How to facilitate Intermodal Transport:

Port Transition Management

MSC Spatial, Transport and Environmental Economics

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Abstract

Sea ports have to cope with an increasing growth in container transport. The transport of containers from the port region to the hinterland involves many actors. Effective transport chains require intensive coordination between involved actors. However, hinterland transport chains suffer from several coordination problems. Port authorities act like a port development company and aim to increase the effectiveness of intermodal hinterland connections. In this thesis, the possibilities for port authorities to increase the effectiveness of intermodal transport are examined and supported by a literature review, a case study and a benchmark study.

This thesis presents 'port transition management', a framework that enables a port authority to coordinate the transition to more effective hinterland transport. The framework is based on transition management theory which describes an iterative and cyclical process that consists of four main activities using three types of mechanisms for economic coordination. The activities of Amsterdam's port authority are analyzed in a business case using the 'port transition management' framework. The analysis results in a number of recommended activities to increase the effectiveness of intermodal transport towards the hinterland of Amsterdam.

Key words: Intermodal transport, hinterland, port authority, transition management

Preface

In light of my master studies Spatial Transport & Environmental Economics at the Vrije Universiteit in Amsterdam, I have examined intermodal container transport in the deep-sea port. This research is commissioned by the port authority of Amsterdam with the intention to stimulate intermodal transport to the hinterland. I have supported my thesis with an empirical study during an internship at the port authority of Amsterdam.

This thesis encountered a difficult start. There were several empirical difficulties as well as theoretical difficulties. However, theory helped me guiding me towards the right direction. The intermodal transport market is very complex with great lack of transparency. I encountered multiple difficulties during my market research. There was very little accurate data available which prohibited me of modelling the market by a thorough econometric analysis. However, delicate theory helped me to cope with uncertainties. An econometric started study became a theoretical analysis. However, this analysis provided useful conclusions and recommendations.

This thesis is meant for people interested in port policy and intermodal transport. More specifically, meant for people who have to cope with port management and hinterland chain logistics. This thesis provides insights about the container transport market and defines the difficulties of intermodal transport. It presents guiding principles for formulating new policy that should stimulate more effective transportation.

Finally, I want to take this opportunity to thank my supervisor at the Vrije Universiteit, Frank Bruinsma, who ensured that my research was going towards the right direction. And I want to thank Jan Egbertsen, who guided me during and after my internship at the port of Amsterdam. Furthermore, I want to thank my colleagues at the commercial department at the port authority of Amsterdam and all other (interviewed) experts who have helped me acquiring valuable knowledge and data during my research.

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1. Introduction

This paper presents a study about the hinterland transport of maritime flows of goods and is executed as a master thesis. Results are supported by an internship at the port authority of Amsterdam.

1.1 Problem Description

Recent developments have shown an exponential increase in container transport[1] and growth expectations remain high. This persistent growth puts the capacity and quality of hinterland transport under pressure. The scale and capacity of seaports grow faster than the capacity of hinterland connections. More efficient handling of growing volumes by intermodal transport is hard to realize. Intermodal transport is defined by the use of multiple modalities. Shippers often consider uni-modal road transport the most attractive form of transportation.

Motivation

The importance of hinterland transport to the market can be explained by the large share (about 40-70%) in total cost of the 'door-to-door' transport (Notteboom & Winkelmans, 2001). In addition, the environmental cost is also a key driver for stimulating intermodal transport. The European Commission (2010) displayed the priority of intermodal transport in the White Paper on Transport. Their policy primarily tries to induce a modal shift from road to other transport modes, such as rail and inland waterways, which are more environmental friendly. Moreover, port authorities have ambitious modal split[2] objectives aimed to be achieved in 2020.

Increasing Growth

The substantial container growth until 2008 showed upcoming problems regarding insufficient cooperation and sub-optimal use of hinterland capacity (Binsbergen et al., 2009; Nieuwsblad Transport – Dossier congestie in de havens (articles from 2007)). These result in practical problems like: "long stay of barges, train and trucks in the port region or at the terminal (often in combination with a peak load at the terminal), limited exchange of cargo and transport capacity, unused, respectively overused rail and road infrastructure, limited quay and crane planning at the deep-sea terminal and limited information exchange with customs and inspection authorities" (de Langen & van der Horst, 2008). These complex problems can be seen as opportunities for innovations. But most solutions require collaboration of multiple actors of the transport chain. Individual actors often do not have sufficient cargo volumes to start an intermodal project. There is a need for radical innovation in containerization management (Notteboom & Rodrique 2008a).

Developments in the transport market introduced a new innovative concept similar to intermodal transport, namely 'synchromodal transport'[3]. Essentially, it implies the same but stresses the importance of a better coordination between transport volumes and modalities so that unused capacity can be utilized. It aims for a more efficient handling of growing transport volumes at a lower

[1] Even though the crisis has slowed down the growth, expectations in growth remain high (European Commission, forthcoming).

[2] The modal split is the distribution of used transport modalities; truck, rail, barge.

[3] More information on synchromodal transport can be found at www.schuttevaer.nl and at Strategisch platform logistiek (SPL). The SPL represents the logistics industry and works with the Ministry of Infrastructure and Environment to strengthen the dialogue on the future of the logistics sector.

cost to the environment (CO2, air pollutants, noise and risks). Within this concept, quality control centres are introduced in which modalities jointly offer logistic services. These services aimed to be optimally tuned between modes (synchronized). Sustainability has become a widely used decision criterion. Cooperation between modes is the key to success in this concept.

Cooperation

Literature also shows that cooperation is the key to success solving these problems. But practice shows that in the intermodal chain, collaboration of every actor is difficult to realize. As a result, innovations exist but are not sufficiently implemented. Van der Horst and de Langen (2008) identified key factors that withhold cooperation leading to specific coordination problems. Reasons why actors choose to optimize their own part of the chain are: Unequal distribution cost benefits, lack of resources or willingness to invest, strategic considerations, risk-averse behaviour and short term focus. Due to the lack of transparency on the market, some actors were able to put profits gained y increasing effectiveness into their own pocket. The high complexity of a hinterland chain causes actors to individually optimize. But individual actor optimization may cause a sub-optimal total chain-effectiveness.

Economic growth is inevitably accompanied by a stronger growth in transport. The container revolutionized global transport by offering high economies of scale[4]. But the rapidly growing container market and its necessary infrastructure come with complex problems. Transportation becomes a major sustainability issue. It has a great impact on the environment, land use and energy consumption.

