social, and legal ground rules that establishes the basis for production, exchange and distribution (Davis & North, 1971:6).

The transaction cost theory is evolved in this research by contributing substantially to the understanding of the concept of actors switching in supply chain networks. Transaction costs are important since switching in supply chain networks implies the selection of new business partners (Verduijn, 2004). According to Verduijn (2004:19), "transaction costs include: search costs necessary to find an organization that can fulfill the requirements; contracting costs, which are related to negotiation of the terms of trade and the drawing of the contract that regulates that exchange; and control and regulation costs for implementation of the contract and the policing of the deviations from the contract terms". The process of switching in supply chains involves various risks; uncertainty of transaction, uncertainty and complexity of needs, lack of trust between the actors, etc. The frequency of interaction (Brouthers & Nakos, 2004) or - as cited in Verduijn (2004) - recurrent transactions enable the parties to build trust by demonstrating norms of equity and reciprocity and in turn trust leads to a reduction of transaction costs.

Besides, the transaction costs derive from structural conditions that affect the fundamental behavioral assumptions, inter alia the limited rationality (Williamson, 1989, cited in Labegalini & Martins, 2007). The concept of limited or bounded rationality was first introduced by Cyert & March (1952) investigating business decision processes, and later by Herbert Simon (1972), who presented approaches of rational decision making in management science, in chess strategy, and in design. The theory behind the rationality concept derives from an attempt to describe "how people or organizations should behave in order to achieve certain goals under certain conditions or how people or organizations, do in fact, behave" (Simon, H., 1972:161).

The bounded rationality presumes that economic policy makers act without full knowledge of the available options and of all the possible consequences of the options (Labegalini & Martins, 2007).

Therefore, actors in the transport market make their choices frequently in a situation of bounded rationality, due to lack of knowledge and lack of time to further investigate alternative options (Kamp & Scheltjens, 2002). This is confirmed, as mentioned above, by the modal shift project - study conducted by EVO and the Dutch Ministry of Transport - within which shippers were not aware of the opportunities that other modalities can offer. Is also found in Samini et al. (2011); shippers were not aware of the rail benefits, and according to the authors their decisions would have been different if they would have inclusive information on the alternative transport services. In fact, Kamp & Scheltjens (2002), argued that the sub-optimization[2] in logistics choices can be explained by the bounded rationality. According to their study, actors do not make choices based on an absolute rational approach, but instead they are bounded in their decision making process (Ibid). All the aforementioned examples, form a general behavioral approach on a modal shift concept, within which bounded rationality plays a key role on the modal choice decision of shippers.

3.7 Conclusions

In chapter 3 an extensive literature was presented on the concept of modal shift; the factors that might constrain or facilitate a modal shift were discussed and various trade-offs were identified. The sub-research question that has been investigated in this chapter was: "*which are the factors that influence the shipper's transportation mode choice decision?*" Modal characteristics, products' logistics characteristics, the logistics costs, and the logistics concepts that a company is embedded in were discussed as factors that influence the transport mode decision making process, which presented in sections 3.1- 3.5 respectively. Transit time and reliability are reputed to be the most important factors that influence freight transport (Allen, 1985; Fowkes, et al. 2004; Muilerman, 2001; Hannigan & Venables, 2006). However, the presence of other factors cannot be denied; freight rates, the value of the product, and sustainability are also of great importance. Besides transport decisions are dependent on the general logistics concepts that a company is embedded in, inter alia frequency of shipment, amount and location of the plants and warehouses, etc. At the same time the choice of a transport mode has an impact on a whole series of costs in the supply chain besides transportations costs, such as inventory costs and production costs. The table below illustrates the evidence found from literature in more detail.

[2] Sub- optimization can be observed when a process/ decision yields less than the best possible outcome or output, which means that actors will stop searching for alternatives since they come across with an acceptable solution for his problem (Kamp, B. & Scheltjens, T., 2002)

Table 3.3 Factors that exert an influence on shipper's transport mode choice decision by author

Authors	Factors that exert an influence on shipper's transport mode choice decision
Baumel & Vinod (1970)	Freight rates, speed, variance on speed , en-route lossage
Allen, (1985)	Time in transit and reliability of transit time
Blumenfed et al. (1985)	Trade off among transport, inventory and production costs
McGinnis (1990)	Transport service quality
Fowkes et al. (2004)	Reliability
Ganeshan & Harrison (1995)	Trade off among transport and inventory costs
Murphy & Daley (1997)	Reliability
Runhaar & Kuipers (1999)	Trade off among total costs and quality of service/ Trade off among product characteristics and shipment frequency
Muilerman et al. (2001)	Reliability
Bolis & Maggi (2003)	Major: Price, Reliability, speed and safety Secondary: Frequency of service and flexibility
Hannigan & Venables (2006)	Reliability
Lammers et al. (2006)	Product's characteristic
Notteboom, (2006)	Time and schedule Reliability
Gursoy,(2010)	Shipping time and price, reliability, accessibility

A modal shift takes place when one mode has a comparative advantage - in terms of time, reliability, and price - over another transport mode. The growing interest on the concept of modal shift and the growing academic work on the subject can be mainly explained due to the large growth of volumes transported by trucks witnessed the last decades, accountable for unpleasant externalities (congestion, noise, accidents).

In fact, many studies have put emphasis on shifting cargo away from the congested roads, promoting other modalities (rail, sea, inland transport) in line with national transport policies (Table 3.4). Such modal shifts are considered necessary from a policy and societal perspective.

Table 3.4 Studies on a national level- Factors that constraint a modal shift

Authors/ Country of focus	Factors constraint a modal shift target
Kim & Nickolson (2013)/ New Zealand	**1.** Transport time (from road to rail) **2.** Accessibility (from road to coastal transport)
Tavasszy & Meijeren (2011)/ The Netherlands	1. Demand side: accessibility of transport modes, transport distance, product characteristics, size of shipment, speed 2. Supply side: insufficient capacity and infrastructure (flows from road to rail and/or inland transport)
Labegalini & Martins (2007)/Brazil	Transaction costs and bounded rationality (from road to coastal transport)

Among the various factors identified, the role of transactions costs emerged as a key determinant of the feasibility of a modal shift. A modal shift requires the selection of new actors/ partners and might imply a switch in the supply chain (Verduijn, 2004). Obviously such procedures involve costs, the transaction costs. Specifically, the transaction costs are the main costs required in order to find new partners and include contracting costs relevant to negotiations and trade agreements. Thus even if there is a comparative advantage offered by another transport mode, shippers are reluctant to get involved in new transactions. In fact, new transactions evolve risks in terms of uncertainty, complexity and trust (Ibid, 2004).

In addition, a behavioral approach towards a modal shift inquiry has been achieved. In fact among the studies that evolved a modal shift concept, a consensus was found. Shippers do not investigate alternative shipping options and they are not aware of the opportunities that other modalities can offer. In other words, actors are bounded in their decision making process and for that reason they do not make decisions on an absolute rational approach.

Research Approach

This section offers a description of the research approach that was used in order to shape the research design, collect the data and answer the main research question. In order to apply the theoretical framework presented in the previous chapters a case study was considered as the adequate research design for this thesis. The research design should provide practical insight into the theoretical approach of a modal shift concept. The case selected is the trade between China and Europe. The reason is quite obvious; the most TEU is traded on this route, and China is Europe's largest import market (CCTT, 2012). Moreover, the exports from China are expected to increase in few years' time taking into consideration China's emergence as one of the world's leading export nations (Stalk & Waddel, 2007). Besides, it was the first trade route, in which Maersk applied slow steaming, a fact that gives evidence on the increasing interest of speed reductions on this route and provides coherence on selecting it as case study.

Goods from China to Europe are mainly shipped via ocean with destination the Northern ports (Rotterdam, Antwerp, Hamburg, Bremen), passing through the Suez Canal, and in turn the freight is distributed to the rest of Europe by road, rail or inland waterway transport. However assuming that shippers face extra costs and unreliable services, as it was demonstrated previously in the thesis, the potential modal shift in question will be investigated.

The research process can be divided into 4 phases:

1. Overview of sea freight volumes on the China-EU route & Investigation on products susceptible to a modal shift
2. Investigation & evaluation of shipping alternatives - Determining the options available to the decision maker
3. Discussion of the decision making process

Research phase 1- Overview of sea freight volumes between China and EU

First and foremost, an analysis of the sea freight volumes on the China-Europe route is demonstrated, providing a general overview of the freight transport market in the study area. Second, this section investigates which

products are susceptible to a modal shift, answering the sub research question: "which products may have the potential modal shift to rail or air?". Based on the theory, a modal shift primary depends on the costs, the products characteristics and the nature of the demand of the product. Initially, evidence from the literature is combined with practical insights from the interviews, building reasoning on the modal shift potential. Data were collected on the exports from China to the Netherlands based on year 2010, in terms of value (euros) and weight (tons). The value per ton is calculated for each of these products by dividing the total value with the quantity of the product transported. This figure will function as an indicator to answer the sub research question.

Research phase 2- Shipping alternatives on the China-Europe route

Analyzing a modal shift decision-making process requires not only the analysis of the chosen shipping option (research phase 1), but also of other alternatives (Ben-Akiva & Bierlaire, 1999). Emerging shipping alternatives are presented on the China-Europe route. These are available transport options that logistics managers might consider, as an alternative to sea shipping, seeking for more efficient and effective supply chain structure. However, the majority of the shippers are not aware of the alternative shipping options, as it was demonstrated earlier on the literature, fact which limits their decision process. In order to examine the potential of each of the alternative shipping options in terms of costs, time, and freight flows, data are collected from literature but also from ETISplus database.

Research phase 3– Decision making

A synthesis of the previous outcomes will take place in this phase in order to draw the concluding remarks on a modal shift potential. "The decision-makers preference for an alternative is captured by a value, called utility; therefore the decision maker selects the alternative among the choices with the highest utility" (Ben-Akiva & Bierlaire, 1999:6). In other words, depending on the importance each shipper adds to the different criteria of transport in question, he will finally opt for the alternative shipping option that best fits these requirements.

Research design

The research design should guide the execution of the research methods (Bryman & Bell, 2007) and provide the framework for the collection and analysis of data. To determine whether the theoretical approach on the feasibility of a modal shift in question can be practically applied, and to determine whether slow steaming is a window of opportunity for other transport modes, it is considered that a case-study

is the appropriate research design for this thesis. According to Yin (1993:59), a case-study is an empirical inquiry that "investigates a contemporary phenomenon within its real life context and addresses a situation in which the boundaries between phenomenon and context are not clearly". The central defining characteristic is concentration on a particular case (or small set of cases) studied in its own right (Robson, C. 2002).

Research Method

The research method is the technique that was used in this thesis to collect the data. Different methods are involved in this thesis; interviews, questionnaire and official statistics from an online database (ETISplus). In line with Bryman and Bell (2007) a distinction can be made between primary data and secondary data. The first two methods contain original data and are characterized as primary data, since they were collected from the author. Secondary data are data that have been obtained from another researcher or company and therefore there is no involvement of the author in the process of collecting the data. Both primary and secondary data are considered.

Since an extensive explanation of the interview and questionnaire method was presented in Chapter 1 section 1.3.1, only a quick overview follows. The collection of data as a research method will be presented below.

Overview on interviews and questionnaire as a research method

The interviews will definitely contribute to a deeper understanding of the main research question, but also of the general field of research. In total 7 in-depth interviews were conducted for this research, 6 during the months October- December 2013 and one final interview took place by the end of April 2014. An interview questionnaire was prepared in advance including open questions. Logistics managers and transport operators (mainly rail and air operators) were interviewed, regarded as the most appropriate interviewees. For this research both face-to-face and telephone semi-structured interviews were conducted. Few telephone interviews executed mostly due to interviewees' limited availability. Moreover, after request from few contacts a questionnaire was sent via email, however, only two questionnaires were sent back.

Transport Data

To begin with, the data used for this study are collected from the ETISplus database. ETISplus is a European Transport Policy Information System, combining data and analytical modeling (official website). ETISplus has been collecting data from other

international and national databases for the base years 2005 and 2010. Quality checks have been achieved in order to provide excellence and value on the information. ETISplus database is perceived as the most adequate source in transport related data therefore it is considered as the appropriate source to use for the analysis required in this thesis.

Transport data were collected for the base year 2010 forming a database of 2.611.242 observations. The observations collected are:

- Sea transport freight flows (20.670 observations) between China and Europe[3] in terms of mode of appearance and sea freight exports from China to the Netherlands, tonnes transported of each product (NST2 classification)
- Rail transport freight flows (684 observations) between China and Europe, tonnes transported of each product (NST07 classification)
- Rail transport freight flows (80000 observations) between EU(27)[4] tonnes transported of each commodity (NST1 classification)
- Air transport freight flows (9.270 observations) between United Arab Emirates and Europe in tonnes
- Trade TEU, tonnage and value of each product (according to NST2 classification) between country pair, exports from China to the Netherlands (432 observations)

At that point some remarks can be made: the NSTR classification differs among the different transport modes (NST1, NST2, and NST07), fact that could be conceived as a drawback. Moreover, the large amount of data collected formed a rather complex database, and the interpretation of the results appeared to be a time- consuming process.

[3] Including Croatia

[4] In rail transport, data were collected also for Russia and Belarus, in order to explore the rail connection between Europe and China via Russia

4. Case Study on China-Europe route

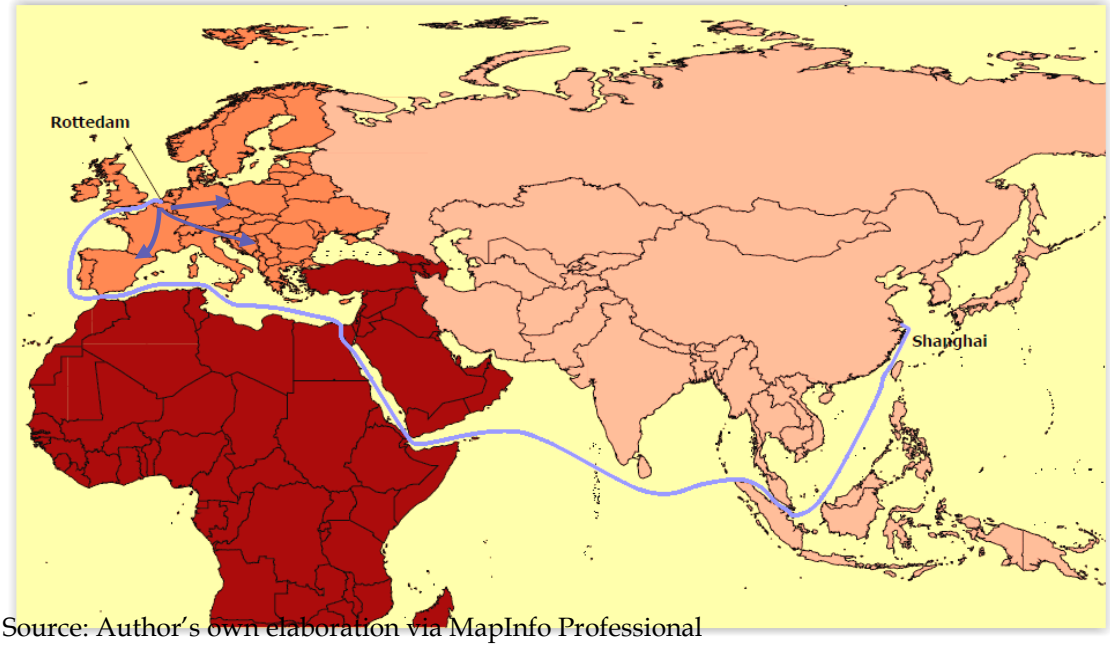
The aim of this case- study research is to investigate how the possibility of modal shift can be applied in the China-Europe route, taking into consideration that the increasingly unreliable services (Nieuwsblad Transport, 2012; Containerization International, 2013; Containerization International, 2012, Review of maritime transport, 2010) provided by the shipping liners, due to slow steaming, implies disruptions in shippers' supply chain, and might influence their transportation decisions. In this chapter evidence from the interviews is provided in order to gain a better understanding on the case study. The analysis of the interviews however, follows in chapter 5. The four phases introduced earlier in the research approach are presented in the following sections.

In section 4.1 the sea freight volumes on the China-Europe route are displayed and a general overview of the freight transport market is given. Section 4.2 provides a logistics structure analysis vis-à-vis the products characteristics. The underperformance of the air cargo industry, that has been observed the last decade, is discussed and examples of specific products that shifted to ocean are given (Seabury, 2013; interview). Next supply chain trends that influence transportation decisions and in general make logistics decisions more complex are presented. A match between the different types of products and the different transport modes takes place below, by combining the characteristics of logistics, of the products and of the transport modes. The latter were previously specified in chapter 3, section 3.1, and table 3.2. Section 4.3 identifies the alternative shipping options on the China-Europe route, namely, a. the potential railway connections between China and Europe, and b. the sea-air combination via Dubai. The freight volumes on both the alternatives are presented and analyzed investigating their feasibility. Furthermore, initiatives and relevant transport developments that facilitate these transport options will be discussed. Based on the previous sections, section 4.4 draws concluding remarks on the potential of a modal shift on the China-Europe route.

4.1 Sea Freight Volumes

China's trade with the EU has been growing at a high pace for the last two decades. In fact, Europe is China's largest export market, and China is the second most important destination of export from the EU (Appendix 2). In this section, the sea freight volumes on the China-EU route are provided. Goods from China to Europe are mainly shipped via ocean to the Northern ports (Rotterdam, Hamburg, Antwerp,) and then the products are distributed to the rest of Europe by short sea (feeders), rail, road or inland waterway transport. In fact, 98% of transit cargo is transported between the EU and the Asian Pacific Region via sea, passing through the Suez Canal (Vinokurov, 2009). The figure below illustrates the main sea route via the Suez Canal (Figure 4.1). China's main logistics and shipping centers are mainly located in the South of the country, specifically the Pearl River delta, the Guangdong, the Zhejiang and the Shanghai region (Ibid).

Figure 4.1 Sea route via the Suez Canal



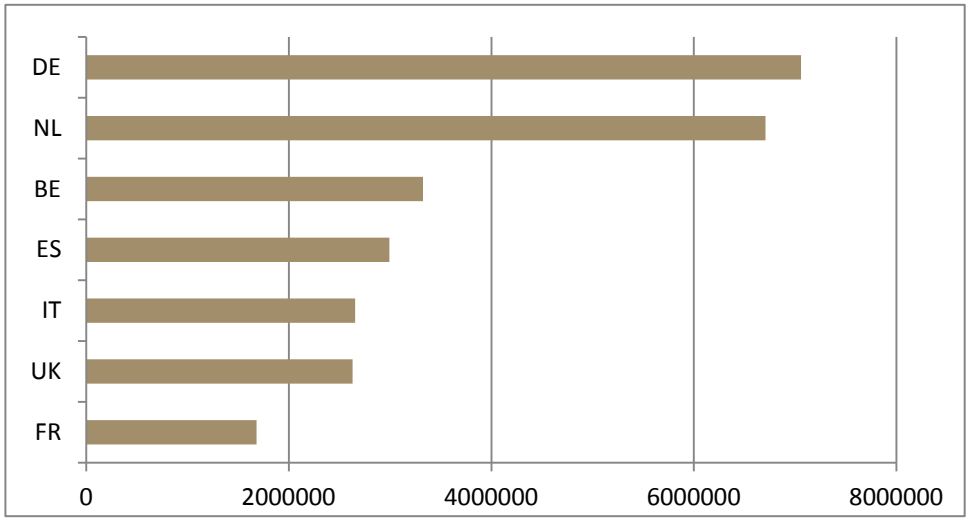
Source: Author's own elaboration via MapInfo Professional

China has become, to a great extent, "the world's factory", due to the attractive production costs, mainly supplying North America and Europe with apparel, food, electronics, and components for manufactured goods (Fu et al.,2011; Stalk & Waddell, 2007). More specifically, South China produces more shoes and electronic, in Shanghai toys and clothes are largely produced, and the Northern provinces are rather a cluster of industrial facilities (Vinokurov, 2009). The efficient distribution of goods and the effectiveness of global supply chain networks are major challenges related to China's growth. In addition to this, logistics costs account for 18% of the country's GDP in 2010, and have been around this level since 2001 (Fu et al. 2011). This is almost twice as much, in comparison with most developed countries. Besides

that the country's manufacturers due to the high labor costs that continue to rise, may decide to move to nearby lower cost countries (Stalk & Waddell, 2007). Another concern is the imbalance of the cargo

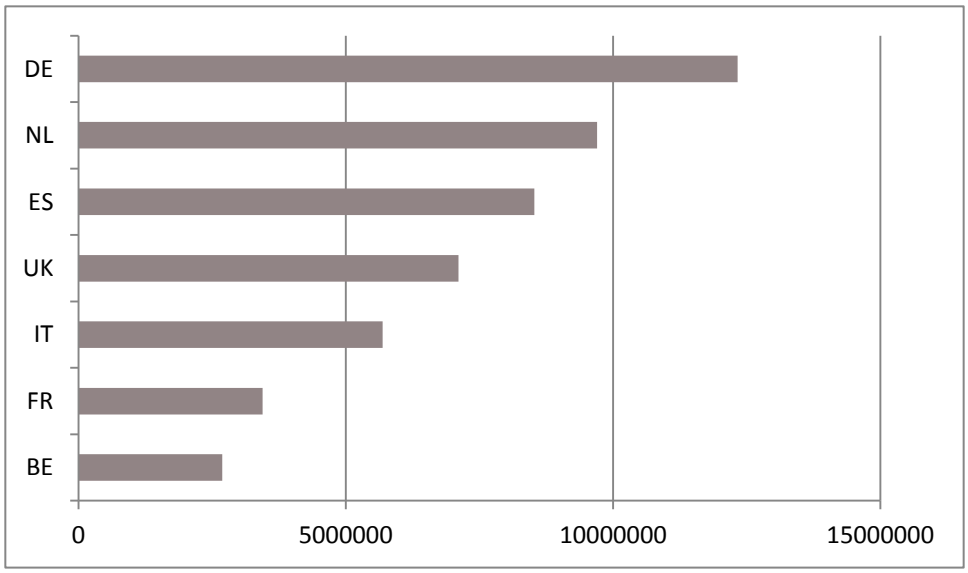
The figures below illustrate the container sea volumes, imports and exports from China to Europe, based on trade statistics collected from ETISplus database for the year 2010. Countries with relatively limited volumes imported/exported are excluded. However, the total sea freight volumes can be found in Appendix 3. The data are collected on origin-destination basis, and not on a port-to-port basis. This might limit the consistency and reliability of the figures, for the reason that possibly more ports are located in the same region-province, especially in case of China.

Figure 4.2 Container sea volumes in tones, exports from Europe to China, 2010



Source: Author's own elaboration based on data from ETISplus database (2010)

Figure 4.3 Container sea volumes in tones, exports from China to Europe, 2010



Source: Author's own elaboration based on data from ETISplus database (2010)

According to the data collected for the year 2010, ETISplus database, the total sea freight volumes on the exports from Europe to China account for 34 million tons, from which almost 29 million represents containerized cargo. On the exports from China to Europe, the total sea freight volumes are approximately 57 million, from which the 51.5 million represents container traffic.