1.2 Relevance for Amsterdam's Port Authority

Recent developments indicate that the quality and quantity of hinterland connections become very important in port competition. All significant ports in the Hamburg-Le Havre range have equivalent maritime facilities. Ports try to differentiate and compete through unique selling points[5] concerning the hinterland side of the logistic chain.

Notteboom and Winkelmans (2004) show that container flows can switch rather easily between ports. The presence of stable, good hinterland connections is an important decision criterion for shipping companies. As a result, ports compete by improving their quality of hinterland transport services. Still, more efficient handling of growing volumes by intermodal transport is hard to realize. Road transport often is the most attractive modality, especially on short distances. Quality of hinterland connections becomes an important unique selling point for ports in the Hamburg le-Havre range.

The substantial container growth until 2008 showed upcoming problems in insufficient cooperation and sub-optimal use of hinterland capacity. Now the biggest part of the financial crisis is behind us, economic growth will resume accompanied with the according growth in transportation. Ports will have to cope with higher volumes than before the crisis. Research on the handling of large volumes to the hinterland is therefore desirable.

[4] Recently Mearsk announced the production of 18.000 TEU ships.

[5] Unique Selling Points stands for unique and distinctive characteristics of a product or service. An USP can be brought to attention of the audience. A product or service is likely to succeed if it has a certain added value compared to other (equivalent) products and services.

1.3 Project & Research Scope

This study has been conducted for a master thesis at the Vrije Universiteit for the master Spatial, Transport and Environmental Economics.

This research is commissioned by the port authority of the port of Amsterdam. The problem is examined from the view of the port authority. Relevant data and valuable information are acquired during an internship at the port of Amsterdam. Please note that, given the perspective of this research, a helicopter-view has been used to identify the problem. A transport chain can be approached from multiple levels, from the individual actors to the more aggregated view of the port authority. Naturally, individual business cases are important but ultimately this research examines the whole chain using the knowledge about each separate actor. Moreover, it is important to realize that a port authority has no cargo, making the problem more complicated. This study presents a methodology to assess the forces in a transport chain and defines the factors to be considered for specific port policy to induce a modal shift.

The port authority of Amsterdam has connections with several research forums. This study is part of two large and comprehensive projects: World Ports Climate Initiative[6] (WPCI) and Motorways of the Sea - Strategic Demonstration project[7] (StratMos).

The scope of this research limits to maritime flows of containers, only studying the hinterland-part of the transport chain. Container flows are very fragmented. They often consist of multiple flows of low volumes. Hence, efficient use of intermodal transport is not self-evident. Unlike bulk, when volumes are large enough to exploit economies of scale using intermodal transport. The considered intermodal alternatives are rail and barge transport.

1.4 Aims and Objectives

First aim is to capture the forces in the hinterland chain using a new approach and focus on the multi-actor component of the hinterland chain.

The hinterland chain is difficult to model due to lack of transparency and the involvement of multiple actors. This research aims for greater transparency and will be empirically supported by an internship at the port authority of Amsterdam. Goal is to develop a new multi-actor approach through cost-effectiveness analysis and transition management theory. It aims to be a contribution to current literature in a new emerging applied research field (Bontekoning et al., 2004).

[6] WPCI is a knowledge platform where fifty-five of the world's key ports share knowledge using their unique capacity as key hubs in global supply chains. The ports committed to improve their sustainability while continuing their function as valuable and vital economic centers. This research relates to an ongoing project that concerns intermodal transport. See www.wpci.nl for more information.

7 The main purpose of StratMos is the promotion and facilitation of sea-based intermodal transport in the North Sea Region. Implementation of StratMos aims to improve the accessibility and facilitate integration into related transport networks of logistical chains. This research is part of the StratMos project called 'Project DP3d Hinterland by barge and rail', examining the role of hinterland transport within the StratMos project. See www.stratmos.com for more information.

The port authority can only play a role enhancing intermodal transport if it has good insights and knowhow in the forces of the hinterland chain. Insights in cost and effectiveness of each actor in the hinterland chain will benefit the transparency of the market.

After examining the different forces within the transport chain, studied theory will help to define key elements for port policy that should stimulate intermodal transport. Ultimately, this paper will present recommendations for the port authority of Amsterdam, formulating policy implications with positive potential for stimulating intermodal transport.

1.5 Research Question

The problem described above can be translated into the following research question:

How can transition management theory help a port authority to improve intermodal transport by increasing the effectiveness of intermodal hinterland chains of its sea port?

Sub Questions

Answering the main research question requires sub-questions dividing the problem in smaller, clearer sub-problems. Some questions require profound theoretical research where other questions are answered by empirical research. Ultimately, both perspectives are used to answer the sub-questions. Depending on the subject, the emphasis will be on theory or practice. These sub-questions immediately provide the overall structure of this paper.

1. Who are the important actors of an intermodal hinterland chain and how can they be properly displayed into a multi-actor hinterland chain model? (addressed in chapter 4)
2. What are the available instruments of a port authority? (addressed in chapter 4)
3. What is the cost structure of an intermodal hinterland chain of a sea port? (addressed in chapter 5)
4. How to model an aggregate effectiveness of the total hinterland chain? (addressed in chapter 5)
5. Which qualitative criteria are important in decision making to actors interested in intermodal transport? (addressed in chapter 6)
6. Where are the opportunities to enhance and facilitate the effectiveness of intermodal chains? (addressed in chapter 7)
7. What does the theory suggest when implementing transition management to the policy of the port authority, using the available instruments? (addressed in chapter 8)
8. What do practitioners think about the implementation of transition management into the policy of the port authority? (addressed in chapter 8)
9. What are the proper actions of the port authority, putting theory and practice together, in order to stimulate intermodal transport? (addressed in chapter 8)

1.6 Thesis Outline

The structure of this thesis is partly based on the order of sub questions. Chapter 2 discusses relevant policy at different levels of governance, further illustrating the social importance of the problem. Chapter 3 deals with recent literature developed to examine intermodal transport. It also introduces transition management theory. Chapter 4 elaborates on the theory and presents the analytical

framework that will be used in this thesis. Chapter 5 explains the method used to perform a case study presented in chapter 6. The case study provides numerous useful insights about the market for container transport. Chapter 7 presents a benchmark study about initiatives of other port authorities. These initiatives will be discussed using transition management theory, providing input for chapter 8. Chapter 8 combines theory with empirical research. Acquired knowledge during the literature review, case study and benchmark study are used to develop 'port transition management'. According to 'port transition management', an action model is developed with different activities to induce intermodal transport. Chapter 9 uses this framework to examine recent initiatives of the port authority of Amsterdam and determines which challenges lie ahead. The conclusions and recommendations are dealt with in chapter 10. This thesis ends with the discussion in chapter 11.

2. Intermodal Policy

Public authorities recognize the social importance of intermodal transport and develop stimulating policy. Social relevance is often reflected in the intensity of policy regarding the subject. This section reviews the policy that discusses intermodal transport on different governmental levels.

2.1 European Policy

The European commission is currently preparing a new White Paper on Transport to release in early 2011. A challenging scenario of 2050 is added in which the importance of sustainable transport is stressed. The White Paper on transport consists of three parts: challenges, goals and vision and strategy. A draft version (dated 6 August 2010), also examined by the European Sea Ports Organization[8] (ESPO), will provide good input about the expected European policy.

Part one stresses the importance of the balance between the modes of transport. The European Commission regards the shift in modality as one of the main objectives. A modal shift should be realized through regulating competition between modes and by promoting intermodal transport. Railway transport became uncompetitive due to the absence of competitive pressure on rail operators. The most important initiatives to revitalize the railway market are included in the three railway packages[9]. These initiatives include opening up the railway market, introducing common standards in the EU and improving the interoperability between national railway networks.

Formulated in part two, goal is to become a single European integrated and efficient transport area in 2050. Aim is to create a competitive and user-friendly transport system. The system must be sustainable in the long term, starting with internalizing external costs. Public authorities have a clear role in promoting technical development and stimulation of every link in the innovation chain.

Part three consists of strategy proposals to achieve the goals and challenges formulated in part one and two. The commission proposes measures to establish a true European network. The development of Trans European Networks for Transportation (TEN-T), which started at the end of the 80's, is the backbone of European infrastructure transport planning. Constantly adapting to future needs, the program focuses on intermodal connections within Europe[10]. Another important measure is the removal of regulatory administrative and technical barriers. Information exchange across modes is one of the most important barriers in intermodal transport. The e-Freight[11] initiative is an example of simplification of administrative requirements for multimodal transport. The introduction of Intelligent Transport Systems has the potential to dramatically enhance the efficiency of the total European transport network. Per modality independent development of rules for dangerous cargo result in an accumulation of rules leading to complications and additional costs when using multimodal transport. Especially the maritime container transport, which is particularly suited to low-cost high-risk cargo, is experiencing a lot of trouble. Measures that remove barriers in the European network aim at cheaper and more efficient intermodal transport. The European Commission wants to internalize global (linked to fossil fuels) and local (air pollution, noise, congestion) externalities. It proposes to do this coordinating parallel with all other transport modes using a global market based

[8] A mailing to ESPO Members about the leaked Transport White Paper, a synopsis draft version, 29/11/2010

[9] Detailed information on the three packages is available under http://ec.europa.eu/transport/rail/index_en.htm

[10] Thorough interpretation of the TEN-T policy can be found in the Intermodal Yearbook 2010 published by the European Intermodal Association (EIA)

[11] Detailed information on e-Freight is available under http://www.efreightproject.eu/

instrument. It targets optimization of assets and the reduction of externalities resulting in an increasing competitive position of more sustainable transport modes.

Concluding, the European Commission will give economic incentives to intermodal freight and promote research & development and innovation in transport. They stress the importance of cooperation in research, the exchange of good practices and technical assistance for sustainable transport.

At national level in the Netherlands, the 'Rijksoverheid' defines the policy of the traffic and transport in the 'Nota Mobiliteit' (2004). Due to the unpredicted rapid growth in transport demand, the Rijksoverheid made an addition to the policy in 2008 and published 'Mobiliteits Aanpak'. Recognizing the faster growth, the government commits to earlier realization of required policy.

2.2 National Policy

National transport policy aims to process the most increasing traffic flows. A well-functioning multimodal transport system helps processing by providing higher flexibility and more choices for logistic companies. The functionality of this system depends on the ability of modalities to compete with each other. Similar to the EU policy, national policy focuses on the removal of barriers, on knowledge and innovation, and on the use of spatial planning of business areas where rail or waterways can be unlocked. However, the German Maut policy indicates that not all policies are successful, see box 1 for illustration.

Box 1 Case: The German 'Maut-policy'

In Germany, national policy developed a system to price road usage by Heavy Goods Vehicles (HGV). The government realized that a lot of foreign HGV-trucks cause high wear and tear on the roads in Germany. The polluter pay's principle is a basic motivator for the German 'Maut-policy'. It let HGV-trucks, the most intensive users, contribute to the infrastructure costs. The axel-weight of the truck and its emissions classification determines the height of the toll, where it applies to trucks weighing 12 tons or more. On average, the MAUT taxes 18 cents per kilometre travelled.

Tsamboulas et al. (2007) did an assessment of transport policy potential for modal shift on European scale. They pointed out that the Maut-policy is not harmonized across rail/terminal/port operations. In order to lift this barrier, they suggested to involve more actors by creating a harmonized pricing system for freight transport in de EU.

The EU did not realize a harmonized pricing system and the effects of the Maut-policy were mixed. Despite the foreign detours, some positive effects were the increase of leading emission technology trucks (Euro 5) from less than 1% to 37% and a decrease in highest emission technology trucks (Euro 2) by 33%. Also, distribution of cargo became more efficiently (Wieland, 2005; Thompson et al., 2010).

With respect to this research, the Maut-policy has not caused any noticeable increase in freight tariffs. And most importantly, it did not induce a modal shift. (Thompson et al., 2010)

Important to realize is that the Maut-policy only affects one actor within to the total transport chain. This small case illustrates that in order to provoke a modal shift, all actors of the total transport has to be involved.

Policy in the rail and short sea sector mainly focuses on the removal of barriers (physical and administrative). International rail corridors are crucial for the future of rail transport and require international cooperation of customs administrations, regulators, infrastructure managers and railway operators. Reducing terminal handling cost is one of the issues in the innovative programs for inland shipping and sustainable seaports. The government reserved 10 million euro in 2006 to encourage innovation in inland shipping.