Significant container sea volumes from the Chinese ports to the West-Northern European ports are illustrated in the figures above. More specifically, on the exports from Europe to China, Germany and the Netherlands, with leading ports Bremen-Hamburg and Rotterdam respectively, rank higher in container sea volumes than the rest of the European countries. Belgium, Spain, Italy, United Kingdom follow. On the exports from China to Europe the picture is quite different. Germany ranks first, leaving the Netherlands behind by approximately three million tones. Comparing the two figures, the imbalance of cargo between the Westbound and Eastbound volumes can be observed, which means that empty containers return to the point of origin.

4.2 Products susceptible to a modal shift

Elements such as a logistics structure analysis concerning the character of the products, supply chain trends, and transport mode suitability are discussed below. The following analysis will contribute to investigate the sub-research question: "Which products may have the potential modal shift to rail or air?"

Logistics structure analysis

The products' characteristics determine the logistics structure and decision-making process of the company. For instance, the logistics characteristics of a high-valued product with short shelf life could be characterized by high reliability, high responsiveness and short lead times but also by a high degree of flexibility (Kuipers & Eenhuizen, 2004). The value density and the packing density are also of great importance. In fact products with high value density and high packing density are sensitive to interest costs and handling costs (Ibid; Goor, 1989). Therefore shippers with high-valued density products should focus on minimization of inventories (Goor, 1989). Figures 4.4 and 4.5, present the logistics structure of the products in terms of value and costs.

Figure 4.4 **Value and shelf life determine the logistics and supply chain structure of a company**

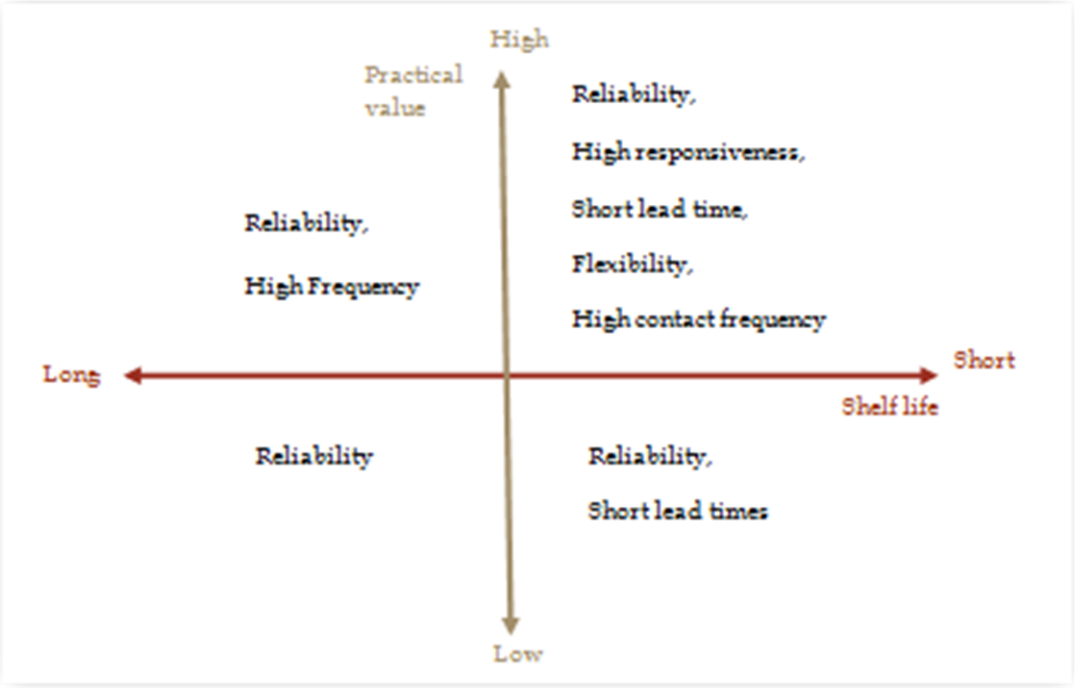
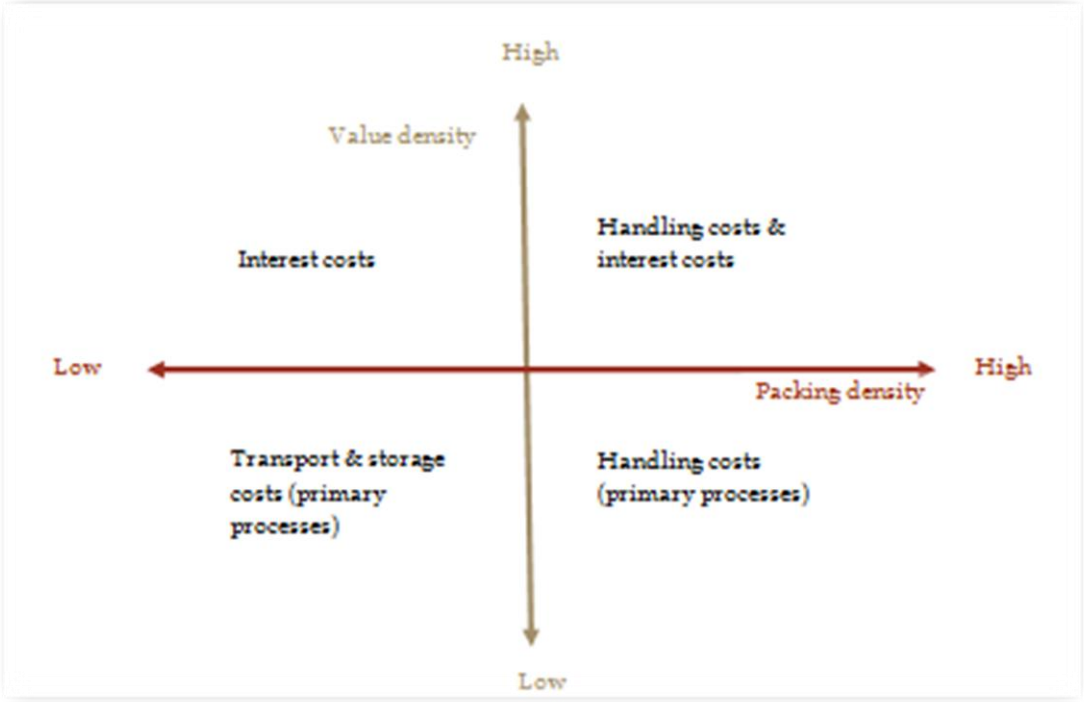


Figure 4.5 **Value density and packing density determine the costs**



Source: Adapted by Kuipers & Eenhuizen (2004:15)

In addition, the nature of the demand of the product shapes the logistics structure of a company (Fisher, 1997; Hoek et al. 2001), and in turn influences the transport mode choice decision (Hummels & Schaur, 2010). The products based on their demand patterns can be classified into primarily functional and innovative (Fischer, 1997; Hoek et al. 2001). Products that satisfy basic needs and they do not change over time are characterized as functional. These products mainly have stable and predictable demand. On the other hand, products with short life cycle such as fashion clothes and personal computers are characterized as innovative products, and they have mostly unpredictable demand. Functional products require a physically-efficient supply chain and innovative products require a market-responsive supply chain (Fischer, 1997; Hoek et al, 2001). The table below presents the main characteristics of these two different supply chains strategies with respect to the uncertainty of demand.

Table 4.1 Physically-efficient and market-responsive supply chain

	Physically-efficient process	Market-responsive Process
Primary focus	Efficient supply at the lowest possible cost	Minimize stock outs and obsolete inventory by quickly respond to unpredictability in demand
Manufacturing focus	Maintain high rate utilization rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimize inventory throughout the chain	Deploy significant buffer stocks of parts or finished goods
Lead-time focus	Shorten lead time as long as it does not increase cost	Invest in ways to reduce lead time
Selecting partners	Choose primarily for cost and quality	Choose for speed, flexibility, and quality

Source: Adapted by Fisher 1997:108

As may have become clear from the previous sections, the products' characteristics and the nature of the demand of the product shape the logistics and supply chain structure of a company. Therefore the match between the different types of products and the different transport modes is also related to the overall logistics structure of the company. Furthermore, one of the interviewees, expert on air freight, highlighted the primarily factors that exert an influence on shipper's modal decision; namely, the

costs and the product's demand. On the question: "which transport mode – between sea transport and air transport - to use and for which product?", he explained that when the stock is empty then the products will be shipped by air and in contrast when the stock is full the products will be shipped by sea. However, very high value products will always be shipped by air (Mr. Schuchard C., 2013, pers. comm..,28 November; Mr. Osinga, E., 2014, pers. comm..,29 April).

Freight transport "paradox"

Although, it is perceived that high value products are shipped by air, given that their logistics characteristics primarily require high reliability, and short lead times, the last decade, the air freight market has witnessed underperformance (IATA & Seaburry, 2014). Besides, this can be explained also by a natural growth in demand for products that are shipped by sea, and a broad modal shift from air to ocean freight (Ibid). The cost – the difference between sea and air freight rates is significant – is the main drive behind a shift from air to ocean (Ibid). According to the same report raw materials, perishable goods (fresh food), fashion, high-tech, and machinery parts have experienced significant shifts to ocean.

Amongst other goods, products with respect to their shelf life and obsolescence possibility have matured, and since the lead time allows it, shippers ship their products by sea instead of air (Ibid). That applies in general to high tech industry products, for example hard drives. Another example, mentioned by an air cargo expert, are pharmaceuticals products. Somebody would think that air cargo is much more reliable than sea, but the reality is different (Mr. Osinga, E. , 2014, pers. comm., 29 April). Nowadays, despite the long transit times, the temperature of the container that contains the medicines can be kept constant along the transport, which applies to long shelf life medicines (Ibid). On the other hand medicines with short shelf life cannot be shipped by sea. Another "paradox" in the freight market appears to be the transport of flowers - a typical air cargo product. Some years ago, managers could not imagine transporting flowers on a container, given that flowers require very short lead times, in order to keep their quality in a good condition. However, logistics managers in an attempt to minimize the transport costs found out that some types of flowers can have maximum 24 days on an average transport temperature of around 0.5 degrees Celsius (Nieuwsblad transport, 2013, Mr. Osinga, E. 2014, pers. comm.., 29 April). According to Wenink (cited in Nieuwsblad transport, 2013), the flower sector and especially the ornamental plants, can benefit from lower transportation costs by making use of container ships.

Of interest, as stated by one of the interviewees, "it is not necessarily a modal shift from air to ocean, but it definitely plays with the modalities" (Mr. Osinga, E., 2014, pers. comm.., 29 April). In fact, fashion goods have been shifting to – and from – air, with high volatility since 2000 (Seaburry & IATA, 2014) (see figure in Appendix 3).

Supply chain trends

In recent years a growing interest on managing and designing efficient and responsive supply chains can be observed. At the same time companies have to face a plethora of emerging trends and changes in the environment, within which they operate (Verdujn, 2004; Tachizawa & Thomsen, 2007). These trends further make logistics decisions (inventory management, transport and location decisions) more complex and lead to unprecedented volatility and uncertainty (Skintzi, 2007). As a result, flexibility in supply chain has emerged the last years, as the key success factor, not only in building competitive advantage (Fischer, 1997; Tachizawa & Thomsen, 2007; Bertrand, 2003), but it is also characterized fundamental in order to stay in business (PWC, 2011). A number of supply chain trends are discussed below that exert an influence on the freight market transport, evidence from the literature and the interviews is included, providing practical insights.

- Globalization & outsourcing of logistics activities vs nearsourcing

Globalization enables the sourcing of logistics activities (production, sourcing) to take place in different locations around the world, known as "global sourcing". In fact China has claimed its position in international manufacturing networks, due to the attractive labor costs (Stalk & Waddell, 2007). However, the last years, many companies that have outsourced their production in the past, faced rising labor costs, lack of quality and an inflexible and inefficient supply chain (Stalk & Waddell; 2007;Accenture, 2007; Berman & Swani, 2010; Cagliano et al., 2012). Given that, companies have to rethink and redesign their supply chains. In fact, some companies moved their production closer to the market or back to its origin– near-sourcing and re-shoring respectively (Cagliano et al. 2012). It is obvious that this will impact mode choice decisions. In fact, according to Seaburry Group (2013), production closer to consumer will negatively impact the air cargo volumes. This is confirmed as well from the discussions with the experts. Of interest, one of the interviewees, expert in the air cargo industry, described the process of near-sourcing as a virtual modal shift (Appendix).

- Customers needs are more diverse than ever

Customer satisfaction and responsiveness is the key success in today's market (Hoek et al, 2001). Companies are competing nowadays in a highly unpredictable consumer demand (Ibid), while customers are becoming more demanding in terms of quality, time delivery, availability, product service (Kumar et al. 2008; Kumar & Desmukh, 2006). Besides, "customer preferences change more quickly and unexpectedly as the media stimulate the spread of new hypes" (Verduijn, 2004: 7). Uncertainty of demand and the customers' diverse expectations influence modal choice decisions. In fact, companies increasingly use air freight transport vis-à-vis the high uncertainty of demand (Hummels, 2007; Hummels & Schaur, 2010; Seaburry, 2013).

- Information and communications technology

Technological developments had considerably increased the efficiency of logistics processes. In fact information technology facilitates the exchange of information among companies and partners, and complex supply chain practices in the past, have been relatively simplified (Verduijn, 2004). The improved railway technology connecting China and Russia via the Trans-Siberian railway is a significant innovation, providing shippers a transport choice between the slow ocean and the expensive air transport. At the same time, the integrators – air cargo - are growing, since internet and e-commerce enabled the personalization of the products (Mr. Osinga, E., 2014, pers. comm.. 29April).

- Product life cycles becoming shorter

Consumers and businesses both demand more diversity and better quality. Besides, technological developments, product developments, and time and speed to market concepts have been emerged, shortening simultaneously the products' life cycles. Therefore, logistics and supply chain processes need to be reliable and flexible.

- The greening of the supply chain

As already demonstrated earlier in this thesis, the greening of the supply chain has emerged as an essential element of business strategy in the modern world (Esty & Winston, 2006). From production to the packaging of the product and to the transport, in all the stages of the supply chain, companies are increasingly trying to operate under green principles. In fact, Wal-Mart has raised the pressure on its suppliers, as regards the desirable packaging, waste and fossil fuel reduction (Ibid). In addition, BP saved more than $2 million in efficiency by internally trading greenhouse gas emissions between business units (Ibid). These examples confirm the growing concern about sustainability. Parallel to this, national and international governments are promoting sustainable transport modalities, such as rail, waterway and intermodal transport.

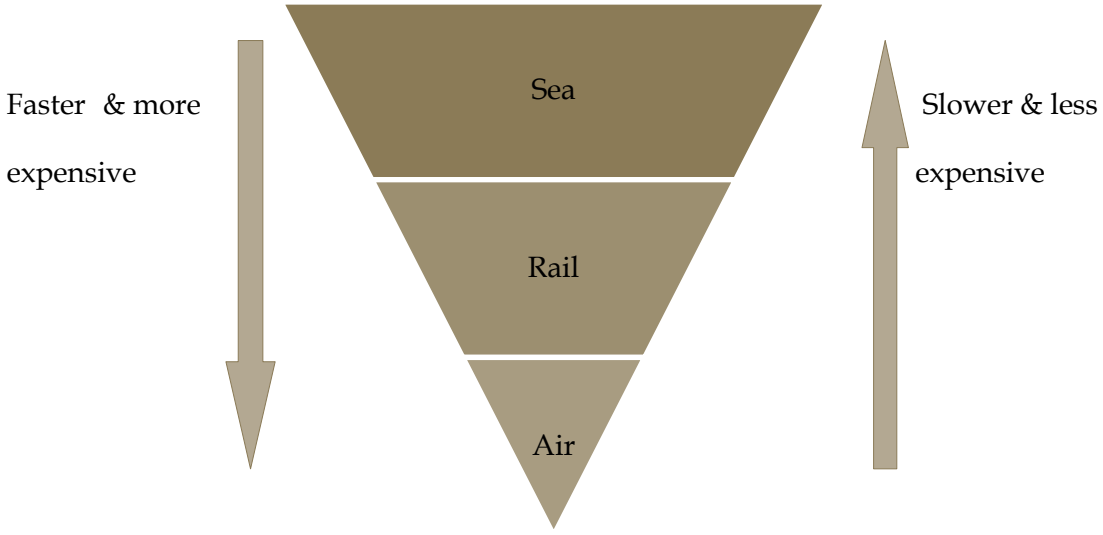
Transport mode suitability

Air transport is a fast but expensive transport option, and on the other hand, sea transport offers slow and inexpensive transportation. High value and time-sensitive products are considered as air cargo products, whilst low value and large products in terms of volume and size are considered as sea cargo products. Besides, shippers need to balance the tradeoff between uncertainty and transportation cost to determine an optimal mix of air and ocean shipping (Hummels & Schaur, 2010). At the same time the development of the rail connection between China and Europe and the development of the Trans-Siberian railway offer a "middle optimal alternative" (Mr. Osinga, E., 2014,pers. comm.., 29 April). This is mainly a threat for the air cargo freight, since in the train you can load more products and it is cheaper (Doesburg, J.,

2013, pers. comm.., 9 October). Currently, products are shipped by air, because they can't be in transit for 40 days, in the case of sea transport, but they could be shipped by rail in about 20 days time. Products that can be shipped via rail transport are foodstuffs, electronic equipment, clothes and shoes, chemicals, automotive products and furniture (Vinokurov, 2009; Mrs. Birman, I., 2013, pers. comm.., 1 November; KombiConsult expert, 2013, pers. comm.,25 October).

The figure below illustrates a modal evaluation in terms of transport costs and speed.

Figure 4.6 Modal evaluation in terms of time and cost

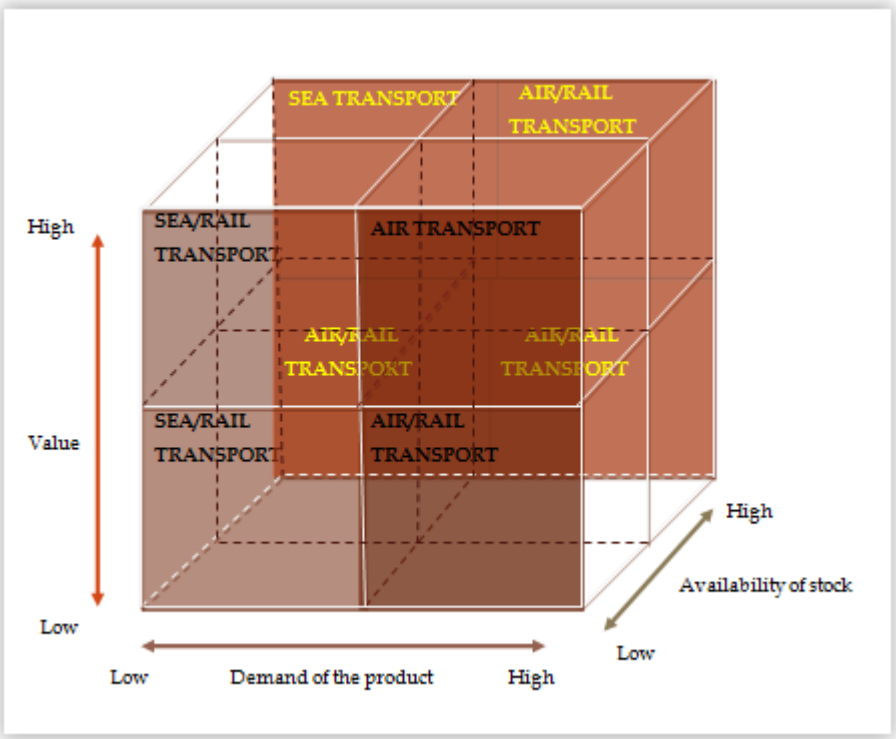


Source: Adopted from Adjadjihoue (1995)

Although the transport mode choice decision is case specific, depending upon products' characteristics, logistics concepts that the company is involved in, the demand, etc, below a general overview is given. The following factors will function as indicators on transport mode suitability for different types of products: value, demand and availability of stock-inventory. These factors were perceived among the literature studied and the interviews as the major decisive criteria. The value of the product determines the quality of the transport service required (Runhaar & Kuipers, 1999). At the same time high value products are sensitive to inventory costs and in contrast low value products are sensitive to transport costs. The demand of the product determines the level of speed and flexibility required in the supply chain. The availability of stock is a critical factor given that, for instance, a full stock does not need to be replenished immediately, allowing the company to use slow and cheap transport modes, such as sea transport (Mr. Osinga, E., 2014, pers. comm.., 29 April)

Figure 4.7 illustrates an indicative mode suitability assessment according to the availability of stock, the value and the demand of the product.

Figure 4.7 **Transport mode suitability assessment with respect to the value, the demand of the product and the company stock's availability.**



Source: Author's own elaboration

As the figure above illustrates, there are 8 different combinations identified by the three factors, illustrated in the little cubes respectively. Inside of each cube the adequate transport mode appears. For instance, a high value product, with high demand and low availability of stock needs to be shipped as fast as possible (air transport). On the other hand, if the stock of the company is full, then the products will either be shipped by air or rail. That depends on the value of the product, but mainly on the actual market demand of the product. Logistics managers need to have a deep knowledge on consumer behavior and logistics in order to opt for the adequate transport mode. An interesting example was given by one of the interviewees that demonstrates how a false estimation of the demand could lead to profit loss (Osinga, 2014:). Apple launched their new product, the iphone 5, to the market, so by having a full stock they thought that they could ship the products by ocean, considering that the products would arrive on time before retail stores would be out of stock. At the same time, the company would achieve a lot of savings in transport costs. Although, at the moment it perceived as a victorious decision, later it emerged as a mistake that appeared costly for the company. In reality the stores were out of stock, almost globally very quickly. Consequently Apple lost a massive market from Samsung.

4.2.1 Trade tonnage China-Netherlands

Taking into consideration the longer transit times and the increasing unreliable services that shippers face due to the increasingly applied slow steaming practices (Containerization International, 2012; Containerization International, 2013; Nieuwsblad transport, 2012; Review of maritime transport 2010), the potential of a modal shift is questioned.

In this section the sub-research question: *"Which products may have the potential modal shift to rail or air?,"* is investigated. Multiple factors are involved in a modal shift concept, as demonstrated previously in the literature. One of these factors is the products' characteristics and mainly the value of the products transported (Kuipers & Eenhuizen, 2004; Goor, 1989; Lammers et al. 2006). Moreover, from the literature studied and the interviews, the demand of the product and the availability of stock ranked amongst others, as major factors that influence transport mode choice decisions. However, these two factors are case specific. For that reason, the value per ton will be determined to function as an indicator, in order to find out which products are susceptible to a modal shift. The value per ton is based upon trade statistics, TEU trade of China-Netherlands imports. The total amount of tonnes and the corresponding values over the year 2010 are provided per type of product. It is important to mention that the data provided are rather incomplete, since only the volumes from Guangdong and Tianjin- China ports – to Rotterdam port are available. However, here the figures will work as an indicator on the value per ton, therefore any limitation on the volumes does not appear to be significant.