2.3 Regional Policy

The national government is responsible for the main axes and other national infrastructure. In the province, municipalities are responsible for regional and local infrastructure. Traffic and transportation policy applicable to the port of Amsterdam is set out by the province of North Holland in the 'Provinciaal Verkeers en Vervoersplan' (2008) and in the 'Provinciaal Meerjarenprogramma Infrastructuur' (2011). Regional governments play a key role in determining conditions for spatial planning. They have the right to establish and alter the zoning plans of industrial sites suitable for access through multiple modalities. This will potentially increase the competitive position of rail and barge transport. Reactivation of old business sites can also be an option. However, this initiative lies primarily with the companies involved having explicitly stated the specific need for rail and / or water transport.

2.4 'Port Strategy Guide 2008 - 2020'

The municipality of Amsterdam and the port authority of Amsterdam co-developed a strategic sustainability guide for the port authority in the 'Havenvisie'[12]. It presents policies that stimulate sustainable development regarding 10 years to come (2008-2020). The 'Havenvisie' or 'Port Strategy Guide' describes the current situation and strategic objectives that should be realized in 2020.

The port authority of Amsterdam aims to evolve into a 'smart cargo hub' by reducing administrative burdens, increasing safety and develop knowledge. The 'Sustainability Innovation fund' (DIHA) is an important project of the 'Port Strategy Guide' regarding intermodal transport. Each year, this fund puts two million euro available to stimulate sustainable initiatives. Other more specific projects are the construction of rail infrastructure and realizing new intermodal shuttles with inland terminals. These actions are taken to affect the modal split, aiming for a decrease in road in favour of rail and water transport (respectively 53%, 43% and 4% in 2006 to 45%, 49% and 6% in 2020).

The 'Port Strategy Guide' has been developed with strong influence from higher governance levels. The guide incorporates and specifies the objectives of European and National policy fitting the situation in Amsterdam. It combines social objectives of the municipality (e.g. sustainability, environmental friendly, congestion, etc.) and business related objectives of the port authority as a firm (e.g. accessibility, improvement of competitive position, profits, etc.)

2.5 Concluding

Policy makers consider a modal shift as a necessity to cope with the economic growth in future scenarios. Important motives for the development of sustainable transport are accessibility, congestion, emissions, environment and competitive position. Sharing the same vision of intermodal

[12] The 'Havenvisie' can be downloaded at the website www.portofamsterdam.nl .

transport is very important in the transition to sustainable transport. The European Commission formulated global visions and goals which are top-down implemented into the 'Port Strategy Guide'.

Policy attempts to steer a modern society. Relevant firms are tempted to move into a certain direction by promotion, subsidies and grants. Usually, transport policy does not force developments but aim to stimulate and encourage a modal shift. The construction of infrastructure and the imposition of legal restrictions, the HGV-toll for example, are some exceptions of forced developments.

The European Commission proposes a number of subsidies available for new projects[13]. Plans for intermodal investments and subsidies are a trend that continues to lower levels of governance. Indeed, local authorities can use the subsidies of the European Commission and have the task to specify the projects regarding their area.

One can however conclude that there is a bottleneck in the translation of promotion and subsidies into specific concrete projects. Policy makers do not have enough expertise to specify objectives and transform plans into more concrete projects. This might be a reason for the insufficient implementation of policies. Policy can only play a significant role if it is based on good insights of the current situation. Specifying sustainable objectives into concrete projects requires expertise of the transport chain. Therefore, more information and knowhow of involved actors and their critical success factors is needed.

[13] In the past decade, the European Commission already funded multiple research projects that address intermodal transport. Some examples of such projects are: LOGIQ (2000), PROMOTIQ (2000), IQ (1997), RECORDIT (2001) and SULOGTRA (2001).

3. Literature Review

This chapter describes the studied theory relevant to this research. Some relevant prior studies will be discussed. First the relevance of this study will be pointed out in the second part of this chapter.

Research in intermodal freight transport has developed into a significant sector of the transportation studies. There is a distinction between two main themes in the theory about hinterland transportation that are highly related and often considered together. Some studies consider policy opportunities and its effectiveness (i.e. Rodrique & Notteboom, 2008b; Notteboom & Winkelmans, 2001; Roso et al., 2009) where other studies focus on the economic analysis of intermodal transport (i.e. Kreutzberger, 2003; Ricci & Black, 2005). But, most studies use both themes depending on the application (i.e. Blauwens et al., 2006; Tsamboulas et al., 2007; van der Horst & de Langen, 2008; Macharis et al., 2010). Basically, the economic analysis is used to support the studied policy measures. Bontekoning et al. (2004) reviewed the literature on intermodal transport in rail-truck freight transport until 2001. They conclude that a new applied research field is emerging in which they stress the importance of a multi-actor approach. Cooperation between actors is essential. Therefore, it is appropriate to add theory of innovation through alliances. See figure 1 below for a graphical presentation of relevant subjects found in literature.

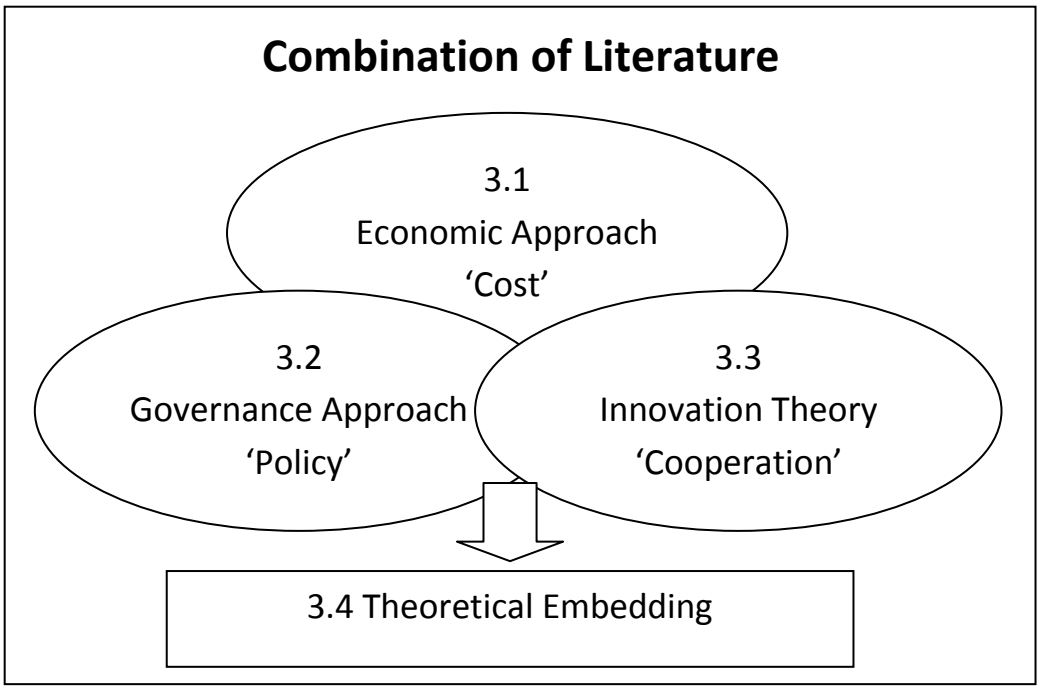

Figure 1: Combination of themes in literature.

3.1 (Cost-) Economic Approach

Literature describes various ways to analyze the economic aspects of intermodal transport in networks. Every method includes costs. Hence, costs can be examined from many different perspectives. All methods aim to provide a better understanding of the costs of multimodal transport.

Blauwens et al. (2006) used a business oriented approach when modelling the market for container transport. Their analysis also limits to hinterland transport chains and is based on an inventory-cost

framework. Specific attention is paid to the difference in inventory costs affected by the choice of transport mode. A shipper's choice for more expensive transport can be rationalized when inventory costs are significantly lower. Considering these costs, the effectiveness of policy measures aimed to trigger a modal shift to intermodal transportation was analyzed. Their analytical framework defines four main logistic parameters of transport to calculate the market share of transport modalities: transportation costs, loading capacity, average lead-time and variance of lead-time. Blauwens et al. (2006) also stress the importance of the shipper's logistical requirements. These are qualitative requirements which largely depend on the characteristics of the actual goods and impose demands on the used modality. Besides the four main logistic parameters of transport, the framework uses six flow properties to determine the total logistics costs for the shipper. These flow properties are annual volume, average daily demand, variance of daily demand, value of the goods, holding cost and a safety factor. Now using all parameters, the total logistics cost of the shipper consists of the transport costs and inventory related costs. This approach incorporates the cost of having a large inventory in cycle, the cost of inventory in transit and the risks involved with variable demand. Blauwens et al. 2006 used the total logistics costs to calculate the market share of different transport modalities in a hypothetical hinterland transport market. After determining the market shares, they analysed the impact of an increase in road transportation cost, of a decrease in combined transport's lead-time and of a decrease in rail transportation cost. Blauwens et al. (2006) concluded that a combination of policies can induce a modal shift. Main limitation of the inventory cost approach is that the analysis mainly focuses on the shippers and ignores the organizational structure of the different actors in the transport chain. However, their framework does provide useful insights in the main logistic characteristics of transport and illustrate that one should also consider the characteristics of the flow of goods. Their analysis illustrates that time and costs are important elements.

In the Netherlands, Rijkswaterstaat started in 1998 a large research called 'Economic Effects Research Infrastructure" (OEEI) and developed a method of applying Cost-Benefit Analysis (CBA) in the selection procedure of transport investments. The result was the 'OEEI' guideline (Eijgenraam et al., 2000), an applied welfare analysis. Ongoing, Rijkswaterstaat developed 'Overzicht effecten infrastructuur' (OEI), which is required by law when starting a regular MIT-project (Meerjarenprogramma Infrastructuur en Transport). The OEI-guideline uses very thorough social cost-benefit analysis to measure the overall social effect of a transport project. Given the scale of this study, a social cost benefit analysis is nearly impossible. Moreover, the OEI method is difficult to apply because a port authority has no decisive power over selection of projects, as it can only attempt to influence or steer (more over the instruments of the port authority in chapter 4.4).

Cost-Benefit Analysis (CBA) is not an undisputable method. The approximation of qualitative effects is one of the major criticisms to CBA. CBA monetizes every effect but monetizing limits to costs and fails to evaluate qualitative competencies. Moreover, CBA assumes perfect substitutability of effects. In perspective of this study, qualitative decision factors, like frequency, reliability or convenience, are difficult to monetize. Similar to CBA, a Cost-Effectiveness Analysis (CEA; Belli et al., 2001) is also part of the obligatory OEI-guideline. CEA is thoroughly researched in the healthcare sector (Garber & Phelps, 1997) to approximate qualitative benefits, for example in gain of extra live years. CEA could provide insights into the total cost-effectiveness of a hinterland chain.

European Commission DG Regional Policy (2008) describes the cost-effectiveness analysis in the "Guide to Cost-Benefit Analysis of Investment Projects". CEA is an appraisal technique calculating the cost per unit of 'none monetized' benefit. It is the business analysis of the effect in a cost-benefit analysis. The proper way to compare projects is based on incremental cost-effectiveness ratios. A cost-effectiveness ratio (R) can be displayed in the following formula:

Source: European Commission DG Regional Policy (2008)

Now project *a* can be compared to project *b* in terms of costs (C) and effectiveness (E). The above formula defines the incremental cost per unit of additional outcome. If project *a* is both less costly and more effective than project *b*, then project *a* dominates project *b*.

Generally, CEA solves optimization problems when deciding how to allocate resources. Given a fixed level of budget or effectiveness, choices will be made to maximize effectiveness or minimize costs. CEA is partly applicable because of the monetary aspect of the costs and the qualitative aspect of the benefits. But, CEA is a tool, generally used to compare projects with only a single dimension of effectiveness. This limits the applicability of this method. Most transport projects have effects that contain multiple dimensions. The hardest challenge will be manipulating the CEA for simultaneous approach of multiple actors. Eventually, all effectiveness measures should be aggregated to the level of the total hinterland transport chain.

Panayides (2002) studied the best way for firms to approach the organizational structure of intermodal transport, starting with transaction-cost economics. Transaction cost theory, thoroughly described by Williamson (1975), mainly considers the economic interaction between two actors. Transaction costs are costs that firms have to make when establishing and monitoring a transaction. The level of transaction costs depend on three critical elements of transactions, namely uncertainty, asset specificity and frequency. A high uncertainty about the other actor (true information, competence, reliability etc.) as well as the complexity of the asset in question results in high transaction costs. However, a transport chain consists of many actors. Hence, additional economic elements are needed. Panayides recognized the lack of attention for inter-organizational coordination and integration. He concluded that the organizational structure of intermodal transport also depends on product costs and strategic considerations. He presented an analytical framework, firmly grounded in transaction cost economics, to analyse strategic decisions considering cooperation with other firms in the transport chain. He states that practitioners must achieve an economically efficient governance structure that minimizes the costs of transaction and production without compromising the strategic direction of the firm. His results stress the importance of cooperation in the transport chain and indicate that vertical integration may provide the competitive advantage in intermodal transport. A vertically integrated governance structure would significantly minimize the transaction costs considerably but raises the barriers to enter and eventually may lead to excessive market power. It remains difficult to actually determine the transaction cost, especially considering the additional elements. Panayides' (2002) study does not provide an empirical analysis to test his framework. Given the limitations, the framework of Panayides will have little contribution to this thesis. However, a vertically integrated governance structure will prove to be important.