ETISplus database identifies ten different categories of products, namely: 0.Agricultural products and live animals, 1. Foodstuffs and animal fodder, 2. Solid mineral fuels, 3. Petroleum Products, 4. Non-ferrous ores and waste, 5. Metal products, 6. Crude and manufactured minerals, building materials, 7. Fertilizers, 8. Chemicals, and 9. Machinery, transport equipment, manufactured articles and miscellaneous articles (ETISplus, 2010). The value per ton is calculated by dividing the total value with the total tonnes for each type of product. Values per ton vary between €169,92 (Lignite and peat) and €25.524,35 (Other machinery apparatus). The values per ton calculated for each type of product can be found in Appendix 1. Below the value per ton for each commodity is demonstrated (Table 4.2).

The category machinery transport equipment, manufactured and miscellaneous articles are high value products; with value per ton €22.687. Parallel to that, the quantity of this commodity is also very high, accounting for 34% of the total trade tonnage transported. The rest of the products have relatively low value, with solid mineral fuels and petroleum products having the lowest value per ton, €179,62 and €442,05 respectively.

Table 4.2 Value per ton per category of product, China-Netherlands imports (2010)

	Commodities	Total tonnes	Total value in euros)	Value per ton
0	Agricultural products and live animals	387.825,9	706.627.300	1.822,02
1	Foodstuffs and animal fodder	112.576,1	177.961.700	1.580,81
2	Solid mineral fuels	568.680,1	102.147.900	179,62
3	Petroleum products	124.476,2	55.024.600	442,05
4	Non-ferrous ores and waste	78.780,6	138.572.900	1.758,97
5	Metal products	371.023,7	767.333.700	2.068,15
6	Crude and manufactured minerals, building materials	779.974,3	596.381.700	764,62
7	Fertilizers	449,1	411.300	915,83
8	Chemicals	575.143,4	1.691.599.100	2.941,18
9	Machinery, transport equipment, manufactured articles and miscellaneous articles	1.569.489,6	35.607.006.900	22.687
	Total	4.568.419	39.843.067.100	35.160,25

Source: Author's own elaboration based on data from ETISplus database (2010)

In general, a product that can be shipped via multiple transport modes (sea, land, air), provides to the company flexibility in their logistics, in comparison with products that can be shipped by a single mode (Kumar et al., 2008). For instance, heavy machines may only be shipped via sea due to its size and weight. In that case, there is no possibility of a modal shift in question. However, in case of a production failure or a kind of delay, they might have to be shipped by rail. Rail transport, as it has been clear from the previous sections, is an intermediary mode between sea and air with respect to time and costs (figure 4.6). In addition to that, the rail transport service from the hinterland of China to the West or centre of Europe, is more cost-effective than the traditional deep sea shipping via the Suez. As demonstrated earlier, amongst other, products that can be transported via rail transport are *foodstuffs, electronic equipment, clothes and shoes, furniture, chemicals, and automotive products* (Vinokurov, 2009; KombiConsult expert, 2013, pers. comm., 25 October). On the other hand, high value and time-sensitive products with small volume can be shipped via air, such as consumer's electronics, and perishable agricultural products.

Low value products can be shipped via sea, since their logistics allows them to be in transit for longer periods. That applies for instance to *tubes, pipes iron and stell castings* or to metal products. However, when the demand is high and the availability of stock is low, these products might be shipped by rail. Again, in case of a production failure or a kind of delay, they might be delivered by rail or air (Doesburg, J., 2013, pers. comm.., 9 October). As it is intuitively obvious, intermediate products that can be either shipped via air or sea or rail, with high demand, appear to have a higher possibility of modal shift. That applies for instance to textiles, other machinery apparatus, and consumer electronics which are also high-value products.

4.3 Emerging shipping alternatives on the China- Europe route

Even thought, sea freight is the most commonly used mode of transportation, it is not a "panacea". Longer transit times, delays, and unreliable services are significant negative effects that ocean shippers face since the increasingly applied slow steaming practices (Containerization International, 2012; Containerization International, 2013). At the same time, according to UN ESCAP (2007:39), containerized transportation between both directions from Asia to Europe and Europe to Asia, will reach by 2015, the 26.1 million TEU and the 17.7million TEU, respectively. Thus the Suez Canal is expected to reach its maximum capacity for container vessels by 2015 (Vinokurov, 2009). For that reason the diversification of the Euro-Asian freight transport and exploration of new routes is required. It is expected that the opportunities for alternative transport services to gain container traffic will grow.

This section provides transport alternatives on the China-Europe route, which emerged from both literature and interviews, providing answer to the sub-research question: *"Which are the emerging shipping alternatives on the China-Europe route?*. Specifically, two transport alternatives are discussed below: 1. the land-bridge railway connection between China and Europe, and 2. a sea-air combined transport via Dubai.

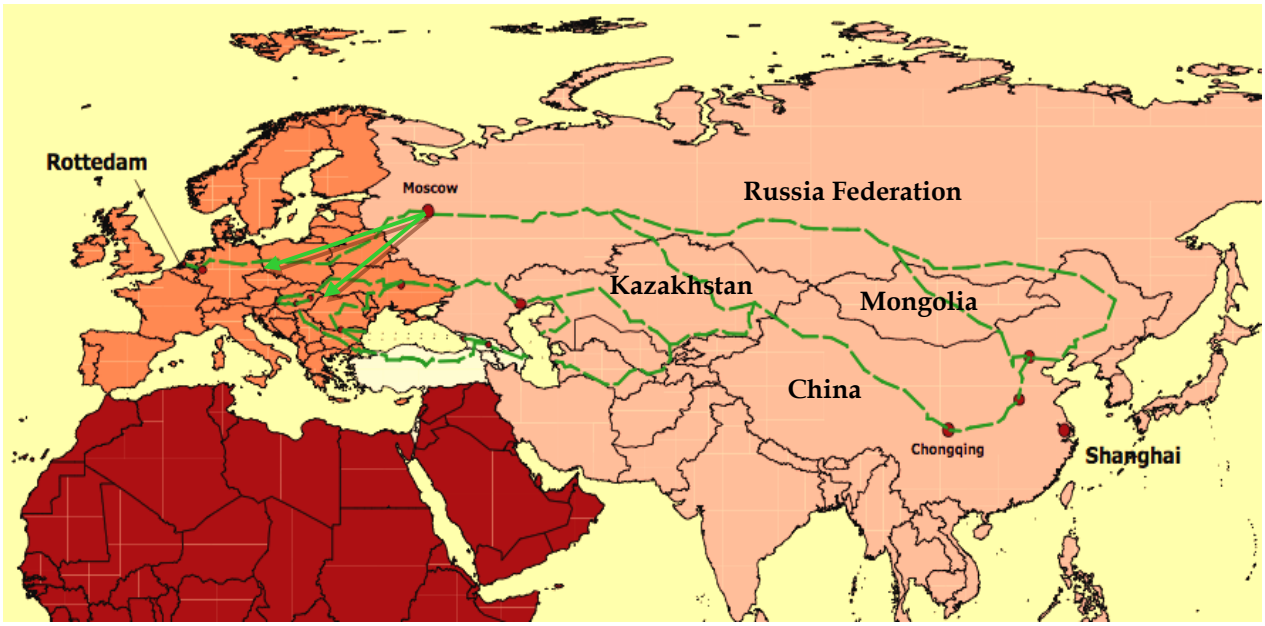
4.3.1 Railway connection from China to Europe

Rail freight land bridges provide a transport alternative service to contemporary ocean route (figure 4.8). An expected increase on the freight volumes between China and Europe, coupled with congested and prolonged maritime transport, provide opportunities to increase trade volumes on railway corridors (Vurnikov, 2009).

The Trans-Siberian railway is the longest railway in the world, running for about 10.000 km, connecting St. Petersburg with the port of Vladivostok via the city of Moscow (Liliopoulou et al. 2005; Tavasszy et al. 2011; Psaraftis & Kontovas, 2010). Moreover, the Trans-Siberian route facilitates transcontinental communication by linking the Asia Pacific region, not only with Russia, but also with the CIS countries, the Baltic countries, and Europe (CCTT, 2013). Other main railway connections[5], which connect the Western Europe with China, are: 1. the Trans-Machurian (via Zabaykalsk), 2. the Trans-Mongolian (via Mongolia) and 3. the Trans-Kazakh (via Kazakhstan) railway route (Tavasszy et al. 2011).

[5] See Davydenko et al.,2012, for an overview of these railway routes

Figure 4.8 Railway connections between China and Europe



Source: Author's own elaboration via MapInfo Professional

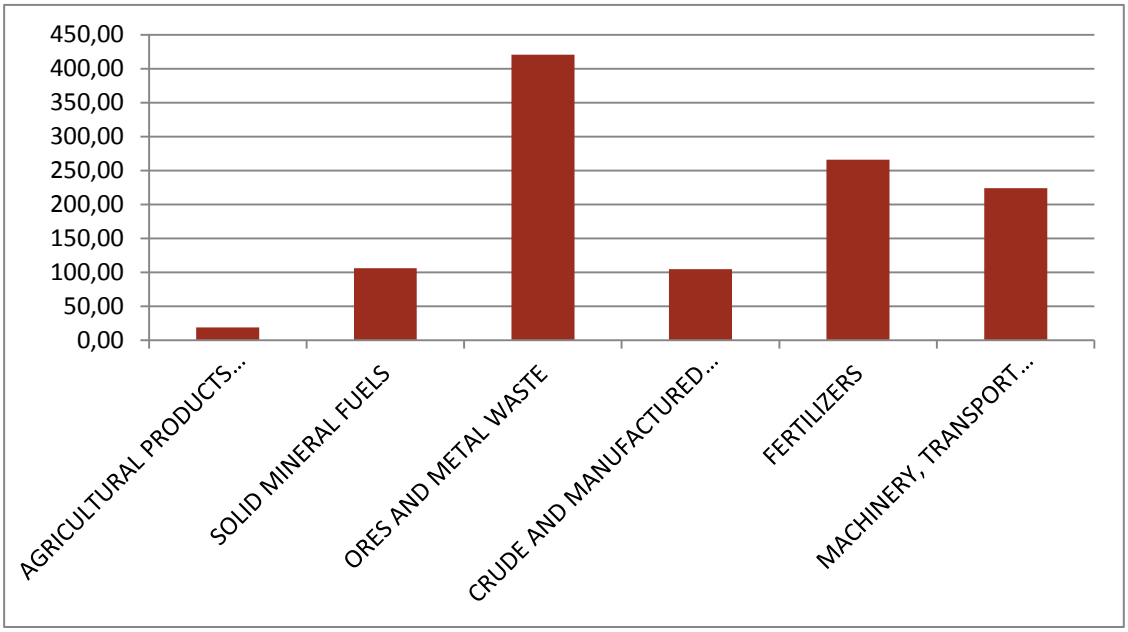
The TSR has capacity to transport up to 130 million tons of cargo per year, including approximately 500.000-600.000 containers with import/export cargo and about 250.000-300.000 transit containers (CCTT, 2012). Every train on the Trans-Siberian consists of 57 wagons, each transporting two 40' containers (Davydenko et al. 2012). China has invested in its railways, significantly improving their logistics infrastructure through transport plans and strategies.

Moreover, the economic and transport potential of the Trans-Siberian railway is illustrated not only by the growing interest and academic research (Tavasszy et al. 2011; Verny & Grigentin, 2009; Liliopoulou et al. 2005; Hilletofth et al. 2007) but also by the various projects operating in this route. The current import-export projects operating on the TSR, according to the International association Coordinating Council on Trans-Siberian Transportation (CCTT), can be found in Appendix 6.

4.3.1.1 Current freight volumes

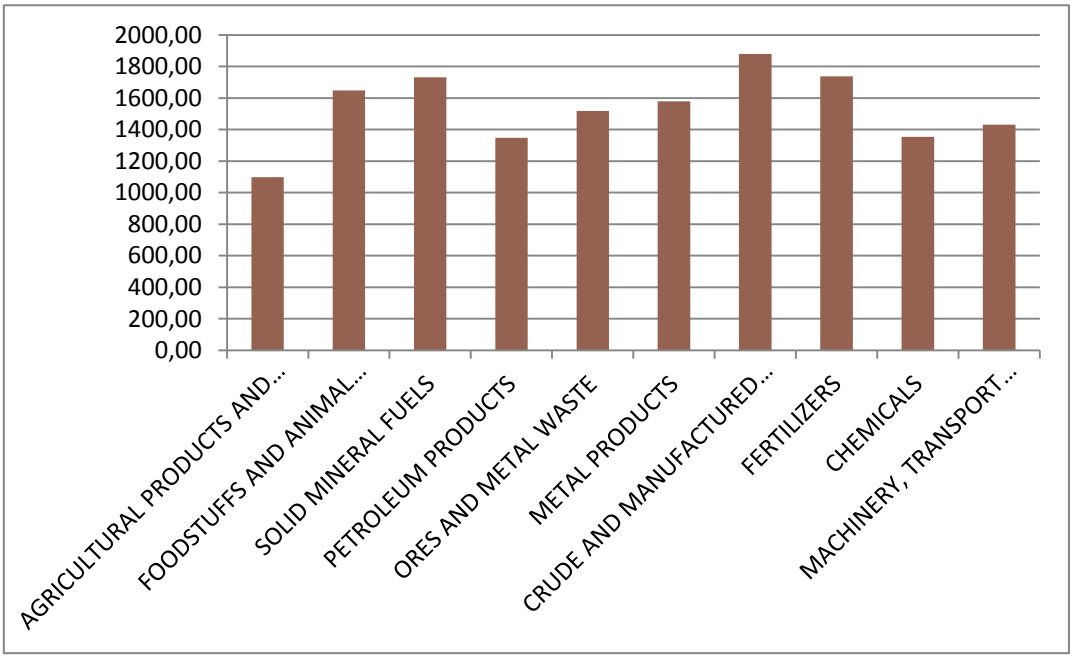
China's main exports to Europe are finished goods, namely, office and transport equipment, textiles, chemicals and metals (Vinokurov, 2009:). Europe's main exports to China are machinery equipment and electrical equipment (Ibid:). Rail freight data, collected from the ETISplus database, and data from literature and interviews are combined in order to have an overview on the rail freight flows between China and Europe. From the ETISplus database, the data appeared to be rather restricted. In fact, the only data found are exports from China (Anhui) to Latvia and Poland (figures 4.9 & 4.10).

Figure 4.9 Rail freight volumes from China to Latvia by commodity, in 2010, tones



Source: Author's own elaboration based on data from ETISplus database (2010)

Figure 4.10 Rail freight volumes from China to Poland by commodity, in 2010, tones



Source: Author's own elaboration based on data from ETISplus database (2010)

The rail freight volumes appear to be insignificant especially between China and Latvia. Main commodities transported with destination Latvia are ores and metal

waste. Commodities transported from China to Poland, in large volumes are crude and manufactured minerals, and building materials, fertilizers and metal products.

Although the data appear to be limited, various container transport services exist between Europe and China (table 4.3).

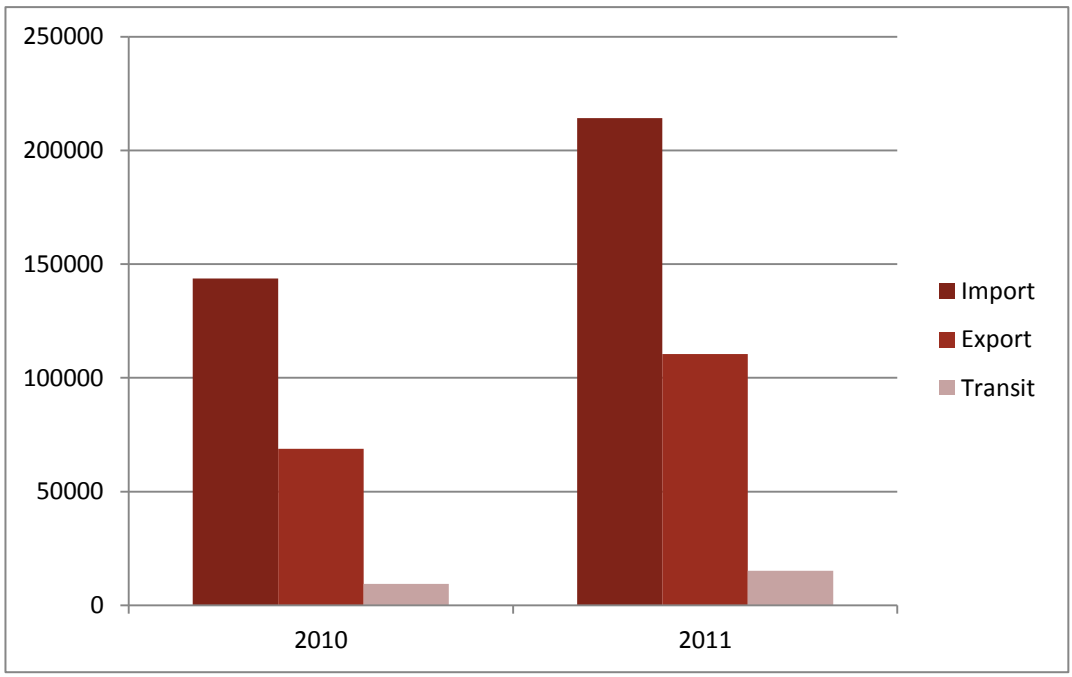
Table 4.3 Container transport services between Europe and China

Train connections	Frequency	Operator	Service started	Duration, days	Remarks
Neutraubling Shenyang	Pilot train, 5 times a week perspectively	Transcontainer	2010	18	BMW spare parts
Leipzig - Shenyang	4 pilot trains, from November 2011 daily	DB Schenker Rail Automotive	2011	23	via Zabaykalsk, BMW spare parts
Duisburg - Chongquing	Weekly (7 times a week perspectively)	Transcontainer, TEL	2011	20-25	via Ilezk, Brest (not using Transsib)
Großbeeren – Moscow (Ostwind)	4 times a week	InterRail Services TEL	2006	3,4	futher connection to Kazakhstan/PRC possible
Brest - Erlian (Mongolian Vektor)	Twice a month	Transcontainer, Belintertrans	2005	8	futher connection to PRC possible
Brest – Arys (Kazakhstan Vektot)	on demand	Transcontainer, Belintertrans	Since 2008	3,5	via Ozinki or Ilezk, Brest (not using Transsib)
Cherkessk-Chongquing	1 pilot train (7 trains in 2008)	Transcontainer, Kaztransservice, CRIMT	2011	14	Via Ozinki, car spare parts

Source: Davydenko et al. (2012: 110)

The rail freight connection between China and Russia is rather significant. Figure 4.11 illustrates freight volumes transported via the Trans-Siberian railway between Russia and China in terms of imports, exports and transit cargo for the years 2010 and 2011.

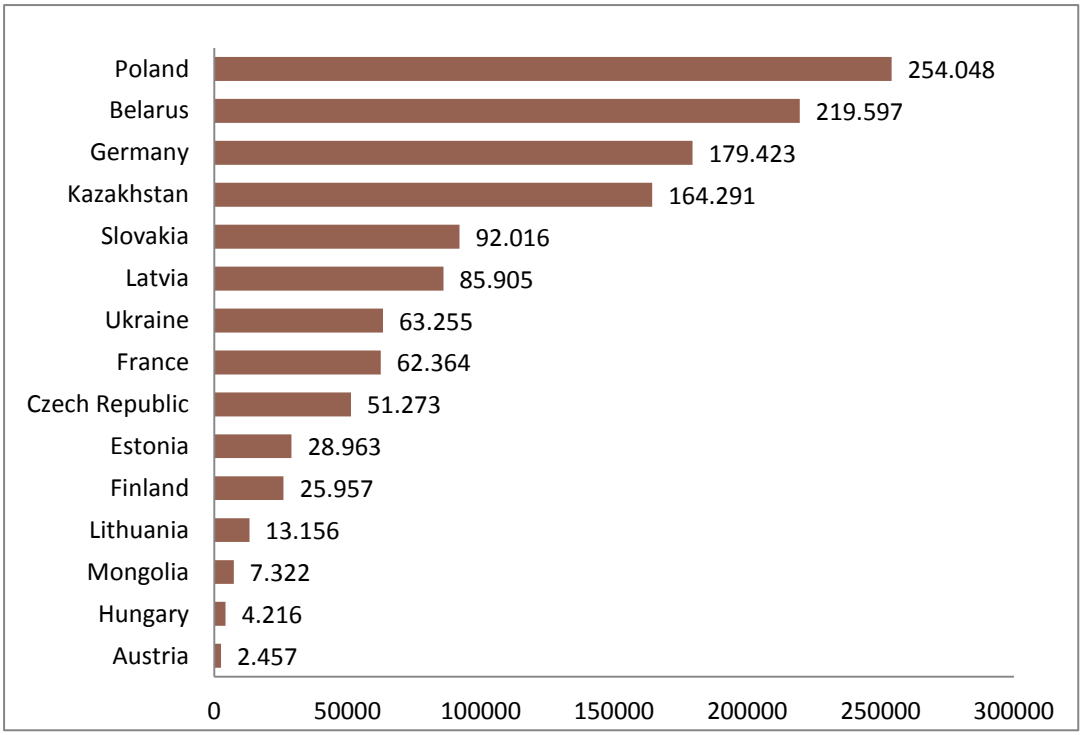
Figure 4.11 Volumes of container transportation on the TSR between Russia and China, TEU



Source: CCTT, 2012:82

An increase on the freight flows can be observed from 2010 to 2011. More specifically, imports freight flows increased by 49%, exports by 61% and transit cargo by 53%. Although the transit container volumes are relatively low, Russia plays an important role in the Eurasian railway connection. While Central and Eastern Europe are consuming about 12% of Europe's GDP, no more than 1% of the products transported via sea, are delivered directly to these regions, but the remainder is transported via the Northwestern Europe (Davydenko et al. 2012). The potential of the direct shipments via the land bridge connections needs to be realized. In fact, this cargo can save considerable time, by directly shipping it to Eastern Europe (Russia). The rail connection from Russia to the rest of Europe is investigated. No official data on transport volumes on the TSR route are published. However a variety of sources were used (CCTT yearbook, 2012, Ibid, 2013, interviews) to provide an overview of the freight flows. The figure below illustrates the total rail exports from Russia by country.