Cost-economic literature often focuses on one particular actor and pays little attention to the interactions in the total chain. There are several difficulties using the cost econometric approach due to the difficulties of obtaining and determining cost-related data. The use of a qualitative approach might be more beneficial and applicable to intermodal transport research. A governance approach is more suitable to explain the interactions between multiple actors. The port authority is a governmental body which aims to influence the interaction between the multiple actors in the hinterland chain. However, the cost element cannot be ignored as the container transport market is all about low-cost services.

3.2 Governance Approach

Other authors mainly focus on the effectiveness of policy and use economic theory to support the analyses.

Van der Horst and de Langen (2008) performed a study on coordination in hinterland chains. Their research highly focused on the existence of multiple actors in the hinterland chain. They state that, in general, cooperation problems arise due to an imbalance between costs and benefits, strategic considerations, unwillingness to invest and risk-averse behaviour. These problems are specified in truck, rail and barge transport, considering all relevant actors in the hinterland chain. The most important coordination problems and involved actors in the hinterland transport chain are described in table 1. These problems occurred in the port of Rotterdam and are expected to be experienced in other relevant ports.

Coordination problem	**Actors involved**
Insufficient information exchange of container data causes limited planning	Container shipping line, container terminal operating company, logistic service provider, trucking company, barge operator, rail operator
Investments in hinterland terminals do not arise from itself	Logistic service provider, rail terminal operator hinterland, barge operator hinterland
Introducing new hinterland services requires a basic volume, however cargo controlling' parties do not commit to new services of other transport providers	Logistic service provider, shipper, container shipping line
Insufficient planning on transporting and storing empty containers	Container terminal operating company, rail terminal operator in hinterland, barge terminal operator in hinterland, container shipping line
Coordination problems related to Custom clearance of a container. Limited planning and information on customs declarations. Physical and administrative inspections causes delay	Logistic service provider, Customs, shipper, trucking company, barge operator, rail operator, Inspection services

Table 1: General coordination problems in hinterland chains. Source; van der Horst and de Langen (2008).

The most prominent problem is the insufficient exchange of data and information between actors in the hinterland chain. This illustrates the importance of synchromodal transport, already mentioned in chapter one. Another severe problem is the lack of commitment of transport companies regarding new services. The handling of empty containers also causes difficulties. They have to be transported back to their owners, most often container shipping lines. Empty container movements are costly

and are the consequence of inefficient planning[14]. The last set of coordination problems concerns customs clearance, which largely depend on lacking data exchanges and the availability of information. To cope with these problems, Van der Horst and de Langen (2008) introduced four main categories of actions to stimulate intermodal transport, presented in table 2. These actions are based on transaction costs and institutional economics.

Main category	**Possible coordination arrangements**
Introduction of incentives	Bonus, penalty, tariff differentiation, warranty, auction of capacity, deposit arrangement, tariff linked with cost drivers
Creation of an inter-firm alliance	Subcontracting, horizontal integration, project specific contract, standardized procedures, standards for quality and service, formalized procedures, offer a joint product, joint capacity pool
Changing scope	Risk-bearing commitment, vertical integration, vertical (dis-)integration, introduction of an agent, introduction of a chain manager, introduction of an auctioneer, introduction of a new market
Creating collective action	Public governance by a government or a port authority, public-private cooperation, branch association, ICT-system for a sector of industry

Table 2: Four types of solutions to solve coordination problems. Source; van der Horst and de Langen (2008).

The first type of solutions aims to influence the behaviour of actors by giving incentives. The second and third types of solutions mostly involve horizontal and vertical integration between actors of the hinterland chain. The creations of inter-firm alliances stress the importance of cooperation. The fourth type of solutions represents an external intervention by (governmental) institutions. This research is focused on the possibilities for the port authority to induce intermodal transport. It is difficult for a port authority to force collaboration. The first and fourth types of solutions are particularly suitable for a port authority. More specific explanation on the available instruments of a port authority can be found in chapter 4.4. The study of van der Horst and de Langen properly analyzed the cooperation between multiple actors in the hinterland transport chain.

Recently, Macharis, de Witte and Ampe (2009) studied a multi-actor approach for the evaluation of transport projects. A multi-actor approach started to become more important due to complexity in transport chains (Bontekoning et al., 2004). Macharis et al. (2009) indicate that a multi-actor multi-criteria analysis (MACMA) is an adequate examination of the economic effects of transport projects. The MACMA method focuses on quantitative as well as qualitative criteria, defined by multiple stakeholders. This stresses the importance of a stakeholder analysis preliminary to the determination of criteria, indicators and measurement methods. Who are the important actors involved? This analytical framework approaches the objectives of the relevant stakeholders by making them explicit. It illustrates the tradeoffs between quantitative and qualitative criteria. This leads to a better understanding of the stakeholders during the decision making process. Macharis et al. (2010) present an application of the method in Belgium (the choice for location of intermodal terminals using the

[14] Estimation consultants estimate that empty container movements may have a share of 40% of all transported containers.

LAMBIT-model[15]) and showed the applicability to innovative intermodal projects. They concluded that involvement of relevant actors into the analysis is time consuming but improves the acceptance of the proposed solution in the end. The study or analysis will be ignored by concerned actors if their interests are disregarded.

Frémont and Franc (2010) also recognized the importance of multiple actors in ports and identified three groups of stakeholders before analyzing the hinterland chain, namely economic agents, public authorities and community groups. After identifying the actors they state that "*the various port stakeholders are all concerned about three issues promoting the use of combined transport: cost, traffic flow and the environment."* The relevant actors and the three concerned shared issues are presented in table 3.

	Costs	**Traffic flow**	**The environment**
Economic agents			
Shippers	Reducing inland transport prices	Need for reliable transport chains	Showing interest in taking into account sustainable development
Shipping lines	Competing with other transport organizers to attract freight from shippers	Offering reliable transport chains	
Logistic service providers		Offering reliable transport chains	Anticipating a possible inclusion of environmental costs in transport costs
Operators	Same as above if the operator also is a transport organizer	Reliability of the involved operations	
Public authorities			
Port management	Interport competition	Interport competition	Promoting a sustainable development
National, regional and municipal governments	Economic development and jobs	Regional planning	
Public opinion			
Community groups	Same as above	Low tolerance for environmental externalities NIMBY[16] syndrome	

Table 3: The benefits of combined transport for different stakeholders. Source; Frémont and Franc (2010).

The economic agents (actors of the hinterland chain) presented in table 3 share quite similar issues, all concerning cost and reliability of transport services. Frémont and Franc (2010) performed a case study in the port of Le Havre and collected pricing data of two competing modes (inland waterway transport and truck). The analysis paid much attention to the way container transport is organized. There are several organizational strategies for the movement of full and empty containers, considering empty depots and one way- or roundtrips. They concluded that intermodal transport can compete with road transport in terms of costs. But, the organizational structure must be taken into account in order to determine the competitiveness of intermodal transport. The case study of Le Havre also provided other relevant results. In this particular case, several major shipping lines are involved in providing the hinterland transport. Their large scale and governance structure (owner of

[15] The LAMBIT-model stands for Location Analysis Model for Belgian Intermodal Terminals. It is a GIS based model and provides a framework for determining the location of new intermodal terminals. See Macharis et al. (2010) for a practical application of the LAMBIT-model. They compare policy measures that internalize the external cost of transport with the effect of fuel price increases. The model enables a visualization of the impact on the market share of intermodal transport. The LAMBIT-model is an application of the MAMCA methodology in the geographical context of intermodal terminals.

[16] NIMBY syndrome stands for the well known Not In My BackYard syndrome. The NIMBY syndrome defines a selfish way of thinking; everything is fine except that which the consequences affect me.

every actor in the chain) make them able to offer intermodal transport services against competitive prizes. These results confirm the conclusions of Panayides (2002), who stated that a vertically integrated governance structure may induce the competitiveness of intermodal transport. Frémont and Franc (2010) concluded that competitive prices are not enough to encourage intermodal transport. Additional services, like additional dwelling times and specific custom advantages, are needed to induce a modal shift. They state that the factor time must become 'an asset of the first order', meaning flexibility in supply chain management. Offering these services requires involvement in the total hinterland chain, which implies intensive cooperation between actors.

Above literature illustrate the organizational importance of intermodal transport. Coordination between multiple actors becomes important. It is necessary to involve relevant actors and emphasize cooperation.

3.3 Innovation and Cooperation

Individual actors in the container transport market often do not have sufficient volumes to start intermodal initiatives. Cooperation between actors is essential and it is therefore appropriate to use theory on innovation through alliances. This study distinguishes between two levels of governance, the level of the firm and a higher level of governance, the port authority.

Tidd et al. (2005) describe the necessity of cooperation by innovation through alliances. Like Panayides (2002), Tidd et al. (2005) distinguish criteria deciding when to cooperate; transaction costs and strategic considerations. The coordination problems defined by van der Horst and de Langen (2008) are practical specifications of these criteria in the hinterland transport chain. In the theory of innovation through alliances, transaction costs focus on short-term trade-offs between in-house development and external mechanisms. Strategic considerations focus on longer-term possibilities for acquiring new organizational, market or technological competencies. Tidd et al. (2005) explain cooperation by combining these two concepts into one framework. However, this framework only considers two firms, which is not sufficient to explain cooperation in a multi-actor hinterland chain. A hinterland chain consists of multiple actors with individual goals, priorities and dominant practices. One can characterize the system of hinterland chains as a socio-technical regime[17] (Rip and Kemp, 1998; Geels, 2002). At the level of the port authority, inter-firm relationships in the hinterland chain become very complex due to the multi-actor property.

Kemp and Rotmans (2004) realized this complexity and introduce transition management theory (2004). They aimed to: "*influence the direction and speed of a transition through various types of steering*" (Kemp and Rotmans, 2004). Transition management can be applied from the view of the port authority and their ability to steer. Transition management is not a strategy of forced

[17] A socio-technical regime is a relatively stable configuration of institutions with dominant practices, techniques, artefacts, rules and networks that by ensuing logic determine the 'normal' decision-making. It is useful to use the multi-level perspective of the same authors when analyzing a socio-technical regime. This perspective makes a distinction between niches, regimes and socio-technical landscapes. Economists would address these levels as micro-, meso- and macro-levels.
The regimes refer to the dominant practices, rules and ensuing decision-making at the heart of the market. The niches (lower level) are little sub-markets where one can experiment with new technologies, practices and rules. The overall setting (higher level) is characterized as the socio-technical landscape and consists of social values and policies. Transition management can be seen as processes of structural change which are the outcome of the interaction of multi-level processes. (Rip & Kemp, 1998; Geels, 2002)

development but "*uses bottom-up initiatives and business ideas of alternative systems offering sustainability benefits besides user benefits*" (Kemp and Rotmans, 2004). It is based on both system improvement (improvement of existing trajectory) and system innovation (a whole new trajectory or transformation). The aim of transition management is to deal with complex societal problems by using long-term envisioning and short-term projects that support policy integration, social innovation and social learning. When analyzing the hinterland chain, the theory of transition management is very applicable considering one particular element: "*thinking in terms of more than one domain (multi –domain) and different scale levels (multi-level); how developments in one domain (level) gel with developments in other domains (levels); trying to change the strategic orientation of regime actors*" (Kemp and Rotmans, 2004).

Figure 2 illustrates the four main activities of transition management. Transition policy starts with the establishment of formulating goals and the development of a transition arena. "*Government has a task not just in the set-up of a transition arena but also in the facilitation of interactions within the transition-arena, not just in process-terms but also in terms of substance.*" (Kemp & Rotmans, 2004) The transition arena is a tool to structure, organize and coordinate problems by enabling social learning, developing shared visions and agendas between all innovative actors.