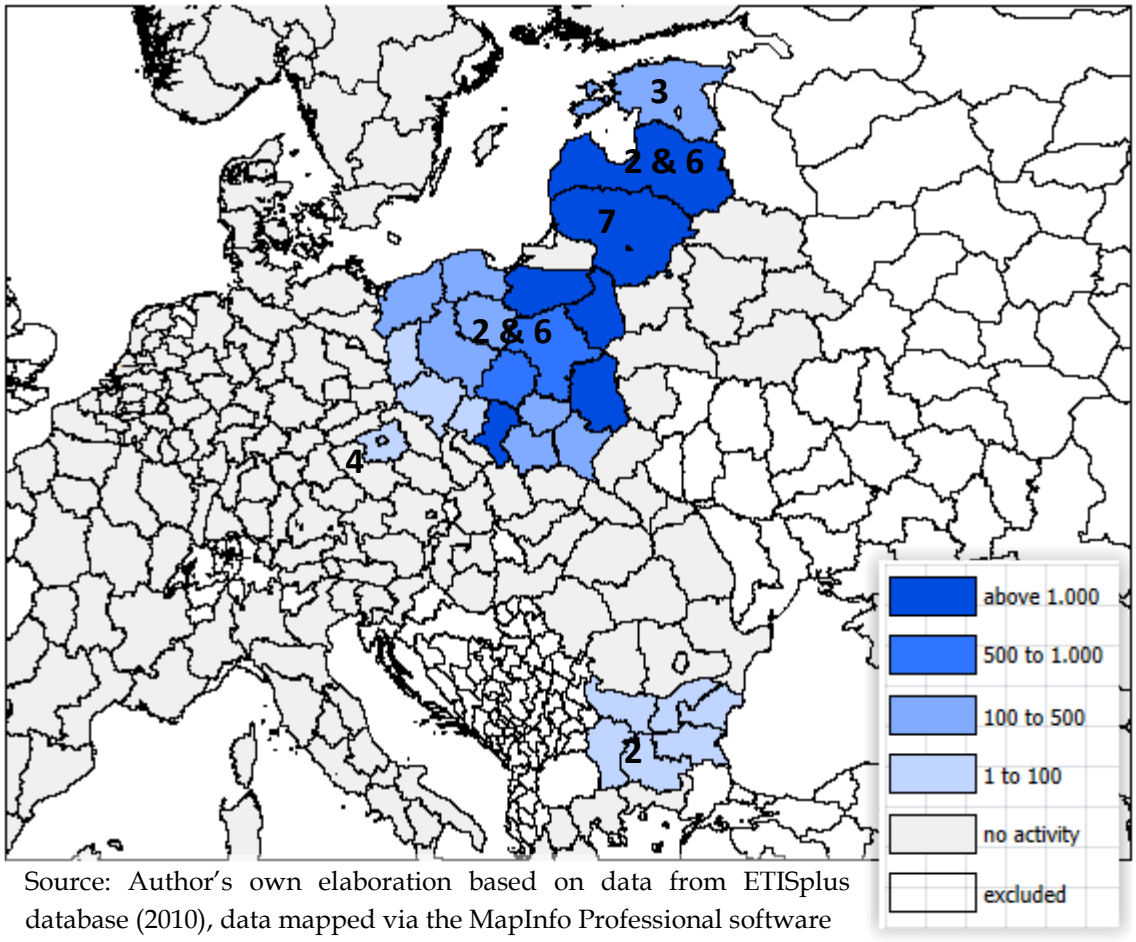
Figure 4.12 Rail freight volumes, loaded & empty high capacity containers in 2011 by the following directions from Russia (TEU)



Source: CCTT (2012: 84)

Significant rail freight connections are illustrated mainly from Russia to Poland, Belarus and Germany with 25.408, 219.597 and 179.423 TEU respectively. Moreover, data collected from ETISplus database on the rail freight transport, exports from Russia (Moscow) to Europe are demonstrated below on the map (figure 4.13). The volumes from origin (Moscow) to destination can be found in Appendix 5. Rail activity between the European countries can be found in Appendix 7.

Figure 4.13 Rail freight activity, exports from Russia (Moscow) to Europe by province, 2010, thousand tones



Source: Author's own elaboration based on data from ETISplus database (2010), data mapped via the MapInfo Professional software

Note: The numbers represent the commodity type that is mainly transported from Moscow to the country of destination (Appendix 5)

The volumes with destination Estonia mainly represent petroleum products (51%). The freight flows to Latvia and Bulgaria are mainly solid mineral fuels accounting for 86% and 91% respectively, of the cargo transported in 2010. Flows to Poland and Lithuania are more diverse. For Poland, solid mineral fuels, crude and manufactured minerals, and ores and metal waste represent the larger proportion of cargo transported with 31%, 31%, and 24% share respectively. For Lithuania, the main import commodities are fertilizers (32%), and crude and manufactured minerals, and building materials (27%).

Last, flows with destination the Czech Republic are ores and metal waste accounting for 93% of the cargo transported in 2010.

4.3.1.2 Comparative advantage over sea transport

Analysis and interviews bring further evidence on the comparative advantage that the Eurasian railway transport can offer to its customers. Railway transport is considered to be more favorable in terms of transit time. In fact, the Trans-Siberian railway reduces the time spent on cargo delivery to 16-20 days and shortens the length of the route to 11,000-13,000 km (David, 2013, Birman, I. 2013, pers. comm.., 1 November) instead of 20,000 km by sea. Moreover, rail transport offers environmental benefits, namely energy efficiency and less noise.

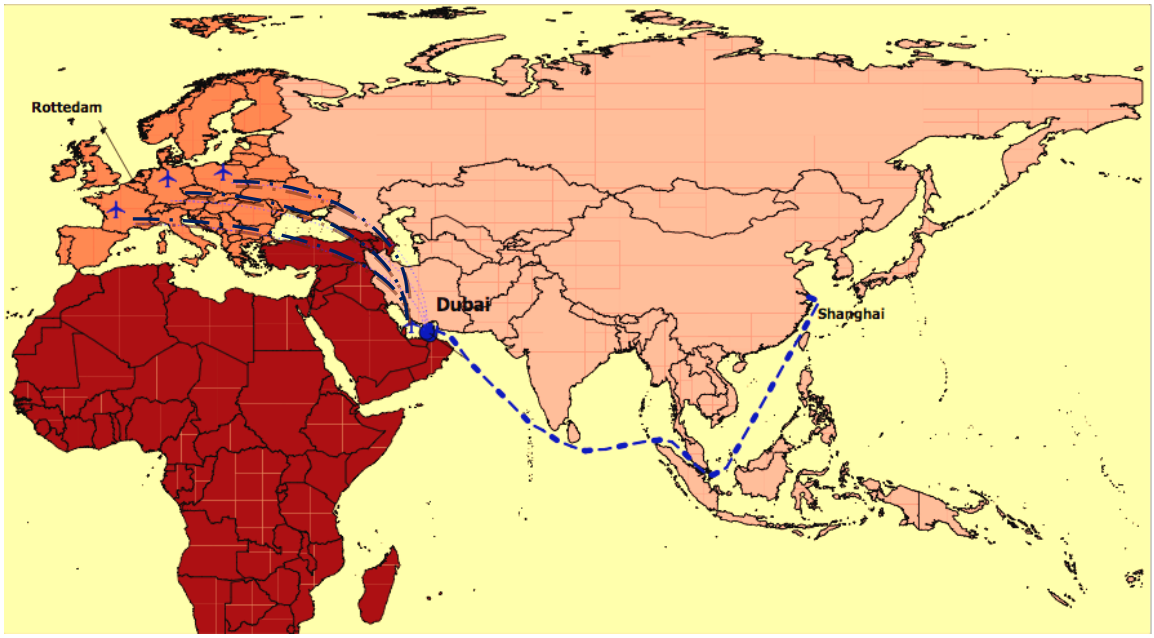
As regards transport costs, there is no clear evidence, due to the limited access, but information was collected from the interviews and from other related studies. Thus, how efficient is the use of the rail connection against the deep sea shipping depends not only on the destination but also on the production site. When interviewed on 25 October 2013, rail cargo expert confirmed that when the production is located more into the hinterland of China, then the rail connection is more cost-effective. In the case of the maritime cargo you still need to transfer the cargo from the hinterland of the country to the main ports in East China. The study for the project of the integrated logistics system and marketing action plan for container transportation analyzed competing routes on the corridors, from Urumqi (hinterland of China) to Berlin. According to this study the Eurasian railway connections, the Trans-Siberian and the connection via Dostyk and Moscow, appear to be more economical than the ocean routes via Rotterdam (JICA, cited in Davydenko et al. 2012).

Currently, the rise in the labor costs (Stalk & Waddel, 2007), especially in the coastal areas of China, as demonstrated in the previous sections, and at the same time the growth in the hinterland of China (KombiConsult consultant 2013, pers. comm.., 25 October), both lead to a shift from the East towards the West of China (Spectrum, 2012; Burgess, A. 2013, pers. comm.., 13 November). According to the market study, SPECTRUM (2012), Unilever has moved six factories from Shanghai to west of the city Hefei and Hewlett Packard has launched a computer plant in Chongqing, South-West China. This shift of production provides a new transport alternative to the transportation of goods between China and Europe.

Despite that various barriers and bottlenecks were identified during the interviewing process, such as institutional bottlenecks, lack of cooperation, infrastructure limitations, and lack of capacity. When these barriers will be solved the rail transport will meet shippers' logistics requirements/ needs and then we will see an increase in the volumes of the rail freight from China to Europe (Mrs. Birman, I. 2013, pers. comm.., 1 November)

4.3.2 Sea- air combination

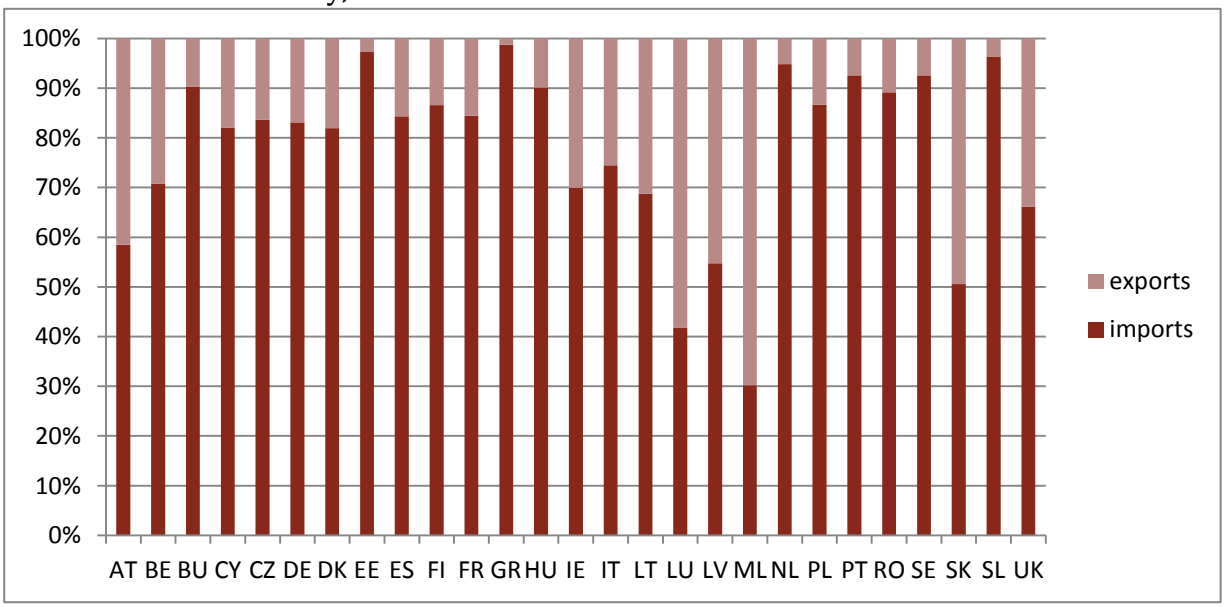
Figure 4.14 Sea-air transport via Dubai



Author's own elaboration, via MapInfo Professional software

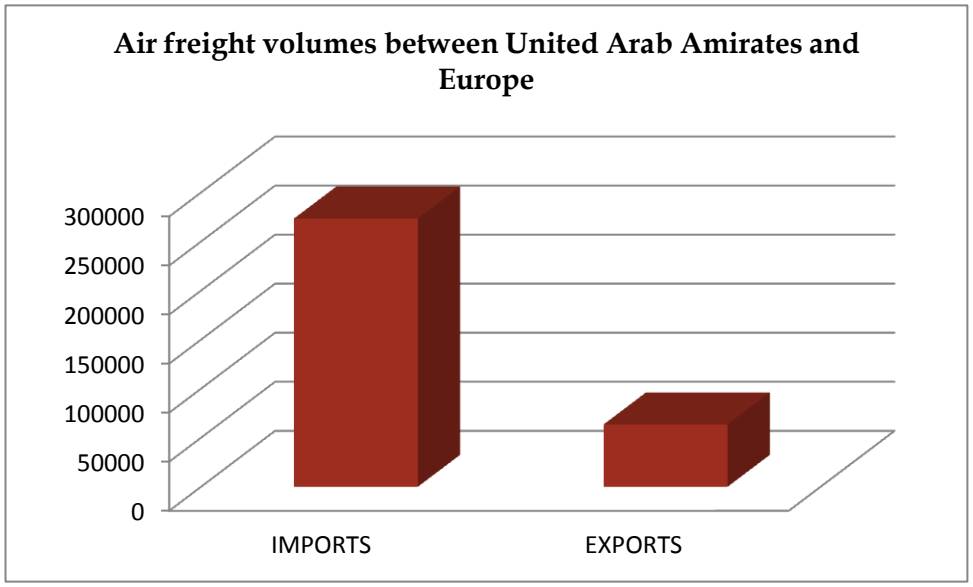
Another alternative service on the China-Europe route is the sea-air combined transport via the Middle East (Abu Dhabi, Dubai), see figure 4.14. In general lots of cargo is shipped from Europe to the Middle East, but they do not produce much of air cargo there, thus the planes are going back quite empty. This imbalance of cargo is illustrated in figure 4.15 and 4.16. Therefore, the sea-air transport service is feasible.

Figure 4.15 Air freight volumes between United Arab Emirates and Europe, by country, 2010



Source: Author's own elaboration based on data from ETISplus database (2010)

Figure 4.16 Total air freight volumes between United Arab Emirates and Europe, 2010



Source: Author's own elaboration based on data from ETISplus database (2010)

Indeed, some shippers ship their cargo to Dubai and then ship it by air to Europe or vice versa, mostly due to the low freight rates from Dubai to Europe. In general it is an intermediate service between air and sea, given that it is faster than sea and cheaper than air transport (Venny & Grigentin, 2009). At the same time, you avoid the main ports of the West Northern Europe, which are often congested and in turn delays can cause bottlenecks to the supply chain (Venny & Grigentin, 2009; Capineri & Leinbach, 2006; Mr. Burgess, A., 2013, pers. comm.., 13 November). Although, it consists of two different segments, both legs of the journey use the same documentation (Verny & Grigentin, 2009). Adequate for middle and high value products (fashion clothes, and electronics) (Mr. Doesburg, J., 2013, pers. comm.., 9 October) sea-air it is a cost neutral transport, given that it does not have a big impact on shippers' goods, as long as they do not have a very high value density (Ibid)

This transport option was already introduced in the 70's-80's. Despite the aforementioned advantages, this transport service is not very popular. According to one of the interviewees, in 2005, it was only 10% of the total air tonnage that came from the Far East to Dubai via ocean and then shipped to Europe by air. This could be explained by the fact that it remains an expensive option, in comparison to maritime transport. However, assuming that shippers face unreliable services and disruptions in their supply chain, a shift is expected to a certain extent, as long as, shipping carriers will keep slow steaming. That applies especially to middle and high value products.

4.4 Decision making process

Logistics decision makers consider reorganizing their supply chains and their modal options, when problems and disruptions arise in the supply chain (SPECTRUM, 2012). According to Ben-Akiva and Bierlaire (1999), the decisions-maker will opt for the alternative transport service that it is best captured by a value, known as utility. Therefore, the logistics managers will opt for the transport service among the alternatives that evolves the highest utility.

Before forming the structure of the supply chain, and choose the adequate transport mode, logistics managers need to consider the nature of the demand of their product (Fischer, 1997; Mr. Osinga, E., 2014, pers. comm.., 30 April). Shippers for instance, with products, characterized by high demand uncertainty, will choose for speed, flexibility and quality. That applies mainly to high value products such as fashion clothes and consumer electronics. These products are more sensitive to interest and inventory costs in contrast with low value products that are sensitive to transport costs. Moreover, the availability of the stock plays a key role, since a full stock that does need to be replenished quickly, allows the products to be transported for longer period of time (Ibid).

Given that slow steaming practices have negative effects for shippers with middle and high value products, will consider reorganizing their supply chains and modal options. In the previous section, alternative transport options on the China-Europe route, which emerged from literature and the interviews, discussed; namely the Eurasian railway connection and sea-air combined transport. Both services are characterized as intermediate options between sea and air transport, with respect to costs and time. Products that can be shipped via multiple transport modes, provide more flexibility in the logistics of the company, and are more susceptible in a modal shift possibility. Products that might shift to rail are mainly textiles, other machinery apparatus, consumer electronics, automotive products (spare parts) and chemicals. At the moment car components and consumers electronics are transported from China to Europe and from Europe to China via the railway connection. This can also be explained from the shift of automotive and computer production sites into the hinterland of China. In fact the feasibility and efficiency of the Eurasian connections depends not only on the destination but also on the location of the production site (KombiConsult expert, 2013, pers. comm.., 25 October). It is not cost- effective to transfer cargo from the hinterland of China for instance to the coast, to the main ports, when there is direct shipment via rail transport. In general, the potential of the Trans-Siberian railway to fulfill demanding service requirements needs to be realized.

The sea-air transport option via Dubai is another alternative transport option instead of sea shipping. This option provides faster delivery but more expensive. When shippers face delays on their supply chains, they will try to find the optimum

combined transportation that will fit the logistics of their supply chain, and will in turn allow their cargoes to arrive faster to their customers. From the analysis of the previous sections, it appeared that products that might shift from sea to the sea-air alternative are fashion clothes, consumer electronics and perishable agricultural products. The feasibility of this transport service is illustrated as well on the rather low air freight volumes, exports from United Arab Emirates to Europe. In fact in 2010, the exports from Europe to the United Arab Emirates were 4 times more than the imports, with about 275.000 and 65.000 tones, respectively (ETISplus database).

Overall, shippers being aware of these alternatives, seeking for a modal shift, need to match the logistics of their supply chain, and their products with the adequate transport service.

5. Slow steaming: A window of opportunity for other transport modes

To gain a deeper understanding of the main topics of this research and answer the main research question, "is slow steaming a window of opportunity for the other transport modes?", some interviews with experts in the shipping industry were conducted during the final phase of this research. The transcription of the interviews is included in Appendix 8. Even though, the opinions of particular stakeholders are up to an extent subjective, they are most of the times the starting point of real discussions and decisions. The analysis and the outcomes of the interviews are presented in the sections below. Section 5.1 elaborates on the impact of slow steaming on shippers and their supply chains, and section 5.2 on a potential modal as an alternative strategy. The factors that influence shippers' transport mode choice decision, as viewed by the different interviewees, are presented in section 5.3. A comparison between the different transport modes (sea, air and rail) is included as well in the latter section. Section 5.4 presents and evaluates the shipping alternative options between China and Europe, as mentioned by the interviewees. Last section 5.5 presents an overview of initiatives and transport developments along the corridors.

5.1 The impact of slow steaming on shippers

Slow steaming becomes part of the daily operational procedures of container shipping lines. The characteristics of the container shipping market forced container carriers to reduce costs in their attempt to achieve competitive advantage. In 2008 carriers introduced slow steaming as a costs reduction strategy with the assumption that sailing with lower speeds leads to less fuel consumption and in turn less emissions. When carriers decide to slow steam by optimizing their business case they do not take into consideration that slow steaming might create problems to the shippers. The following question was asked to the interviewees: "*Slow steaming contributes to a decrease in fuel consumption which means less CO2 emissions and at the same time shipping carriers cut fuel costs, but the question is which are the consequences of sailing at lower speeds for the shippers?*"

According to the majority of the experts, the impact of slow steaming on shippers depends mainly on the interest for the working capital that is invested in the goods and the value of the goods. Therefore when the interest rate is high shippers are losing money by having a "floating stock". Apparently when goods are longer in-transit, shippers are imposed to pay extra costs. Another negative effect of slow steaming on shippers mentioned by the interviewees is the predictability. Although it is assumed that shippers have an agreement with the ship-owners, in reality ship-owners can just decide to slow steam, which means that shippers' products will arrive later in the end destination. In that case the negative consequence has to do as well with reliability. However, currently due to low interest rates slow steaming is

not conceived as a big concern especially for big companies. Since slow steaming is a common practice shippers have been adapted their operations to the slow steaming trend. To sum up, although slow steaming was perceived as a bigger problem when it was first introduced, it is still recognized as a concern for shippers.

Of interest, one of the interviewees, representing a shipping line, as it is intuitively obvious, had a different opinion. When interviewed on 28 November, Mr. Chris Schuchard highlighted that slow steaming was never really a problem for the shippers, since they could adjust their supply chains to the new situation. He further argued that through slow steaming shipping companies may save a lot of money, but at the same time they face huge losses in the shipping industry. Shipping companies need these fuel savings in order to stay "in business".

5.2 Potential modal shift as an alternative strategy by shippers

As already mentioned in the previous section the effects of slow steaming on shippers are inextricably related to the value of their goods in-transit. In fact shippers with higher value cargo will incur higher in-transit inventory costs compared to shippers of lower value cargo. It is expected that several shippers might rethink their transport mode decisions. To gain better understanding on this topic, the following question was asked to the experts: "*Which are the alternative transport strategies that shippers may opt due to the increase use of slow steaming practice? Which products may have a potential modal shift?*"

According to the interviewees there are shippers that do not opt for deep sea shipping due to the longer transit times. Three transport alternatives were identified; air cargo, rail cargo and sea-air cargo. In practice, shippers with high value products will always opt for air cargo. On the contrary, shippers with low value products will always ship by sea, since it is the cheapest transport service. Further there are shippers that their products can either be shipped by sea or air; these shippers are quite flexible on which mode of transport to use.

Most of the experts stated that air transport is more a consequence than an alternative strategy for deep sea shippers. More specifically in case of unexpected delays, shippers need to ship their goods in a "fast way". Shippers make calculations, as mentioned in the previous section, based on the value of their products and the interest that is invested in the goods, and they offset this with the high costs of air transport. Therefore when it takes longer in the ocean, the decision might shift in favor of the air transport. In general when the interest goes up and the speed of the ocean vessels goes down, then the calculation might turn in favor of air transport. Intermediate goods are the most susceptible for a modal shift since all the transport services are feasible, so practically the actual decision depends on shippers' requirements. For instance, for shippers that speed of being present on the market is

very important; specifically in the case of consumer electronics and fashion clothes - air transport might be the optimal transport choice.

Of course in terms of capacity, air or rail transport can never take over the volumes that are currently transported via deep sea shipping, but it will certainly take over some part, mostly specific cargo, which is designed for maritime transport. These will definitely have a positive impact on air and rail carriers.

5.3 Transport mode choice decision of shippers

This research studied literature on the factors that exert an influence on the modal choice decision for shippers. Many factors were identified inter alia products' characteristics, modal characteristics, direct and indirect logistics costs, sustainability, etc. To compare literature with the actual facts, the interviewees were asked: *"Which are the criteria that shippers take into consideration before deciding which mode of transport to use*? *What are the advantages that the other transport modes have to offer over sea transport?"*

Costs are the most important criterion according to the interviewees, followed by transit-time and reliability. Increasing focus is given to sustainability, but is still not one of the most important factors for shippers. Other worth mentioning factors are the interest rate, the product's characteristics (value, shelf life, volume), and the freight rates.

The majority of the interviewees expressed the positive developing possibility to ship goods by rail from China to Germany and vice versa. In fact rail transport is much cheaper than sea transport and at the same time it takes less time - fifteen to eighteen days - to ship the cargo from Europe to Asia. The cost-effectiveness of rail against sea transport depends as well on the production site. For instance, when the production site is located in the hinterland of China, if you want to ship your cargo by sea transport you still have to drive sometimes for two thousand kilometers, which means extra costs for shippers. Another point worth mentioning is the fact that shippers buy slots in the vessels with a specific price in advance, but maybe next month this price is double, a fact that annoys shippers. In case of rail transport, prices are fixed throughout the year. Therefore, regarding both time and costs rail transport is an option between sea and air transport. One of the experts on rail freight transport and logistics pointed out that rail transport is a green transportation since it is the most CO2 efficient transportation mode, highlighting sustainability as an important factor in the supply chains decisions.

However there are few concerns and obstacles that first need to be solved as regards the rail freight transport. There is still need to invest on the infrastructure matters, capacity limitations, institutional bottlenecks, and lack of cooperation. Customs clearance along the corridors is another worth mentioning concern for shippers, stressed out by the interviewees. Last, rail transport is an unusual alternative for

many shippers, since they are not familiar with it. Concerning sea transport, experts argued that the volatility in freight rates is a big concern for shippers. Moreover congestion at the ports further delay and prolong even more the transit times of the products.

Air cargo in general is the most expensive transport service and is adequate for high value products otherwise shippers might not make any profit out of the goods. For shippers of high value goods, air transport is the only optimal transport solution, because it will take them few days to ship their products depending on the destination. Experts mentioned that although air cargo volumes are only 5% of the international trade, in terms of value this is 37% of the world trade. An air transport expert mentioned the threats that the air cargo is facing nowadays. In general globally the air cargo market does not look good, due to the decreasing supply of freight capacity. That is definitely a concern for air carriers especially for the full freighter airlines.

The table below presents the main advantages and disadvantages for sea, rail and air transport services.

Table 5.1 Comparison between the different transport modes, advantages & disadvantages indicated by the interviewees

Transport Mode	Advantages	Disadvantages/ Threats
Sea transport	• Economical • Large loading capacity • Most popular transport mode	• Long transit times (slow steaming) • Congestion at the ports • Volatility in freight rates • Piracy
Rail transport	• Relatively Economical • Large loading capacity • Green transportation • Moderate speed	• Institutional bottlenecks • Lack of cooperation • Infrastructure limitations • Lack of capacity • Non- reliable (Shippers are not familiar with it)
Air transport	• High speed • Adequate for high value & time-sensitive products	• Expensive transport mode • Decreased supply of freight capacity

5.4 Emerging transport alternatives on the China-Europe route

Section 5.3 identified the factors that exert an influence on shipper's transport mode choice decision, and identified the advantages and disadvantages of each transport mode. Currently most products are shipped by sea from China to Rotterdam port, and from there products are distributed to the rest of the European countries either by trucks, rail, barges or sea (SSS). The literature elaborated on alternative shipping options between China and Europe. The interviewees were asked to identify and evaluate shipping alternative options over sea transport.

The majority of the experts highlighted the potential of rail freight connection in the corridor between Asia and Europe via Moscow (Trans-Siberian route). At the moment there are two big shippers (BMW and HP) that regularly ship their products from Germany to China, through that route, and vice versa. However there were plenty of initiatives that actually have stopped. One of the interviewees referred to this example: In case you have a warehouse in a location close to the Trans-Siberian route and you company operates under JIT principle, then railway might be the optimal transportation option. It is an alternative as well for the Western part of China, which is developing fast. The development of this connection is considered by the interviewees to be a threat mostly for the air cargo industry, since in the train you can load more products and it is much cheaper than air transport.

Another alternative option discussed is the sea-air combination on the routes from China, India, Singapore via Dubai, and Abu Dhabi to Europe. In general many volumes of freight are exported from Europe to the Middle East, and in fact the planes are going back quite empty. So there is this intermediate alternative between slow deep sea shipping and expensive air transport. This transport option was actually introduced back in the 70s-80s. Last, one of the interviewees stressed the emerging potential of the route over the Northern circle, which is basically much shorter than the route via Suez.

Apparently the aforementioned shipping alternatives need to meet the shippers' logistics requirements and then we may observe an increase in volumes shipped via these alternative transport services.

5.5 Initiatives and developments

The previous section identified shipping alternatives over deep sea shipping in the corridor China- Europe. These are: 1) the rail connection between China and Europe, and 2) the sea- air combination from China to Europe via Dubai. To finalize this research, the initiatives and transport developments along the corridors that might facilitate further these transport alternatives, are identified. The experts were asked the following question: "Which initiatives or transport developments can you identify along the corridors that facilitate these alternatives?"

In broad the majority of the experts stated that most initiatives and developments are in the direction of promoting rail, waterborne, and intermodal transport. Most of the initiatives and projects stressed facilitate the Eurasian rail connection.

According to the interviewees, growth within the landlocked countries in Asia inter alia Mongolia, Kazakhstan, and growth within the hinterland of China are considered as the starting points towards a further development of the rail freight connection between Asia and Europe. All the countries involved in these corridors have already invested in rail infrastructure actions. In fact the border crossings between Kazakhstan and Western China have improved along the years. Moreover strategies to construct some production sites within the hinterland of Asia further facilitate the rail connection between Europe and Asia.

One of the interviewees mentioned the European actions and transport policies, promoting rail and intermodal transport, towards a mutual European effort to remove all the trucks from the roads (Mrs. Birman, I., 2013, pers. comm.., 1 November; Mr. Burgess A.,2013, pers. comm.., 13 November). Such regulation would impose customers to use the rail transport in Europe to a greater extent and at the same time would facilitate the connection to Russia and China. The European projects and the extension of the broad gauge from Russia to Vienna are additional initiatives that were pointed out by an expert on transport corridors. He further mentioned that this last project's major goal is to connect the European rail system with the mainline of the Trans-Siberian connection and attract cargo from Asia. According to his opinion, however, due to the reducing importance of the European presence in the world the last years and the economic crisis, the Russians have lost their interest and have paused the proceedings.

CONCLUSIONS

6. Discussion

This research focused on a modal shift concept as part of shippers' logistics decision making process. Logistics decision makers consider reorganizing their supply chains and their modal options, when problems and disruptions on their supply chain arise (SPECTRUM, 2012). In fact shippers face negative effects, such as unreliable services, due to the increasingly applied slow steaming practices. Therefore the potential of a modal shift was questioned. To determine whether the theoretical approach on the feasibility of a modal shift in question can be practically applied, a case-study analysis took place as the appropriate design for this thesis. Six sub-research questions contributed to the answer of the main research question:

"Is slow steaming a window of opportunity for other transport modes?"

In order to answer the main research question literature was studied, interviews with experts were conducted and data were collected forming the skeleton of this research. The initial approach was to interview various stakeholders and logistics managers, in order to find evidence on a modal shift potential. However, this proved to be more than a challenge. From the 100 emails that were sent, only 7 in-depth interviews were conducted. At the same time, a questionnaire was prepared and sent via email to few contacts, after request. The total sample therefore includes 7 in-depth interviews and 2 questionnaires.

Literature was studied in order to specify the negative effects that shippers face since shipping liners started to slow steam. The first sub-research question investigated was: *"What is the impact of slow steaming on shippers?"*. The negative effects for shippers can be summarized into time costs and unreliable services. Slow steaming practices imply extra inventory and depreciation costs for shippers (Hummels et al. 2012; Psaraftis & Kontovas, 2010). At the same time, although it was perceived that slow steaming would improve schedule integrity (Dynamar, 2010; Ronen, 2011), shippers face increasingly unreliable services (Containerization International, 2012; Containerization International, 2013; Review of maritime transport, 2010; Nieuwsblad Transport, 2012), that lead to disruptions on their supply chains. The table below summarizes the effects of slow steaming for shippers.

Table 6.1 The effects of slow steaming on shippers

Who	What	When
Shippers	• Extra costs (inventory & depreciation costs) • Unreliable services • Disruptions on the supply chain • Supply chain less responsive to market volatilities • Supply chain carbon footprint reduction	• Owners of middle & high value cargo • Producing under JIT production

The process of interviewing revealed that the impact of slow steaming depends mainly on the interest for the working capital that is invested in the goods and the value of the goods. When the interest rate is high, shippers are losing money by having a 'floating stock". However, the low interest rates and the fact that shippers adapted their operations to the new slow steaming era, reveals that slow steaming is less a concern. The interviews further gave practical insights and confirmed the unreliable services, already demonstrated from the literature studied.

The second sub-research question that this thesis aimed at answering was to *identify the shippers' reactions in response to slow steaming practices.* The following strategies were recognized: advance planning in order to synchronize delivery and productions schedules, increase inventory levels to offset costs and time delays, choose for multiple carriers seeking to achieve the best combination between rates and lead time, require transit time commitments from carriers, source materials closer to production, use air freight especially for smaller shipments (adapted by survey conducted, Centrx, BDP International, and Josephs' University). The meetings with the experts did not really revealed further evidence on overall logistics strategies but the responses were mostly focused on a modal shift.

The third research question investigated t*he impact of slow steaming on the different products shipped.* The effects of slow steaming on the products can be summarized to the effects on the products' physical appearance, and the effects on the products' value. Short shelf life and perishable products, such as pharmaceuticals, food and flowers, will be influenced the most by the slow steaming practices. Perishable goods become worse over time and become less valuable over time.

Table 6.2 The effects of slow steaming on the different products shipped

Who	What	Which
Products	• Effects on the physical appearance/ condition • Effects on the value	• Short shelf life products & Perishable products (food, pharmaceuticals, consumer electronics, flowers, fashion clothes)

Next this research studied literature on the *factors that exert an influence on the modal choice decision*. The table below summarizes the findings from the literature, by author.

Authors	Factors that exert an influence on shipper's transport mode choice decision
Baumel & Vinod (1970)	Freight rates, speed, variance on speed , en-route lossage
Allen, (1985)	Time in transit and reliability of transit time
Blumenfed et al. (1985)	Trade off among transport, inventory and production costs
McGinnis (1990)	Transport service quality
Fowkes et al. (2004)	Reliability
Ganeshan & Harrison (1995)	Trade off among transport and inventory costs
Murphy& Daley (1997)	Reliability
Runhaar & Kuipers (1999)	Trade off among total costs and quality of service/ Trade off among product characteristics and shipment frequency
Muilerman et al. (2001)	Reliability
Bolis & Maggi (2003)	Major: Price, Reliability, speed and safety Secondary: Frequency of service and flexibility
Hannigan & Venables (2006)	Reliability
Lammers et al. (2006)	Product's characteristic
Notteboom, (2006)	Time and schedule Reliability
Gursoy,(2010)	Shipping time and price, reliability, accessibility

From the table above, it can be observed that reliability ranks first as the most important factor that exerts an influence on shippers transport mode choice decisions. Other major factors follow; inter alia transit time, freight rates, total logistics costs, and inventory costs.

The process of interviewing revealed interesting factors. According to the interviewees, the transport costs are the major criterion that shippers take into consideration. Transit time, reliability, and the products' logistics characteristics (value, shelf-life, and volume) follow. Interest rates appeared to play a key role in the modal choice decision as well. Last sustainability as an emerging trend, start gaining attention the last years, but it is not still that important for shippers.

Next literature and evidence from the interviews both were combined to investigate: "*Which products may have the potential modal shift to rail or air"?*. In general shippers with middle and high value products face extra costs. Since these products require shorter lead times. Thus these products are more susceptible towards a modal shift. An analysis of the trade tonnage between China and the Netherlands imports took place, in order to have an overview of volumes and values of the products that are transported in this route. The data were obtained from the ETISplus database for the year 2010. Next, given the corresponding values of the commodities, the value per ton was calculated. The commodity machinery transport equipment appeared to be, the most valuable products among the rest of the commodities, but at the same time this commodity accounts for the largest share. Products such as textiles, other machinery apparatus, consumer electronics, chemicals, perishable agricultural products have the potential modal shift to rail or air transport.

The last sub-research question explored was: "*Which are the emerging shipping transport alternatives on the China-Europe route?".* Although, sea freight via the Suez Canal is the most commonly used transportation on the trade between China and Europe, a diversification of the Euro-Asian freight transport and the exploration of new routes are required. From the literature studied and the interviews, two shipping alternatives emerged, namely, the Eurasian railway connections, and sea-air combination transport via the United Arab Emirates (Dubai). Data collected from the ETISplus database and data from the CCTT (2012, 2013) provided a general overview on the freight volumes and provided coherence to the feasibility of these alternatives.

The majority of the interviewees highlighted the potential of the Trans-Siberian railway. In fact, the last years, many projects are operating in this route in a mutual effort from all the countries where the railway passes through to increase the freight volumes and attract economic development. The Trans-Siberian is an intermediate option in terms of cost and time in comparison to sea and air freight. However, from the hinterland of China, this transport alternative is more cost-effective than the sea route, given the fact that in case of deep sea shipping you still need to drive to the coast of china. For some of the experts interviewed, the development of this connection is considered mainly a threat for the air cargo industry, because the train can handle more capacity and at the same time it is a more cost-effective transport option than the air cargo.

Of interest, during the interviews, trends, initiatives and developments were discussed that further facilitate this railway connection. More specifically, a growth

into the hinterland of Asia and the hinterland of China are considered as the starting points for a further development of the Eurasian rail freight connections. Although, few developments and initiatives are discussed in section 5.5, further research could also explore initiatives and developments into more detail concerning the Eurasian railway connections and the economic development of the wider area.

Sea- air combination via Dubai is another transport alternative discussed. The first segment consists of sea freight from the coast of China to Dubai for instance and the second segment is a flight from Dubai to the main airports in Europe. Data collected from the ETISplus database (2010), provided an overview of the air freight volumes imports and exports from the United Arab Emirates to Europe. In fact the exports from the United Arab Emirates to Europe are 4 times fewer than the imports, and thus the flights are returning empty to Europe. Thus, the sea-air transport alternative is realistic. Even though this transport option was introduced already few decades ago, it is not very popular. However, given the current unreliable services due to slow steaming, a shift is expected partially, especially for high value products.

7. Conclusion

Throughout this research the feasibility of a modal shift was questioned, taking into consideration the negative effects (extra costs, unreliable services, disruptions) that shippers face due to the increasingly applied slow steaming practices (Containerization International, 2012, 2013; Nieuwsblad transport, 2012). Literature review and the case-study coupled with observations collected from the ETISplus database, provided evidence on the possibility of a modal shift on the China-Europe route.

Plethora of factors identified to exert an influence on shippers' transport mode choice decision, which in turn might restrict or facilitate a modal shift concept. These factors are: the transport mode characteristics (McGinnis 1990); reliability (Fowkes et al. 2004; Murphy * Daley, 1997; Muilerman et al. 2001; Hannigan & Venables 2006); transit time (Allen, 1985; Notteboom, 2006), the products' logistics characteristics (Lammers et al 2006); value; volume; shelf life, the logistics costs; inventory costs (Blumenfeld et al. 1985); transport costs, general logistics concepts that the company is evolved in; JIT principles; location of production, and transaction costs (Ruijgrok & Tavasszy, 2007; Labegalini & Martins, 2007; Verduijn, 2004).

Thus, it is clear that a modal shift is case specific, depending on all the factors mentioned above. Having this in mind it can be concluded;

There is no consensus on the possibility of a modal shift from sea to other transport modes. However, slow steaming with the current situation; implying unreliable services, delays and disruptions in shippers' supply chains, it is a "window of opportunity" for other transport modes.

On the China-Europe route the potential of both alternatives was demonstrated, and to a certain extent, it is expected that some volumes of specific products will shift to rail transport or sea-air transport. Products that might shift are mainly middle and high value products. *Textiles, consumer electronics, chemicals, foodstuff, and machinery apparatus* are products that might shift to rail transport and mostly high value and time-sensitive products with small volumes, such as *consumer electronics* and *perishable agricultural products* are susceptible towards a shift to air. However, shipping by air transport can also be a consequence, due to delays in the supply chain or due to production failures (Mr. Doesburg, J., 2014, pers. comm.., 9 October; Mr. Radstaak, B., 2013, pers. comm.., 29 October). In that case this is not considered a modal shift, but a temporary transport solution.

The alternative transport services discussed, can only be competitive with sea transport if they can fulfill shippers' logistical requirements and suit in their supply chains. In fact, as regards, the Eurasian railway connections, especially new developments in the hinterland of Asia and China, towards the economic development of these areas, and the current trend of shifting production sites to the West-China, far away from the coast, will definitely further facilitate, a growth on the railway freight flows. The sea-air combination appeared to have less of a potential. Although it is realistic, since the flights from the United Arab Emirates are returning empty back to Europe, in practice it is not a popular option. The main concern is the fact that the tonnes that can be transported from China to Dubai, need to be stored since every flight can only deliver few tonnes of cargo.

7.1 Limitations

Limitations exist on both literature and on the empirical part of this research. First of all, this thesis considered the effects of slow steaming on liner shipping industry and not on bulk shipping, since containerships sail at 25-26 compared to bulk carriers, which sail at 14-15 knots (see Buhaug et al. 2009: 131). Therefore, in case of raw materials deliver, slow steaming practices are not viable, and so there is no impact on shippers. Moreover, it is assumed that all ships apply slow steaming. That was necessary in order to analyze the impact of slow steaming on shippers and on the products transported. However, in reality slow steaming is not completely applied in all containerships. Another aspect that needs to be taken into account is the sample of the interviews/questionnaire. In fact the interviews with the experts included a rather limited sample of seven different experts, mainly representing air & rail cargo experts, and only two questionnaires were sent back. A fourth limitation to this thesis that needs to be considered is the data collected. Although, the ETISplus database was chosen as the most appropriate transport database, limited volumes might appear especially in rail freight flows. Moreover, the sea freight volumes were obtained on an origin to destination basis and not on a port-to-port basis, which might further imply imperfection on the sea freight flows. Furthermore, during the

interviews, the capacity and infrastructure limitations on the Eurasian railways connections were discussed, which are not included in the evaluation and feasibility analysis, but are only shortly mentioned. Future research could analyze the barriers and obstacles that first need to be solved in order for rail transport connection potential between China and Europe to be realized. Finally, the case study was focused on the trade between China and Europe and therefore the results are not universal. In fact the nature of the case study as a research design involves limitations as regards issues related to reliability, validity and generality.

7.2 Recommendations

This research showed the significance of slow steaming on shippers and on their supply chains. The conclusion drawn is that slow steaming, which implies unreliable services and disruptions in the supply chain, is a window of opportunity for other transport modes. However, further research could consider the percentage of ships that sail with lower speeds and also investigate for which categories of products. During the interviewing process, it was stretched out that ocean carriers may only partly use slow steaming practices and deliver containers consisting of high value products on fast sailing speeds (Mr. Radstaak, B., 2013,pers. comm.., 29 October). In that case the negative impact of slow steaming is minimized, there would not be a modal shift potential in question and therefore the window of opportunity for the other transport modes would close. Additionally, this research could be a motivation for further research; investigate the impact of slow steaming and the potential modal shift on a company-case-study level.

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APPENDICES

APPENDIX 1 - VALUE PER TON CHINA-NETHERLANDS (IMPORTS)

	Type of good	TEU	Total tonnes	Total value in euros	Value per ton
0	Live animals	1,2	62,2	1100300	17689,71
	Cereals	215,3	3238,7	2013400	621,67
	Sugars	3,1	53,4	49300	923,22
	Perishable food	3970,7	45265,3	149505700	3302,88
	Other_non_perishable food	13942,9	174323	175136800	1004,67
	Other fresh or frozen fruit and vegetables	10193,6	107171,3	152351700	1421,57
	Wood and cork	120,6	1484,4	3657500	2463,96
	Sugar-beet	197,2	1971,8	6080100	3083,53
	Other raw animal and vegetable	7506,9	54255,8	216732500	3994,64
1	Beverages	747,9	6635,9	18060200	2721,59
	Stimulants	3489,3	37957,4	74955300	1974,72
	Animal food and foodstuffs	1941,3	30458,7	31311400	1028,00
	Oil seeds and oleaginous fruit and fats	3058,5	37469,3	53578200	1429,92
	Potatoes	5,5	54,8	56600	1032,85
2	Coal	1098,2	94390,8	21557100	228,38
	Lignite and peat	11090,2	474289,3	80590800	169,92
3	Fuel derivatives	255,4	60074	21675000	360,81
	Gaseous hydrocarbons liquid or compressed	1,3	28,3	140700	4971,73
	Non- fuel derivatives	2133,7	64373,9	33208900	515,88
4	Non- ferrous ores and waste	483,1	74046,1	129736000	1752,10
	Iron and steel waste and bleast furnance	331,8	4734,5	8836900	1866,49
5	Pig iron and crude steel	2146,6	35880,4	87681500	2443,72
	Semi- finished rolled steel products	626,8	32997,3	20765800	629,32
	Bars sections wire rod railway and tramway construction	885	17456,7	21270700	1218,48
	Steel sheets plates hoop and strip	2661,9	75981,2	74184500	976,35
	Non- ferrous metals	15891,3	208708,1	563431200	2699,61
6	Tubes pipes iron and stell castings	9212,5	99696,6	235277300	2359,93
	Sand gravel clay and slag	1046,5	16703,4	5276100	315,87
	Salt iron pyrites sulphur	23,1	364,8	88400	242,32
	Other stone earths and minerals	16610,4	652916,4	182112500	278,92
	Cement lime	564,8	10277,3	2926500	284,75
	Plasters	1	15,8	32500	2056,96
	Other manufactured building materials	35078,9	598344,2	170668400	285,23
7	Natural fertilisers	0,4	6,4	25400	3968,75
	Chemical fertilisers	22,9	442,7	385900	871,70
8	Basic chemicals	18375,3	300299,9	706987700	2354,27
	Alouminium oxide and hydroxide	140,3	2045	979700	479,07
	Coal chemicals	11,4	321,7	318900	991,30
	Paper pulp and waste paper	633,3	7755,8	11839600	1526,55
	Other chemical products	22480,3	264721	971473200	3669,80
9	Transport equipment	21807,2	184868,8	532948600	2882,85
	Tractors	1437,7	12068,6	40559900	3360,78
	Other machinery apparatus	140894,6	1372552,2	35033498400	25524,35
	Textiles articles and man- made fibres	94,8	928,3	3789000	4081,65
	Total	351434,7	5167691,5	39846856100	

Source: Author's own elaboration based on data from ETISplus database (2010)

APPENDIX 2 – MAIN TRADING PARTNERS OF EU (27)

IMPORTS

COUNTRY	VALUE (MILLION €)	SHARE IS TOTAL IMPORTS (%)
CHINA	282 531	18.7
USA	170 390	11.3
RUSSIA	160 058	10.6
SWITZERLAND	83 189	5.5
NORWAY	79 435	5.3
JAPAN	65 781	4.4
TURKEY	42 323	2.8
SOUTH KOREA	39 234	2.6
INDIA	33 228	2.2
BRAZIL	32 543	2.2

Source: CCTT (2012): 77

EXPORTS

COUNTRY	VALUE (MILLION €)	SHARE IS TOTAL IMPORTS (%)
USA	242 322	18.0
CHINA	113 274	8.4
SWITZERLAND	105 218	7.8
RUSSIA	86 131	6.4
TURKEY	61 253	4.5
JAPAN	43 856	3.2
NORWAY	41 895	3.1
INDIA	34 797	2.6
BRAZIL	31 390	2.3
SOUTH KOREA	27 938	2.1

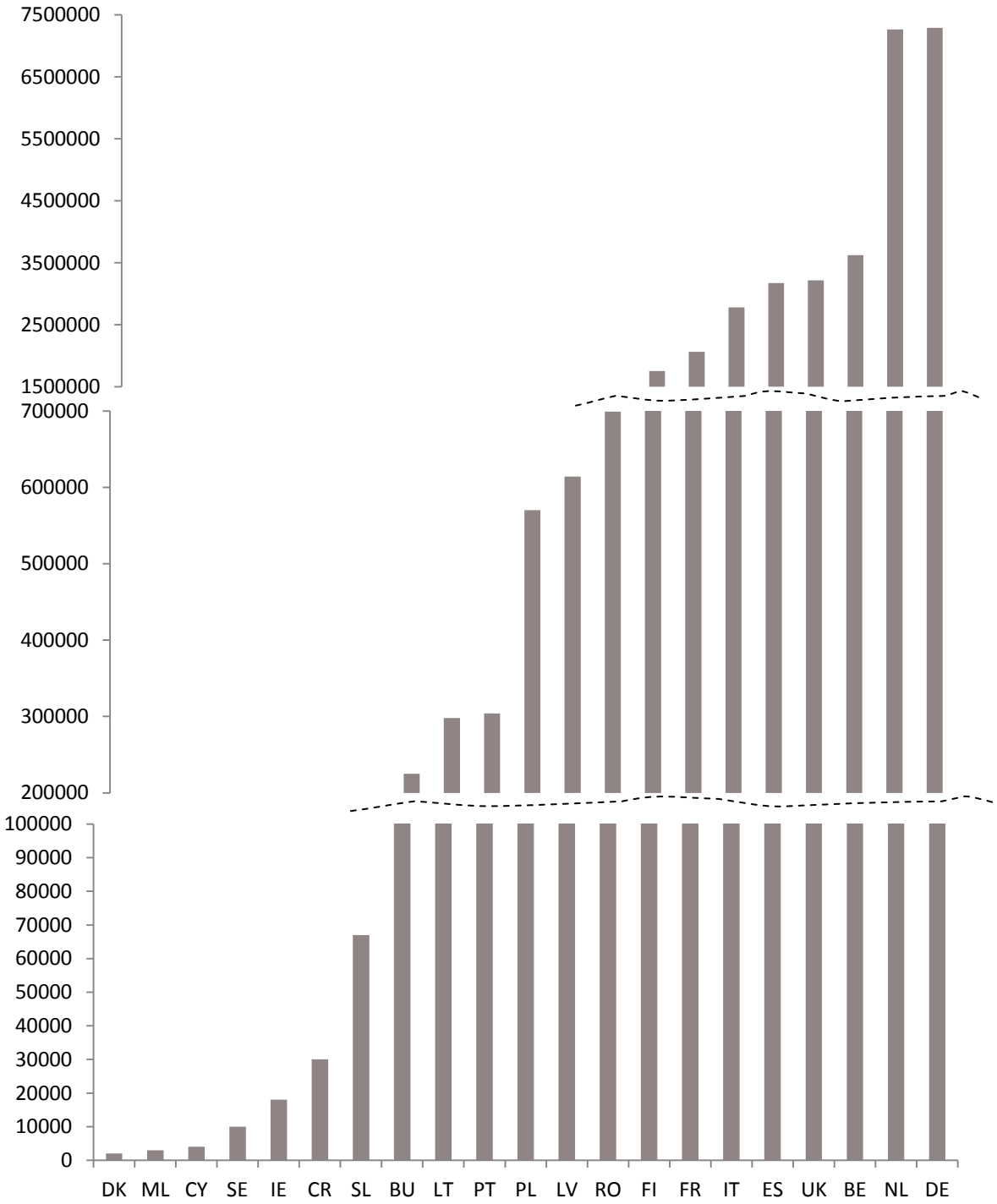
Source: CCTT (2012): 77

APPENDIX 3 – HIGH VOLATILITY OF FASHION GOODS

Source: IATA & Seaburry (2014: 10)

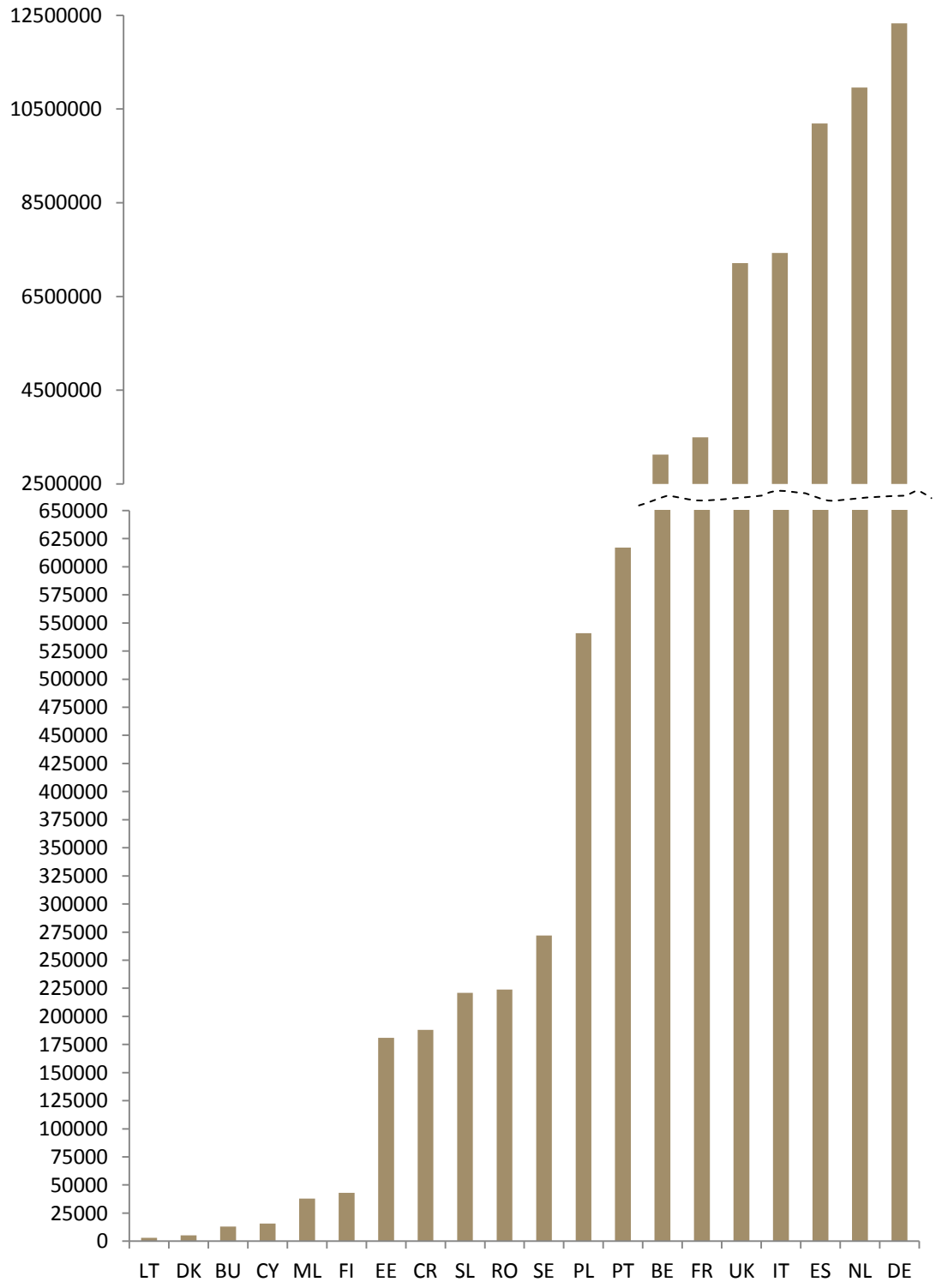
APPENDIX 4 – TOTAL SEA FREIGHT VOLUMES ON THE CHINA-EUROPE ROUTE PER COUNTRY, 2010

Sea Freight volumes in 2010, China-EU (including Croatia) exports, tones



Source: Author's own elaboration based on data from ETISplus database (2010)

Sea Freight volumes in 2010, China-EU (includingCroatia) imports, tones



Source: Author's own elaboration based on data from ETISplus database (2010)

APPENDIX 5 – RAIL FREIGHT TRANSPORT, EXPORTS FROM MOSCOW

Rail freight volumes from Moscow to Europe, by commodity type, 2010, in tones

	0	1	2	3	4	5	6	7	8	9	
Dest. country	Agricultural products and live animals	Foodstuffs and animal fodder	Solid mineral fuels	Petroleum products	Ores and metal waste	Metal products	Crude and manufactured minerals, building materials	Fertilizers	Chemicals	Machinery, transport equipment, miscellaneous and manufactured articles	Total
BU	472,25	359,06	62755,57	211,76	2239,04	81,94	46,76	160,86	1268,63	1464,13	69060,00
CZ	64,89	17,19	1977,81	176,95	76249,92	4,23	790,76	947,01	21,24		80250,00
EE	37170,69	10055,71	58464,71	222821,28	4775,34	17922,94	50815,49	17778,65	6050,99	11144,20	437000,00
LT	66379,25	56290,47	38862,87	60271,30	156943,93	17455,57	359374,49	446111,57	95873,46	84940,44	1382503,34
LV	70582,83	10457,38	2607215,92	47342,58	84685,78	2059,30	76493,71	118526,74	7438,64	2719,13	3027522,00
PL	256544,59	191014,42	2822802,38	156349,01	2218452,74	34415,61	2858706,38	437803,09	90890,21	60355,56	9127334,00
Total	431214,50	268194,23	5592079,26	487172,87	2543346,73	71939,60	3346227,59	1021327,92	201543,17	160623,46	14123669,34

Source: Author's own elaboration based on data from ETISplus database (2010)

Proportion of cargo transported in 2010 from Moscow to BU, CZ, EE, LT, LV, PL by commodity type

	0	1	2	3	4	5	6	7	8	9
Destination country	Agricultural products and live animals	Foodstuffs and animal fodder	Solid mineral fuels	Petroleum products	Ores and metal waste	Metal products	Crude and manufactured minerals,building materials	Fertilizers	Chemicals	Machinery, transport equipment, miscellaneous and manufactured articles
BU	1%	1%	91%	0%	3%	0%	0%	0%	2%	2%
CZ	0%	0%	2%	0%	95%	0%	1%	1%	0%	0%
EE	9%	2%	13%	51%	1%	4%	12%	4%	1%	3%
LT	5%	4%	3%	4%	11%	1%	26%	32%	7%	6%
LV	2%	0%	86%	2%	3%	0%	3%	4%	0%	0%
PL	3%	2%	31%	2%	24%	0%	31%	5%	1%	1%

- 0% indicates that the proportion of the cargo is very small, due to no decimals provided, here is it 0%

Source: Author's own elaboration based on data from ETISplus database (2010)

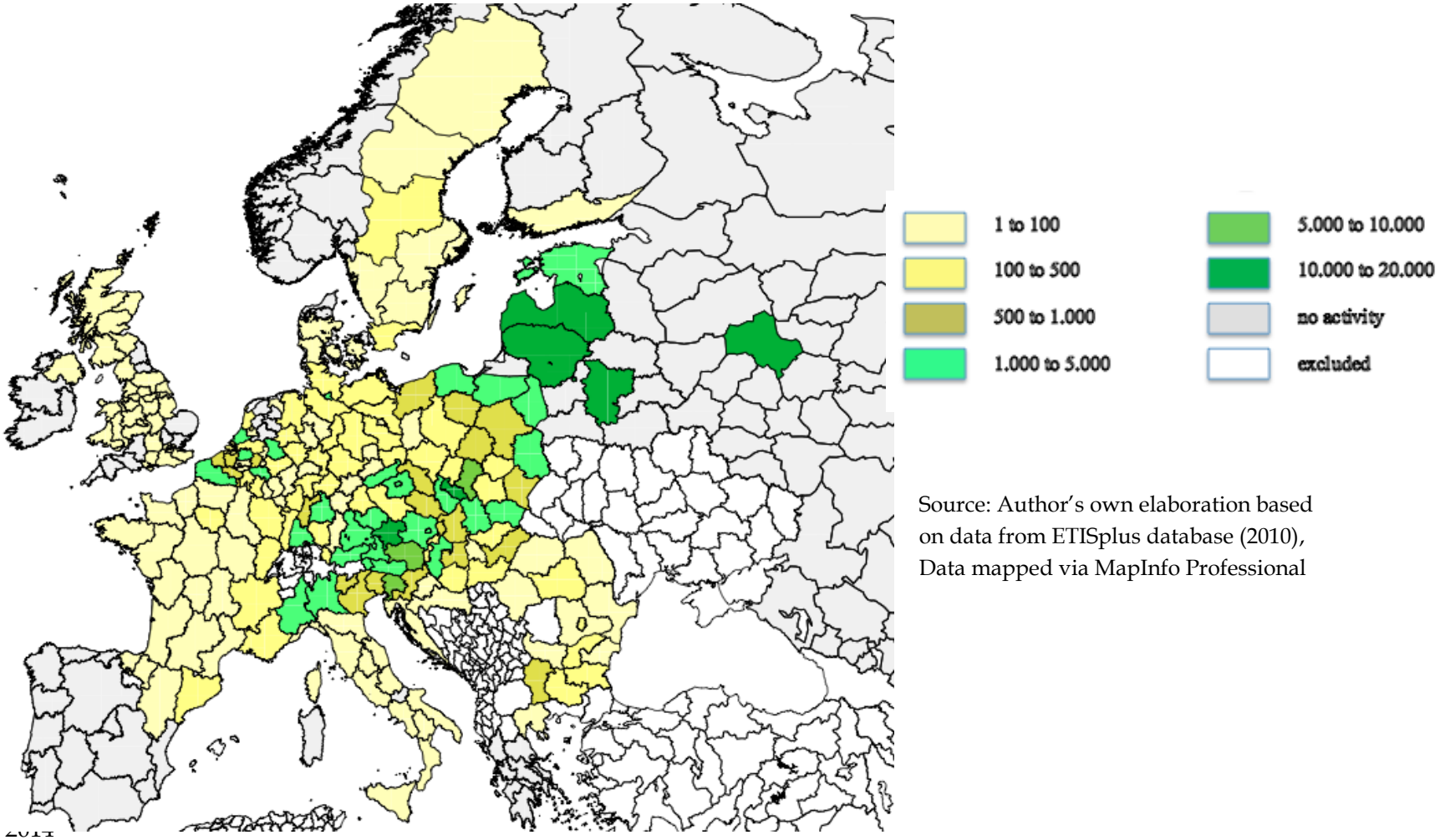
APPENDIX 6 – MAIN PROJECTS OPERATING ON THE TSR

Service	Route	Operator	Additional information
Oostwind-Westwind (since 1995)	Grossbeeren, Berlin – Malaszewice – Brest – Moscow and further to Middle and Central Asia until destination station (Kazakhstan vector)	InterRail services GmbH	• 3-4 times a week from Berlin to Brest • 600 meters • Capacity of 60 TEU • Transportation request in one document
Slavyanskiy express (since 2011)	Block train: Slawkow (Poland) – Bryansk (Russia) Single-platform: to the destination station in Russia, Middle East and Asia-Pacific	Russkaya Troyka and GP UGCTS "LISKI"	• Weekly • 58 hours transit time
TRANSSIB (since 2009)	• Martsevo – Nakhodka – Vostochnaya; • Vladivostok – Perovo; • Nakhodka – Vostochnaya – Moscow - Tovarnaya	JSC "RZD"	• Experimental container trains • 7 days transit time
Since 2005	Nakhodka Vostochnaya – Martsevo	JSC "Russkaya Troyka", JSC TransContainer", "FLV" LLC	Hyundai car assembly transportation
Since 2010	Zabaikalsk – Martsevo	JSC "TansContainer"	Transport of car components from China
Since 2010	Tianjin (PRC) – Moscow ("Irito")	JSC "TransContainer"	Transport of car components from China
Since 2010	Nakhoda Vostochnaya – Cherkessk	JSC "Russkaya Troyka" and Transgarant", LLC	Transport of car components from China to the automobile company "Derways"

Source: CCTT, 2012

APPENDIX 7 – RAIL ACTIVITY IN EUROPE

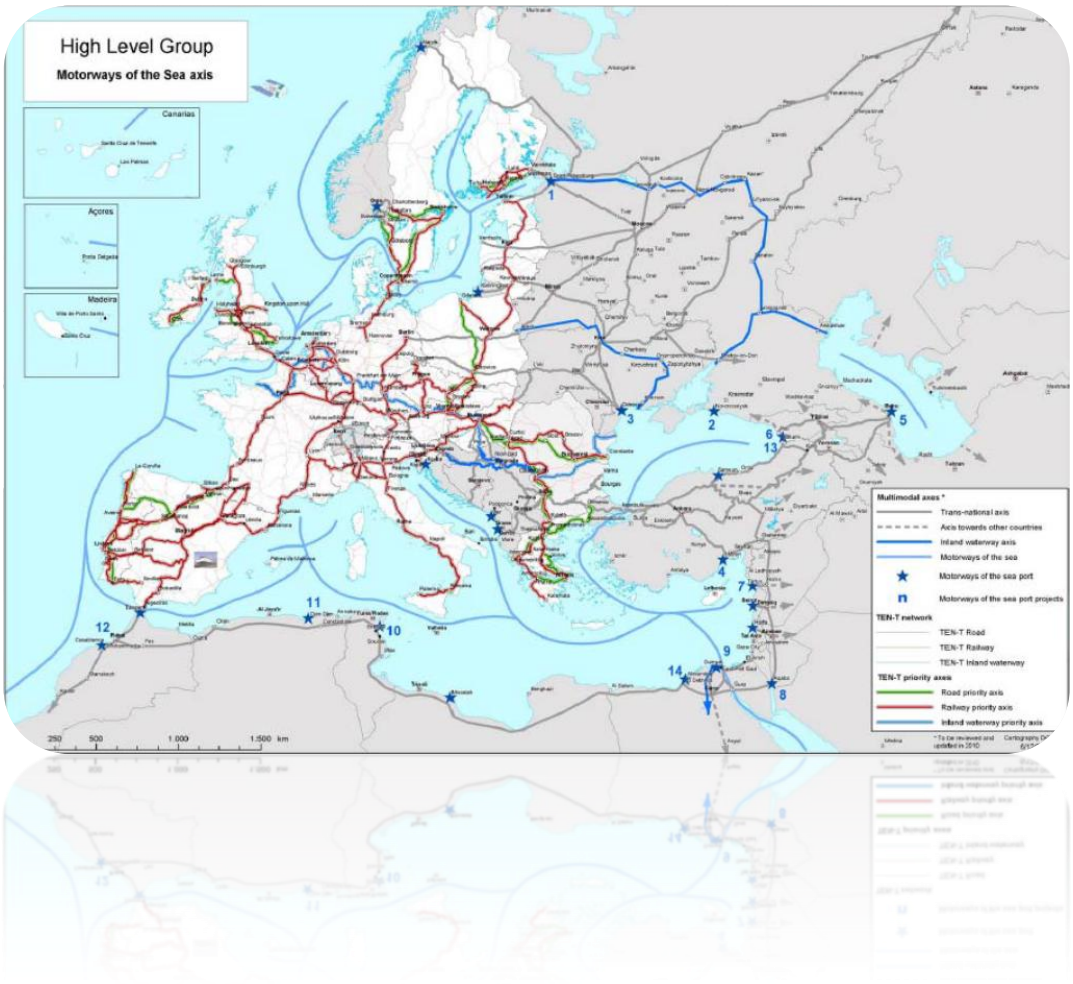
INCLUDING CROATIA, BELARUS & RUSSIA, AND EXCLUDING DOMESTIC VOLUMES, 2010, THOUSAND TONNES



Source: Author's own elaboration based on data from ETISplus database (2010), Data mapped via MapInfo Professional

APPENDIX 8 - EUROPEAN INITIATIVES

TENT-T Projects and International connections



- Construction project of the railway line with a 1520 rail gauge on the territory of Slovakia to Bratislava and Vienna

Main goal of this project is to connect the railway system of Central Europe with the Trans-Siberian mainline through Russia and attract cargo from Asia to Europe. A project on development of a new Eurasian corridor to Vienna coupled with logistics infrastructure could become a breakthrough in developing transport communications between Europe, the CIS countries and China (CCTT, 2012). According to the International association Coordinating Council on Trans-Siberian Transportation, the expansion on the Trans-Siberian route, delivery time from Europe to East Asia, compare to deep sea shipping, will be reduced twice- from 30 days to 14 days.

APPENDIX 9 - IN-DEPTH FACE TO FACE AND TELEPHONE INTERVIEWS

A) Interview Joost van Doesburg, Secretary of the Council of Air Shippers, EVO & Air freight policy manager, European Shippers' Council.

9 October 2013, EVO office, Zoetermeer, 11 a.m.

- *Slow steaming contributes to a decrease in fuel consumption which means less CO2 emissions and at the same time shipping carriers cut fuel costs, but the question is which are the consequences of sailing at lower speeds for the shippers?*

  Slow steaming has mainly negative effects but also positive. The positive effect is that it is much more *sustainable*. It is obvious that when the ship is sailing in normal speeds, it is consuming much more energy and much more fuel than when it is sailing in slower speeds. On the other hand it has also negative consequences and this has to do with the much longer time that the container is on the ship.

  The main consequence for a shipper has to do with the *interest rate*. Shippers and manufacturing companies are losing a lot of money by having a 'floating stock'. In that case shippers need to save a lot of money in order to finance their goods as long as they are being transported. It is apparent that when your goods are twenty days for instance longer in-transit, than before, then you need extra money to maintain them. However, currently, we are in a situation of historically low interest rates, so big companies that are profitable, safe and sustainable for the future can get very cheap loans. Therefore, currently is not that big problem, since shippers can finance it, of course as long as the cargo is not too expensive. Of course when the interest rate will go up again, which will happen probably in few months/ years then will be again very costly and expensive for shippers to maintain this floating stock.

  Another negative point for the shippers is the *predictability*. Although, many people think that shippers make an agreement with the ship owner, unfortunately that is not the case. The ship owner can just suddenly decide to slow steam which means that shippers' goods will arrive later in their destination.

- *But what actually shippers do about that?*

  Well, if shippers would have been informed in advance about slow steaming they could have adapted their operations to that. That is the reason why shippers are complaining about. To picture, if you have scheduled your goods to arrive in China in forty days but now due to slow steaming, the goods will arrive in sixty days and at the same time there is no more stock left in the receiving country, then as a shipper you have a big problem. In order to solve this problem you need to ship your goods in a fast way, 'emergency shipment', covering the gap of twenty days. That is why air cargo sometimes is profiting from slow steaming. However, not all shippers can afford to ship by air since it is much more expensive than deep- sea

shipping. Accordingly, their products will not arrive in the store on time or the raw materials will not be there to be used in the production, dissatisfying their customers. Then the negative consequence has to do with the *reliability*. When slow steaming was introduced at first point, reliability was a much bigger problem. But to be honest since slow steaming has been a common practice, shippers have been adapted their production and their shipment to the current situation. So the problem of unreliability has been relatively vanished.

- *So basically interest costs, are the main negative consequences. But what about the value of the products in- transit. Do shippers need to pay extra depreciation and insurance costs?*

  Regarding the insurance costs the same procedure is taking place either with slow steaming or without and the same risks are involved. Our members, the shippers, are not facing big increases in this kind of costs. Regarding the value of the products, there are some goods that they can simply not be shipped by ship, but you can make profit of it when it is shipped by air. You will never see high value products (ex. chips) being transported by sea. In case of low products, such as regular white t-shirts, then it is not a problem when they will arrive in Europe for instance twenty days later- so deep- sea shipping is the only option for low value products.

- *You mentioned already that shippers sometimes need to ship their goods in a fast way, so having a particular reflection on slow steaming consequences into shippers, which are the alternative strategies that shippers may opt due to the increase use of slow steaming practice?*

  Of course there are shippers that they do not opt for deep- sea shipping since it will take much longer for their goods, but they are looking for alternative ways to ship their cargo. In particular, there are three alternative ways, but all of them are more expensive. As I explained before, air cargo is one option, which is twenty times more expensive that deep-sea shipping. So the question here is, if the shipper is still making profit out of the goods or maybe the receiving company is paying for these extra costs?

  Another developing possibility to ship the goods is by rail, for instance from Germany to China and vice versa. Rail transport is four to five times more expensive option compare to sea but at the same time it takes fifteen to eighteen days to ship the cargo from Europe to Asia. Sea- air combination is another alternative way, which is three to four times more expensive than sea but at the same time your cargo will arrive three to four times faster taking into consideration the current situation- slow steaming practices. For instance, some shippers ship their cargo to Dubai and then ship it by air to Europe or vice versa. It is actually an intermediate option, which exists for many years. For some shippers it is a positive option, such as fashion producers, which are using it quite regularly. But to be honest it is not very popular. Although its potential has been already discussed for many years, it is not really happening yet. I think that sea- air combination is a

good option when you have a production failure and you cannot load your cargo in a ship anymore. We could say that is a cost- neutral transport, so it will not have a big financial impact on your goods, as long as they do not have very high value density.

- *Mentioning the air cargo as alternative shipment, would it be beneficial for some shippers and their supply chains to ship their goods by air?*

  In general for many shippers, transport does not have a big impact on their costs. On average, a shipper will pay only 2-3 % of the transport costs. So it really depends on the types of goods and the value of the goods. For example, there are shippers moving fresh goods, vegetables, or bees or other little creatures around the world, or popular fashion producers that always ship via air. But shippers that produce cheap goods always are shipping by sea and there are the 'in-between' shippers that they have certain goods either entering air or goods entering ships. In general, these shippers are quite flexible on which mode of transport to use.

- *Ok, but which are the criteria that shippers take into consideration before deciding which mode of transport to use?*

  The most important criterion to be very honest is the costs. The second in reliability and the third one is sustainability, but this is not as important as we would like it to be.

- *One point that was mentioned in an article I have read was about a modal shift. It assumed that shippers might be imposed to use land-based alternatives; for instance cargoes maybe moving between the Far-east- Europe route via the Trans-Siberian railway. Do you consider this as a possible alternative for shippers?*

  It is true that there is some development in the rail freight shipping nowadays. Rail as a transport mode is an option between deep- sea shipping and air cargo regarding both time and costs. In my vision the development in the corridors between Asia and Europe is very positive. There are currently, two big shippers operating in this route; HP from Asia to Europe and BMW shipping cars parts from Europe to Asia. But the question is, if this cargo is shifting from the sea or is shifting from the air? I do not really have evidence by numbers but I think that this is a big threat for the air cargo mostly. Currently they are saying that 50% of the cargo in the train is coming from the air cargo supply chain and 50% is coming from deep – sea shipping. But of course when we talk about volumes the air cargo mode is only transporting 0.5% of the international trade, but this is 37% of the value of the world trade. But when you get as much cargo in volume or in kilos out of a plane as you get from a ship, then the share of the air cargo mode is much smaller. So I believe that air cargo will have actually some negative effects from that development.

- *I would like now to move to another alternative strategy that I am searching upon. Allow me to make a small introduction; companies engaged into international supply chains,*

relying on global sourcing with production centered in China, currently has faced with increased labor cost and low quality production coupled with extra costs (increased inventory and transportation costs) due to longer distances. Under such circumstances numerous companies have decided to move production closer to the final market (near shoring). Bearing this in mind and the negative consequences that we discussed earlier, do you think that shifting production closer to consumption would be an option for some shippers and why?

Well, definitely near sourcing or re shoring is something for the future. What is the real concern for the shippers? So in the 1980-1990 many companies outsourced their production to China because the labor cost was very low. However, the last 3-4 years, the labor cost is doubling and the cost of energy in Asia is really high, much higher compare to Europe and US. Due to the more energy intensive, shippers think why do we still have our production in China? Another risk in China it has to do with intellectual properties; you have secured your goods that nobody can reproduce them. The Chinese very often state related companies and they are copying everything, so you have another threat for your company. So more and more shippers are indeed more negative about their production in Asia- China and you see some shippers moving their production from China to Thailand, Vietnam where the labor costs are lower. Some parts of the production, especially for the production of the more expensive goods, that you need better skilled employees, you will definitely see the production shifting and returning to Europe or America. But I do not think that there will be a very big impact on the European market for the next coming years.

That is different in other industries, for instance when you are producing chemicals. You do not really use a lot of labor, but these goods are produced by machines and you currently see a gigantic increase in energy cost in China, since they have a lack of resources themselves and they get resource from other parts of the world; Africa, Australia. They are moving to the cheapest energy spot; currently this is America. Some chemical companies were scheduling an investment in the Netherlands, to build here a new factory, but now they put it on hold, investing in a new production location in the US. In Europe we have much stricter rules regarding environment and energy consumption in comparison to the US and definitely in relation to China. So I do not believe in it yet.

- *Could you in general associate the emergence of near sourcing with the increasing use of slow steaming? If yes could you say more about it?*

I would not really associate near sourcing with slow steaming practices. I see very often in the slow steaming time, the transportation will take longer, which means higher interest costs, but you see a decrease of the transport rates. So in one way it will cost shippers more time to transport their goods but on the other hand the rates are lower. As I mentioned before it really depends on the type of the goods and on their value. Does slow steaming makes transport more expensive in relation to the lower transport rates? Or you have such cheap goods so you can conclude that the

value of the goods that are on board of the ship is almost zero, so slow steaming in relation to the low transport rate is only positive for my production.

Very often what you see with near sourcing is that instead of finished cars being transported (finished products), the component factories are still on the same location. The components are shipped and the assembly of these goods is taking place. So you still have flows of transport. I believe that it will have a negative impact on the volumes being transported in the medium to long term, but I don't think it has anything to do with slow steaming.

I will give you an example, and then we are talking about the opposite of near shoring. You still see many car manufacturers and airplane manufacturers (airbus) moving some production to China. In general manufacturers just want to be closer to the customer.

- *Well, I have no more questions left actually. I do not know whether you would like to add something.*

Well, yes. I personally think that slow steaming is a temporary trend. To illustrate, due to the economic downturn, we start to purchase less goods, and since the majority of the goods is being transported by deep sea shipping then the capacity of the ships declined. In turn the shipping lines behaved rather unwise by building bigger and bigger ships. Therefore the capacity for demand for deep- sea shipping is declining, also for air cargo and in general is declining for every transport mode but the real capacity is increasing. Ship owners are buying bigger and more ships. In the airline industry old planes are being vanished and new planes are entering the market with bigger and bigger capacity. So due to the fact that you have an increase in capacity and decrease in demand, the shipping lines needed to do something, so they start to slow steam and sail with lower speeds reducing simultaneously their year capacity.

But what will happen when the demand will be increased? Of course they have more capacity than we demand but on the other side, they will need to increase the speed and increase their capacity once again. Maybe at the end we will conclude that slow steaming was just something attached to the economic crisis and sooner or later, when we will grow economically again, we will need extra demand.

B) Telephone Interview, consultant of KombiConsult, Frankfurt, Germany

25 October 2013, 14:00 pm

- *Slow steaming practices have negative implications for shippers and their supply chains. Some shippers may choose to use land based alternatives such as rail cargo. Do you consider this as a possible alternative and why?*

It could be an alternative strategy, but it is not only because of slow steaming. Currently there is an increase of the maritime costs and freight rates on the corridors East- West, but not all companies will switch to rail. I would say that it is a back-up strategy mostly for big companies.

- *So which are the other reasons that may lead to a shift to rail?*

In my opinion there are more causes, these can be:

1. A growth within the land -locked countries in Asia,
2. A growth within the hinterland of China and
3. The motor growth within the Asia

This actually means that you have countries like Mongolia, Kazakhstan and the hinterland of Russia, so these regions have mostly the interest of such rail connection between Europe and the East region.

- *Is there evidence that a modal shift from sea to rail is taking place currently due to slow steaming? If yes which categories of products?*

Then we are talking about high value products, which can be from automotive industry, electronic commodities, and also from the chemical industry but not so much.

- *Could you describe the advantages of rail cargo in comparison to sea or air cargo?*

Advantages towards the maritime cargo is the lead time, also the company can increase the working capital.

- *Which countries are going to be benefited the most from the trans- Siberian land bridge from Asia to Europe?*

Mostly Russia, Kazakhstan and China. Russia due to the trans- Siberian corridors.

- *Which are the major obstacles/ barriers that need to be solved regarding the trans- Iberian land bridge routes/ railway?*

You have some barriers such as the custom clearance along the corridor. You have diverse countries involved in such transportation. Custom clearance is one of the criteria as well in order to have seamless transport. The between connections along the countries requires extra awareness / consideration; you need to define two

categories, you have 'block' trains going directly to the end destination and you have 'shuttle' trains. Block trains obviously arrive faster than the shuttle trains.

- *Are there any initiatives taking place towards a further improvement in rail freight in the corridors between Asia and Europe?*

There are definitely some improvements in infrastructure, most countries involved in these corridors have actually already invested in rail infrastructure and are still investing for a further improvement in the between connections. In few years we will see some further development and we expect an increase in cargo movement in these corridors.

- *Some companies, such as HP and BMW, are already using the Trans-Siberian railway from China to Europe and vice versa, could you describe the benefits that these companies have witnessed from this strategy in their international supply chain?*

How effective is the use of the rail against the sea cargo depends on the destination but also on the production site. Some production sites have been already moved to the hinterland in China and here there is the argument; if the goods are being transported by sea then you need further to drive sometimes two thousand kilometers in the hinterland of the country, where the production is being located. So regarding this, the direct connection between Europe and China, by rail would be more cost – effective. Especially if you calculate the working capital, this is why such high value products are very interested in such transportation due to the transport of time, talking about 24-25 days. You will benefit much more than sea freight rates or air transport compare to working capital, so this is why the automotive industry is executing such transportation. There are some strategies to construct new sites within the hinterland in Asia, so in this case you do not need at all to go via the maritime. In the case of the maritime cargo, you still need to transfer the cargo from the coast of the country to the hinterland, in the case of China for example.

- *I do not have more questions left. I do not know whether you would like to add something for instance regarding a forecast in the near future.*

There will be a progress in the future but not in the short- term. In my opinion the growth that Asia will experience will be at the cost of China and in the hinterland, also Kazakhstan, Turkmenistan, and Uzbekistan, such countries, land-locked countries are interested in such transportation, but of course this depends on the products as well. Mostly we are talking about containerized cargoes.

If the demand is too high for example, maybe we will see an increase of rail freights, but there is not really such forecast for this kind of transportation.

C) Telephone Interview, Ben Radstaak, Managing Director at ACN (Air Cargo Netherlands), Schiphol, Amsterdam

29 October 2013, 09:00 a.m.

- *Slow steaming practices have mostly negative implications for shippers and their supply chains. Some shippers may choose to ship their cargo by air, especially for smaller shipments. Do you consider this as an alternative strategy?*

Well, It is less an alternative than a consequence. What do I mean by that? Shippers do make calculations based on the value of the goods and the interest for the working capital that is invested in the goods and they offset that against the higher costs of air transport.

So when it takes longer in the ocean for some cases then the decision may shift in favor of the air transport. But if we look at air transport in general, I think 1/3 of it would be because there is some sort of panics somewhere (problem), events driven logistics, spare parts, etc where ocean will almost never will be an alternative. Another 1/3 would be perishables; such as flowers, were the shift from air to ocean would not happen. There is an interesting article in the Dutch newspaper 'Nieuwsblad Transport' with Edwin Weenink, in which he explains that the transit time is very important, because the longer it takes the less attractive the ocean will be and if the ships keep slow steaming will not be an alternative. That is another category within the air cargo. I can think of fresh food such as meat, fish, vegetables, fruits none of them will go to ocean when it is slower but some of them may shift to ocean when the logistics are perfect and the time allows for that. In the final third there are goods mostly in the high- tech industry where it is really the working capital and the value of the goods; it is decisive to go to air. Of course there are all kinds of intermediate goods, were both are feasible, for instance when the new TV with flat screen was introduced for the first time 10 years ago, they all went by air. But when the cost of the product went down and the capital that has been invested by companies such as Samsung or others, in the stocks goes down too, the transport of these products returns to ocean. When the interest goes up and the speed in the ocean goes down, then the calculation might turn in favor of air again.

That is something you should talk about with someone from Samsung in Tillburg(NL), there is a big European distribution center, imports of electronic goods by air and by ocean. I do not know how close the calculation gets to the switching point.

But that is only a very limited number of shippers, but for air it can be significant. If all the flat screens or the laptop computers, etc would go again by air instead of ocean because of slow steaming, that will really have an impact for the air carriers. For ocean it is a matter of just a few hundred containers, so that is not a really big impact for the ocean carriers. I do not think that ocean carriers will stop slow steaming because of these products shifting to air. The same happens in the textile

industry, the high fashion brands usually go by air. But there too are shippers who make these calculations what is the best and again, if instead of 4 weeks it takes 6 weeks, it doesn't help ocean. There could be some cases that it turns back. But when the interest rate is changing or the value of the goods is changing or the rates of the ocean carriers is changing, I think that these have a bigger impact than the two additional weeks because of slow steaming. But from an academic/scientific perspective, assuming that all the other things stay the same, and then indeed I think there will be some cases that there will be a shift to air because of slow steaming.

- *What about the sea- air combination? Is this another alternative for the shippers?*

Yes it is another alternative, in particular on the route from Asia (China, India) to Europe. Because it takes quite a while to go by ocean and in particular when the ocean carriers start slow steaming, but considering that in eight or ten days from Singapore or even shorter from India you will be in Dubai then the products could be shipped by air. It is true that from Dubai many planes are going back to Europe quite empty, because there is in general lots of cargo coming into the Middle East; Dubai, Abu Dhabi etc, from Europe. They do not produce much air cargo there. So there is indeed sea- air combination as an alternative in between ocean and air on the routes from china, India, Singapore via Dubai, Abu Dhabi to Europe. That is mostly because of the low prices, low rates for air cargo from Dubai to Europe. We do not see that happening in the Netherlands, because out of Europe, the rates to most destinations are not very cheap due to the fact that Europe still produces high value goods that are being transported by air. So there is no reason for instance to transport goods from the East of the USA via ocean to Rotterdam first and then transport them via Schiphol or Frankfurt by air to Japan, which is not a feasible transportation. But on the routes from the Far East to Europe there has been a steady sea- air flow of goods for many decades. I looked at it myself in Dubai, six or seven years ago, I think in those days it was like 10% of the total air tonnage that came from the Far East to Dubai via ocean and then from Dubai to Europe by air. That is very little. Of course they will profit from slow steaming as well. I think that the ocean carriers will only partly use slow steaming and perhaps they will move containers that they have high value goods on the fast sailing ships.

- *As regards the air cargo industry, what are the main concerns/ threats?*

Well the market is still not growing, so a major concern is especially for full freighter airlines. In particular, there is a decreasing supply of freight capacity, because the passenger travel is still quite growing, particularly in and out of Europe, but the cargo is not growing, so the capacity in the bellies of the passengers' planes is increasing. So lots of airlines park full cargo planes in the deserts or they are reducing/rescheduling the schemes to use them on new markets, where there are fewer passengers. That is an issue. We are all hoping that the market will go up again. It is going a little bit better than it was half a year ago.

Regarding the long run, there are numerous threats that the market has to face. Globally the air cargo market does not look very good. If you look at various supply chain trends such as near shoring in which companies are producing again in Eastern Europe or in the Mediterranean area instead of flying from Asia, which is definitely a concern for the air cargo volumes. Moreover, 3D printing is considered to negatively impact the air cargo market.

D) Interview Irina Birman, Director at TRWC BV

1 November 2013, Den Haag, 14:00 p.m

- *Which products TRWC BV offers?*

TRWC was established one year ago and we have created product for the Dutch market. So TRWC BV offers two products; train from Rotterdam to Moscow and train from Rotterdam to Chongqing, location in the middle of the China. These are already established trains from Duisburg onwards, and since we are focusing on the Dutch and the Belgium market, we have extended this train from Duisburg to Rotterdam. We have partners with Russia, and specifically the Russian Railways, which is the general operator of this train.

- *Which are the benefits that rail transport has to offer compare to deep-sea shipping?*

First of all, the transit time is one of the main benefits that this train offers. Principally, the train from Rotterdam to Moscow takes five days instead of fifteen days by sea; for instance the route Rotterdam-Hamburg- St. Petersburg by feeders, it takes seven days and from there unloading from the ship to port and then from St. Petersburg to Moscow by car/ truck due to bad weather will take around eight days. Regarding this route, the price is another benefit. More specifically, by sea it costs approximately 700 euro plus 1.200 euro truck from St. Petersburg to Moscow. Therefore, regarding the transportation costs, this train product is cheaper than sea shipping.

The train from Rotterdam to China (Chongqing) by rail has transit time only fifteen days instead of fifty four days by sea; twenty eight days from Rotterdam to Shanghai and approximately eleven to eighteen days from Shanghai to Chongqing by river.

Nevertheless, cargo by deep sea shipping could be more risky and unsafe (weather, port strikes etc) in comparison to railway transport. Rail transport is also more reliable since you have a schedule of the specific transit time. Last, railway transport is also a green transportation since is the most CO2 efficient transportation over sea, road and air.

- *I had a meeting two weeks ago with the Air Freight Policy manager at the European Shippers' Council and throughout our discussion he argued that the rail freight development in the corridors between Asia and Europe is mostly a big threat for the air cargo. Could you further tell some more things about this?*

The train has capacity of forty four containers in comparison with the plane that can fit only 3-4 containers of products. Air freight is also much more expensive than rail freight so I would agree that the potential that rail transport can offer to its customers it is a threat for the air industry. However, there are of course some obstacles that first need to be solved. We still need to invest on the development of the rail freight regarding infrastructure and capacity limitations. From the moment that these things will be done, the rail transport will meet shippers' logistics requirements/ needs and then we will see an increase in the volumes of the rail freight from China to the Netherlands.

- *Ok, so since the Eurasian railway route has a comparative advantage over deep sea shipping and air shipping, why this development has not happened earlier?*

First of all, only five years ago the full-scale opening of the European rail network for freight transport took place. For instance, Germany and Poland used to have different regulations regarding the railway system but since 2007 one railway system exists, the European Union railway system. In Poland, however there are some capacity limitations in special points. More specifically, in Germany you can load 80 van wagons but in Poland in these special points you can load only 40 van wagons. Giving a solution to that, this operating limitation exists now for the whole European Union railway system. Another operating problem is that the width of the European Union railway track is 1435mm whereas in Russian railways is between 1520-1524 mm, so you can't go directly with a European train to Russia but you need to loaded in another train, fact that costs lot of time. Nowadays this has been solved partially through a special terminal in Brest (Belarus), so the transition is faster.

- *Regarding a modal shift, do you think that some shippers will choose to ship their products by rail? In other words do you see that part of the maritime cargo will shift to the rail? Could you mention which categories of products would be more susceptible?*

As a logistics procedure you would expect products that implement in full circulation of proper using to be more susceptible.

For instance if you have a warehouse in one of the locations where there is access to Trans- Siberian railway and your company is involved in JIT strategies and via the railway your products are on time then obviously the railway transport will be an alternative. Regarding again the comparative advantages that rail transport has over deep sea shipping in relevance to transit time and price, I expect that part of the maritime cargo will shift to the rail.

Furthermore, sea shipping prices expect to rise due to the new convention in 2017 for the Baltic Sea, according to which you can't use vessels with old diesel engine. Under this convention, all the vessels will be replaced by new, which of course will cost money for the shipping companies. Shipping companies have taken a big risk already by ordering larger and larger liner vessels and getting loans in attempt to increase the ship capacity putting at the same time the company in a financial struggle. Another point that needs to be mentioned is that shippers buy slots in the vessels with a specific price in advance but maybe next month this price is double, fact that annoys the shippers. On the other hand, rail prices will be fixed throughout the year.

Generally, rail transport is mostly concentrating on luxury goods, automotive specifically spare parts, and electronics etc. HP and BMW are already using this train from China to Germany. However, are quite difficult products mostly because at the moment the Dutch market is concentrating on vessels and trucks making railway alternative unusual for the Dutch business.

- *Well, I have no more questions left actually. I do not know whether you would like to add something.*

Well, yes. As an entrepreneur, rail transport is challenging first of all because is a new product with promising development and it is realistic. However, we need to change the mind of the people. At the moment, customers are mostly familiar with vessels and trucks and less familiar with the train transport. So it still needs to be developed through a clever transport regulation on all system of logistics.

If we see transportation as a general picture, we have to understand that it has to be a diversification of the cargo from vessel to truck, from truck to railways etc. and all these possibilities need to be used by the shippers. At the same time considering the train capacity of 41 containers whereas feeders can contain 5.000 containers, then we realize that we need to focus on special customers.

However, I would say that at the moment it is not really a benefit to use the train, first of all because is a new product that operates only two to three times a week. But when the remaining capacity limitations will be solved then the volumes of the rail freight will be increased and will be the cheapest option for the shippers. Moreover, by 2016 European Union would like to remove all the trucks from the road so customers will have to use the train in Europe but this regulation would also facilitate the connection to Russia and China.

E) Interview with Arnaud Burgess, Team manager Strategic Research at PANTEIA

13 November 2013, PANTEIA office, Zoetermeer, 15:00p.m.

- *Slow steaming has mostly negative implications for shippers and their supply chains, so some shippers may choose to ship their cargo by rail? Do you consider this as a possible alternative for shippers, regarding the route Asia – Europe*

Well it is an alternative especially for the Western parts of China, which are developing fast. Chinese are increasingly deal with Russia and Europe and the developments between the border crossing between Kazakhstan and Western China is improved, so it will become an important alternative.

- *Which are the benefits that rail cargo has to offer to his customers compare to deep sea shipping in the route Asia- Europe?*

I think in terms of timing and in terms of costs and also there will be a general objective that we have within Europe to accommodate flows, not only through congested port areas. So customers will have a benefit in terms of cost and time and on a societal level the congestion in the ports will be reduced in this way, congestion of the hinterland and infrastructures.

- *Some weeks ago I had a discussion with the Air freight Policy manager at European Shippers' Council. One good point that was mentioned is that this rail development in the route Asia- Europe is mostly a big threat for the air cargo. Could you further explain this? Do you see a shift from the air to the rail?*

I would not really agree with this assumption. Of course in terms of capacity, it can never take over the volumes that are currently carried by maritime transport, but it will certainly take over some part, which is designed for maritime transport. It will be a competition just placed between air and maritime, as there is no alternative since the rail is placed in between.

- *Since the Eurasian railway land bridge has a comparative advantage towards deep sea shipping and air shipping, why this development has not happened earlier?*

Mostly because of institutional bottlenecks and lack of cooperation. Currently however the Chinese are developing their internal corridors. They are going in the direction of the Russian and Kazakhstan borders. Russian and Kazakhs are becoming increasingly aware of the opportunities that exist. The willingness is there to cooperate although the Chinese have a little bit their own attitude towards developing and it will take some more time still to include the Russians in their initiatives.

- *Assuming that part of the maritime cargo will shift to the rail, could you specify which categories of products would shift?*

Containerized transport. You always have to think in terms of balance of transport flow. In terms of what is going to China, is row materials from the central Asia and I think that is the interest of the Chinese because that is close to their borders. But mainly from China finished products and container traffic.

- *Some people argue that slow steaming is something attached to the economic crisis and sooner or later ship owners will sail fast again. Having this in mind do you think that such effect will impact the rail freight market?*

No. Regardless slow steaming or not. Depends if you study the Retrack reports and especially the parts of Russian development, there is a tradeoff between the costs of access so connecting transport with maritime and direct rail transport. Overall there will be no effect.

- *Some companies such as BMW & HP are already using the Trans- Siberian railway connection from China to Europe and vice versa. Could you describe the benefits that these companies have witnessed from this choice in their international supply chains?*

First of all, you have to think in terms of safety and security. One of the disadvantages that still has to be solved and the CCT working group is paying attention to, is the liability issue in Russia. Somehow BMW solved that with the Russians. However, this has to be solved on a wide scale regarding as well the harmonization of legislation there. I think for the moment what you see is mostly West- East transport and that is a bit of risk reducing strategies. So they developed this kind of supply chain but at the same time they are using maritime transport as well. And before the issues are really solved then you will see rail transport increasing from the West to the East. For the moment it is an experiment from BMW, if things run well, they will develop it increasingly. However there were a lot of initiatives that actually have stopped.

- *Regarding strategies by shippers due to slow steaming practices, is near shoring or in shoring, an option for European shippers?*

I would not say that it is the next big thing. There is a movement of a reallocation production closer to Europe. We should not forget that Europe economic presence in the world is reducing and I think other countries are becoming more important in developing, like India or China. Even the Russians lost their interest a bit in Vienna; there was this idea to have the 'broad gauge' of the Russian railways close to Vienna and from Bratislava they would construct a railway line. I think that under the given economic circumstances the Russians lost their interest in that connection and Europe said we are not paying for this towards the Russian system. If it would be very interesting for the Russians they would invest in it immediately since they have the money to do it. Maybe in few years time when the economic conditions will be better we may see this start again. I am convinced that we will have a good connection from central Europe to Russia but it will take some more time still.

F) Interview Chris Schuchard, retired- last position: Managing Director M.O.L. Southern Africa

28 November 2013, Rotterdam, 17:00 p.m.

- *Slow steaming contributes to a decrease in fuel consumption which means less CO2 emissions and at the same time shipping companies cut fuel costs, but the question is which are the consequences of sailing at lower speeds for the shippers?*

Maersk Line is having now the triple E container ship with capacity 18.000 TEU expecting to be the most efficient container ship per twenty- foot equivalent unit. So with slow steaming Maersk basically first of all have guaranteed to the shippers because of the Triple- E that they can carry the goods for less money and also that they will give money back to the shippers (If I remember well around 320 euros). The other part is that the trip from the Far- East to Europe is taking longer of course, so they have to take care that their supply chain is not being disrupted. Although if you are very realistic about it; the first trip is slower, but the second trip then you have an 'eagle', a separation between the sailings. So basically the first sailing might be a bit disruptive but after that all is back to a weekly schedule again. If the difference would be from 12 days to 14 days for instance, I think that is not that a big deal and is easy to set up your supply chain again. So in principle, if it is 'rolling' then it should not be a lot of difference for the shippers.

- *It is not a big problem for the shippers nowadays because slow steaming is a common practice, so shippers have been already adapted their operations to the slower sailing, or was not a problem as well when slow steaming was just introduced?*

In my point of view, I do not think that slow steaming was really a problem. I will explain myself, if the sequence is in place then you have difference between one sailing and the next sailing instead of 7 days it is maybe 10 or 11 days. So if it is let's say 10 days each every time you can basically you can base yourself on that specifically sequence, so you can make your supply chain. Of course shippers have to adapt their supply chain and since they do that, slow steaming should not be a problem.

- *Ok, so my hypothesis actually is that some shippers may choose to ship their products with another transport mode and not deep sea shipping either rail or air. Do you consider this as an alternative strategy?*

If you consider the sea cargo volumes between the Far- East/ China to Europe, even if you take the North Atlantic trade between America and Europe, these are two big pipelines, you are talking about million of containers, it is huge. You can try to put it through the air but apparently that is not possible. I do not think air basically is a counter proposal for this. Lastly the much higher cost for air traffic will be an obstructive factor.

- *But what about the potential of sea- air combination through Dubai for instance? Taking into consideration as well the empty flights from Dubai to Europe.*

Still the volume is enormous that I do not think that it is an option, unless we are talking about very specific cargo that is needed very quickly then you can put it by airfreight. Sea- air was already introduced in the 70's- 80's, it was basically done at that time, but I do not think it has ever taking off to that extent that you can say that it will be an alternative for that part of the volume or that will have a critical mass. Every flight can take some amount of tones but in the sea transport we are talking about hundreds of tones. If we talk about flowers from Eastern Africa, Kenya, there are many fresh flowers transferred to Aalsmeer every day, and then of course you have to do this by air, but then we are talking about very specific cargo. Still air cargo is a more expensive transport choice, but for few products such as fresh goods, electronics and in general high value goods air cargo is the only transport possibility.

- *What about the rail transport connection from the Far- East to Europe through the Trans- Siberian railway for instance?*

I would say difficult. Of course it will be on the increase, everything is on the increase, since world trade is increasing. So yes if you offer a rail solution of course the numbers will grow and again on the sea- air the numbers will grow, since you offer that product. But I do not know if the numbers will ever be increased in that extent that air or rail will ever compete against sea transport. I think that the world trade if it grows by 5% let's say a year, then the shippers after the shipping companies will not see that as a huge competitor. Another thing, if you take from China to Europe at the moment everything goes via Suez or Cape Town but now the route over the Northern circle is opening up, which is basically much shorter than via Suez. So you should consider this route as well I think, because it will take shippers less time to transport their goods than it does now.

- *I would like now to move to another alternative strategy that I am searching upon. Allow me to make a short introduction; Companies engaged into International supply chains, relying on global sourcing with production centered in China, currently has faced with increased labor cost and low quality production coupled with extra costs (increased inventory and transportation costs) due to longer distances (longer transit times). Under such circumstances numerous companies have decided to move production closer to the final market (near sourcing) - case of Mexico for US market, East Europe for North Europe market. Bearing this in mind and the increased costs that shippers face due to slow steaming do you think that shifting production closer to consumption would be an option for some shippers and why?*

From the moment you business is profitable you will always look at that. You always look for a market that you can buy cheaper but at the same time to buy good quality. In the textile industry for instance around the Indian Ocean, in the old days it used to be in the Far East then production was at Mauritius and then it moved to

Madagascar. So you see this happening in the industries from place to place where the labor cost is lower.

Another example is the furniture companies. Numerous companies took the furniture from Indonesia but in order to make sure that the quality is good, they had complete quality teams set up in the Far East as well. So although you always look for cheaper sources particularly for lower labor cost, you need to make sure that the quality is good as well otherwise you can't sell your product. Therefore it is not so simply to say that I will just take the plant and locate it somewhere else.

In the automotive industry is happening exactly the same, TOYOTA for instance have huge factories in South Africa but there is such control around these factories, so it is not so easy to move that from one area to the other area. Of course everything can be done but it is not easy, depending of course on which industry you are looking at. In the textile industry is maybe easier to move the factories but in electronics or car industry it is much more difficult to happen. Overall of course it can be done and every shipper will make sure that he will produce his products in the cheaper place with the highest quality possible.

- *Well, I have no more questions left actually. I do not know whether you would like to add something.*

I personally think that slow steaming was never really a problem to the shippers since they could just adjust their supply chains to the new situation. Certainly, through slow steaming shipping companies save on fuel a lot of money, they cannot deny that; it is hundreds of thousands of dollars, but they also need that in order to stay 'inside the business'. Shippers need to realize that and if you are wise enough, you make sure to transfer your products with Maersk, CMA-GCM, and MOL or COSCO lines

- *Ok, but isn't it unfair for the shippers?*

Well, no it is not. If you calculate the transport costs that shippers pay to transfer for instance shoes in a 40 foot container, it is absolutely 'nothing'. But it was and it will always be the same argument; according to shippers shipping companies make and have made a lot of money. But reality shows a different picture; huge losses in the shipping industry. As I mentioned before shipping companies need these fuel savings in order to stay 'in business'.

G) Interview Enno Osinga, Senior Vise President Cargo, Amsterdam Airport Schiphol Group

29 April 2014, Office at Schiphol Airport, 16:00 p.m.

- *About a modal shift, what drives the decision process from a logistics perspective?*

Well, when you go back to the 1980s literally the air cargo was air cargo, it was flown within Europe. What happened in the 1990s is that the air cargo moved to road. It was still theoretically air cargo, in other words it was a truck flight. It had a flight number but it was in fact put in the truck, mainly within the range of 400-500 km. On the assumption that you can flight it at night but since most businesses do not need it until the next morning you might use the truck over night. Since then the only air cargo that is mainly remained in Europe is air cargo flown by the integrators, TNT, FedEx, UPS, DHL, who have an overnight express service and therefore they need to fly. They need to pick up a document and it needs to be delivered in the morning so they have to fly it. That was phase one for the air cargo.

The next shift that happened became a sea- air shift partially. They were building on sea- air combinations. In other words, they would move it by ship from China or India to the Middle East and then they would fly it by air to the end destination, so it was a multimodal leg. What we are facing now is the next step- full substitution- whereby cargo is moved away from air totally, origin-destination to sea. And we also know in the long haul that cargo is being moved from the air and sea to rail- connection between China and Europe. These are developing services. Interesting enough you will find that air cargo people talk about that in comparison to sea cargo people who do not talk about it. Because if you take the full capacity of the train from China to Europe, you talk about an equivalent of 747, which is big, but translated into containers for shipping it is nothing. So there you have a different perspective. Also from air to sea you see air cargo talks about loss of business, you never see sea cargo to talk about gain of business. I always say that in terms of volumes- here we do 1,5 million tons per year, in Rotterdam they do 400 million tons per year. So again now this is a different perspective.

Going back to the reasons, the original shift within Europe, from air to road, was driven basically by two issues; costs but mainly sustainability; noise, night flights etc. Also due to the change of the aircraft; it used to be that they would fly passengers during the day and then you could take out the seats and fly cargo during the night. From a quality perspective you could not do that anymore to a passenger aircraft and from a costs perspective to have a full freighter you cannot use it all day.

The shift from air to sea is different. To the largest extent this shift is costs-driven and in some cases quality-driven. Cost driven is logical because air cargo is lot more expensive than sea cargo. But also cost is a variable item; when you go back to again the 80s, interest rates were pretty high; 6-7 % which means that your costs of inventory is very high. So if you transport your goods by ship and they are on board

of a ship for six weeks, your cost of inventory is very high. In relative sense made air cargo much cheaper. Also fuel costs were lower, the difference was then compensating. Today we have a situation where the interest rates are virtually null and fuel costs are very high, so air cargo is becoming much more expensive and one of the advantages, the reduction of cost of inventory disappeared, therefore that is the main reason for the shift. Quality wised specific when you talk about the cool chain, for example pharmaceuticals, once you will think that air cargo was much more reliable than sea shipping, the reality is different. To illustrate, in case of maintaining the temperature, you can fully low the temperature of the whole container with the pharmaceuticals, and then you move it to the ship and the goods do not leave that container until the end destination. Regardless the fact that it was 6 weeks in transit, the temperature of the products was constant. That of course applies only to medicines where temperatures are important and they have a very long life and very late expiration day. If you have on the other hand, medicines that they have an expiration date in a year's time then you cannot ship them by sea. I think out of the total pharmaceutical market, roughly nowadays only 15% of the medicines goes by air and the rest goes by sea. But again driven on a combination of value and saturation state- what day they will be expired.

The typical air cargo products are flowers. These products need to be maintained fresh so they need to be transported very quickly. So you would not normally think to put flowers on the boat. However, they have done a lot of research and it turns out that if you keep, not all of them, but some flowers on constant temperature; I believe between 1-3 degrees, the flowers actually go to sleep and they can last three weeks. Because flowers get measured in temperature days, so let's suppose that a rose has a total lifecycle of 20 temperature days at 15 degrees. The total life cycle is 300. If you keep them 21days on these temperatures that means they have used only 21 days of their life cycle out of the 300. Therefore, they discovered that they can ship flowers by ship, for instance from Ecuador to the United Kingdom, without losing quality. Given the low cost of sea versus air cargo again that causes a significant modal shift. Experts anticipate that probably 25% to 30% eventually can be moved by ship, which is a big shift.

Next factor that influences a modal shift is the state of the economy. When the economy starts to collapse in 2008, suddenly everybody realized that they had too much stock. In that case the first thing you do is to reduce stock which means that the transportation stops. Specifically on goods that they have high stock, for instance fashion products, air cargo dropped 35%. Then when the market slowly starts recovering, you sent the goods by ship because again you do not have costs of inventory. So the fact that actually your products are on transit for six weeks doesn't matter but in fact it is your cheaper storage. If you have sent them from China by air you pay a lot for the air cargo but at the same time you would have to pay more money on storage. This is another reason why we see a modal shift.

The modal shift turns back as you see now when the market picks up again. Because suddenly when consumers start buying stuff, suddenly the stocks finish very quickly and you could never replenish them on time by ship. Then these products will be shipped again by air cargo. So it is not necessarily a modal shift but I would say that it plays with modalities.

Another factor- mentioned by a very interesting presentation by Ericsson. In fact few years ago when we had the ash cloud in Europe and the skies were closed for almost a week. So Ericsson who was depending for 60% of their goods on air cargo, they discovered that air cargo was not working anymore and they needed desperately to change it. So they did discover that they could change it and in fact it was a lot cheaper. So they started thinking about their logistics and the fundamental change- which is beyond modal shift- that happened, is that they finally realized that logistics is not transportation. Logistics is the entire chain from raw material to recycle material. If you only look at transportation then you see that it is cheapest to produce in China, then you make it in China and you ship it in Europe. If you look at it in an integrated sense then you saying well maybe it is cheaper to put it in China and the complexity and the cost of transportation actually ads up so it might actually be cheaper to produce it in Eastern Europe. So this is a virtual modal shift, where companies maybe should think where my manufacturing is and if I should move my manufacturing back from China to Europe- that is a virtual modal shift. In general there is not a single factor but all these factors implement a modal shift.

Another factor is technology. Technology nowadays means that everybody knows a lot more about their business. They are much better at predicting market behavior and predicting consumer behavior. So whereas in the past you produce something and you put it in storage, because when you are going to sell the product you need to have it. Nowadays, they are fine-tuning their demand cycle and while you fine-tuning your demand almost per region per product and you link that with your supply you are in a very variable model. H & M for instance they have summer and winter collection, so they have a continuous change of the collections. How quickly you need the next one depends on the popularity of this collection. If that goes very quickly you better get it there by air otherwise you can send it via sea because you do not need it. This in-depth knowledge about the market behavior allows companies to plan in a much better and more reliable way. By that planning in combination with the low interest rates you start optimizing between the modalities. In general when you optimize between modalities you always optimize on the cheapest transport mode, which is never air cargo so any optimization leads far away from air cargo.

The only part of air cargo that is growing very quickly is the integrators, which is to a very large extent driven by a total different factor- personalization and internet. When you order something via internet and you make it more personal, which means that it is not a mass shipment but then it becomes an integrator. That is not really a modal shift but a change in consuming behavior and in global sourcing. Nowadays you can buy things all over the world and you order things and you

might not even know where these products come from sometimes. That is a different trend.

Then the next thing came up; the increase of the railway technology followed with the opening of China and Russia and the development of the Trans- Siberian railway. A train door-to-door from China (Chongqing) to Hamburg or Duisburg, which are the main rail terminals, takes 17 days against 38-40 days by ship or 24 or 48 hours by air. Many things that go by air are only shipped by air because they cannot wait 40 days, but this rail product is a middle optimal alternative. At the moment is in a try out base, but there are three lines; running to Hamburg/ Duisburg/ Warsaw. I think this will take off in few years time. Last thing there is a line running from Turkey (Istanbul) via Afghanistan to Pakistan and then is going to connect to China. Somebody could argue thought that especially the current political uncertainty in Russia which will have a negative impact on the trade via Russia, then this line is still another optimal alternative connecting China with Europe. This line though is very new so cannot say with certainty what is going to happen.

In a nutshell that is what is happening in modal shift domain from an air cargo perspective.

- *What is the next phase for air cargo?*

The challenge for the air cargo is double. If you look at the air cargo, at the transportation flow growths then you see a picture whereby the integrators grow, sea grows and traditional air declines. So we are being attacked from two sides for air cargo. I think the challenge is to tackle the integrators problem which is extremely expensive. In general the average transit time for air cargo door-to-door is 6 days, but it is ridiculous that it takes 12hours to fly it but then it takes five and a half days to handle it on the ground. So we need to speed up that chain and bring it that back for example to forty eight hours. That will get back some business from the integrators. The second thing, specifically in the pharmaceutical area is to improve full chain and make sure that we have a totally reliable product from origin to destination.

It is interesting that the air cargo always runs six months ahead of the economy. In fact the economy start going down in the middle of 2008, but the air cargo went down from January 2008, so we knew that it is coming. Similarly this year, we see air cargo slowly going up again. With the economy coming up again, with consumer's confidence increasing and start spending, we will see that the stocks need to be replenished so we will see an increase in air cargo. We saw a massive increase in air cargo in November- December, why; XBOX2 & Play station 4, two new products that needed to be on the market before Christmas, completely competitive products, so they needed to be ahead of the market versus the competition. Therefore all the companies used air cargo. That also tells you that consumer's spending is going up again. So air cargo is extremely cyclical. The challenge for the industry is how you cope with that enormous variability in the mount.

- *I assume that there are full freighter airlines; is not that a major concern especially for the full freighter airlines?*

One very interesting fact is that; half the air cargo that comes here in Schiphol comes in full freightus and the other half comes in passenger aircraft. A modern wide body aircraft, like the triple seven, when it is completely full with passengers with their baggage, because it is so big, still has space for 23 tons of cargo. So the biggest airline flying cargo in the North Atlantic at Schiphol is Delta airlines. In fact they do not fly freightus, but they fly seventeen airbuses a day. That is approximately 350 tons of cargo in and out. With the aircrafts becoming bigger and bigger, by definition if you built the aircraft bigger it gets a bigger belly, simple because of the design. That means that you have more space and because you have more space you can carry cargo, you need to carry cargo, because if you do not you have empty space, and empty space means no profit. So what is happening is that more and more cargo is being moved away from the traditional freightus into the belly of the passenger aircraft. There will always be room for freightus, but of course there are restrictions on the height of the products, which mean that we still need main deck freightus. Imagine these massive machines they built in China that they have to go to Korea for instance and they are very expensive products- cost millions of Euros- they have to go with freightus. So although we need the freightus, the current discussion in KLM is; if we should get rid of the freightus and ship everything in the bellies of the passengers and leave the freightus to the specialists. The beauty of a freighter is that it can be extremely flexible, but the passenger aircraft you cannot do that, since passengers book a flight and there is a fixed schedule. For cargo you do not need the schedule, it is a different type of operation, and what some of the traditional airlines find is that they have grown up to be scheduled airlines, they do not know. In fact KLM does not know how to work with the flexibility, is not in our system. So I think you will see a split into dedicated cargo freightus, but the biggest growth will be in the belly.

Internet shopping would not exist without air cargo. You are not going to buy something through internet in China and say will be delivered in five weeks time. Air cargo is a very rational business; you need a very efficient process, you make sure it is reliable, safer, and quicker.

Slow steaming might initially had an impact on shipper's modal decision, but as I said the ultimate decisions are: when I need it and what the cost is. Costs include the cost of inventory as well. Slow steaming increase the cost of inventory but as I mentioned above due to the low interest rates nowadays, it is not that a big problem. I talked with a logistics clothing manager last year, because I wanted to know how they make their decisions: what would they send by ship and what by air, I thought that is a quite complex decision. So if the manufacture delivers on time then it goes by ship and if delivers too late it goes by air, if the shop is empty it goes by air, if there is enough store it goes by ship. If the manufacture is late and is his fault then he pays and if we missed the ship because we missed the booking on the boat then we

pay. This is very important since the total cost of transportation is 1,5 % of the value of the article in the shop and if I optimize it I can make1,3 %. That's a lot of money. Of course that is different from low cost products such as t shirts.

- *Overall which specific products will still be carried by air cargo?*

Pharmaceuticals; if they have a limited life cycle, for instance 3 months, then you are not going to put it on the ship, cause then it loses more than 30% of its life cycle.

Live animals, gold & diamonds, and in general very high value products will always go by air. Flowers also and it can be fashion clothes which have as well short life cycle will as well always go by air.

I will give another example; I think it was the previous XBOX; they missed Christmas for the delivery so they had to put it for next year and there was no competitive product coming on the market, so they delivered it by ship. The logic behind this decision is that since they missed Christmas they did not care if the product would arrive in March or April etc. in the stores, so they just shipped everything by ship which was much cheaper for them. If there would be still a competitive product in the market they would definitely ship it by air.

Another example with Apple: with the iphone 5 they made a huge mistake; they thought they really understood the market demand and their logistics, and they delivered all the products by ship. What happened is that they were out of stock very quickly, almost globally

APPENDIX 10 – QUESTIONNAIRE

Master Student at Erasmus University Rotterdam, the Netherlands

Master Research on "The impact of slow steaming on shippers and on their supply chains: a window of opportunity for other transport modes. Case studies on China Europe route".

1. Slow steaming contributes to a decrease in fuel consumption, less CO2 emissions, and at the same time shipping carriers cut fuel costs, but which are the consequences of sailing at lower speed for the shippers?
2. Would you support the hypothesis that slow steaming impact shippers' logistics and transportation decisions?
3. Despite slow steaming, the last years we see a decrease in air cargo and an increase in the ocean transport; which factors and trends do you think are responsible for such modal shift?
4. Which are the criteria that shippers take into consideration before deciding which transport mode to use?
5. Which products do you think have shifted to the ocean and which products might have shifted to the air due to slow steaming?
6. Please indicate and comment on each of the following alternative shipping options on the route from China to Europe rather than deep sea shipping via the Suez Canal.
    1. Eurasian railway connection (Trans-Siberian railway)
    2. Sea-air combination via the Middle East