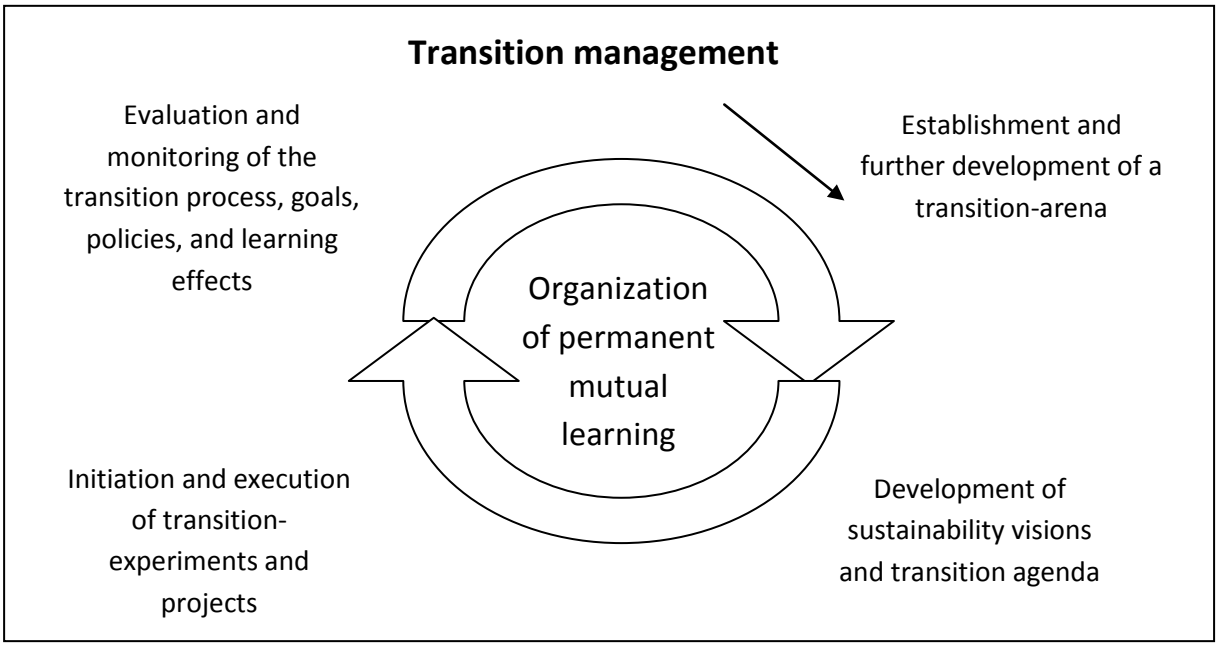

Figure 2: Activities of the cycle of transition management, Source: Kemp and Rotmans (2004).

All arena participants bring their own agenda into the transition-arena. A transition-agenda is a joint action program for implementing innovations. It translates long-term objectives into short-term actions. Developing shared visions and building joint action agendas are typical top-down elements. Visions have the primary function of mobilizing efforts, resources, ideas and notions of actors involved in the transition arena (van den Bergh & Bruinsma, 2008). Naturally, after planning, initiation and execution of the transition program follows. Important elements are transition experiments designed to learn. Niches, like a particular intermodal transport chain, can play an important role in strategic transition experiments. The fourth activity regards evaluating and monitoring the developments during the transition process. The alliances between the different

arena actors must be monitored. And, where needed, being a mediator when coordinating alliances. Another important activity is the evaluation of executed projects.

The four activities of transition management are performed by using three types of economic coordination, namely markets, hierarchy (e.g. planning and control policies) and institutional coordination. It uses markets by relying on rational decisions of actors regarding products and services. It also uses authorities by formulating indicative planning that consists of transition and policy objectives. New and old institutions are useful to coordinate the transition process. They can perform functions like introducing new policy, transition agendas and goals, fostering of networks and determining decision making responsibilities.

Transition management theory stresses the importance of mutual learning during the whole process. The transition is not a deterministic process but institutions and stakeholders jointly determine objectives. Innovations are developed by arena participants during experimental projects (bottom-up initiatives). Cooperation between arena-actors (alliances) and development of shared visions of sustainability are central aspects. Firms in the arena that share the same vision of sustainable transport are more likely to cooperate and form alliances. However, innovation theory also tells us that the degree of cooperation is constraint by the nature of the technologies and markets, and especially the degree of complexity and tacitness[18]. This can be confirmed by transaction cost economics (Williamson, 1975). A transition to more sustainable container transport will be challenging. The market is very complex, lacks transparency and actors maintain relatively much tacit knowledge.

The approach used in transition management has been criticized by Berkhout et al. (2004). They state that the theory relies too much on bottom-up initiatives. The high expectance of solutions emerging from niche management is another comment on the model. Solutions often are niche specific. Hence, it is very difficult to apply niche solutions throughout the entire market. In contrast, van den Bergh and Bruinsma (2008) argue that the conceptual strength of transition management lies in the combination of both bottom-up, as well as, top-down elements.

Transition management theory is an indispensable framework when trying to model complex system innovations. Besides transport related themes, transition management theory has been used to approach other areas like agriculture and the use of natural resources. Van den Bergh and Bruinsma (2008) successfully used transition management theory to interpret the transition to renewable energy in the Netherlands (See box 2 for illustration).

[18] Tacit knowledge is very difficult to transfer and almost impossible to write down. Effective transfer of tacit knowledge generally requires intensive personal contact and trust.

Box 2 Case: The transition to renewable energy in the Dutch energy sector

The energy sector has to cope with major sustainability problems concerning pollution (CO_2, SO_2 and NO_x emissions) and dependency to natural resources. Van den Bergh and Bruinsma (2008) examined the developments during the last century in the energy sector by using transition management theory.

In the period of 1900 to 1960, a stable energy regime emerged based on the consumption of coal. The national government was positioned outside the energy regime without control or influential power over the energy market. There was no policy in effect within the energy sector and users were not able to exert direct influence. The actors producing the power also distributed the energy and controlled the total market.

From 1960 to 1973, perceptions and goals changed. In this period, large supplies of natural gas were found beneath Groningen. The national government created a public-private national monopoly (Gasunie) to exploit the gas. This enabled the national government to influence the energy market. The national government ensured a more controlling role and began to pressure for efficiency. With the introduction of gas, industrial co-generation was implemented. This made co-generation of heat and power (CHP) possible.

In the period of 1973 to 1989, the government started with direct interventions. The increasing societal concerns about environmental pollution caused the government to develop the first Energy White Paper. The Energy White Paper introduced issues like harmful emissions, thermal water pollution and safety risks. The government became part of the energy regime, trying to influence goals, objectives and agendas. During this period, landscape developments, like the recession in the 1980s, severely influenced the energy sector. The government forced the CHP's to connect their power production to the national grid without extra compensation. The former power producing actors lost even more market power.

From 1989 to 2004, a new actor was introduced, initiating the biggest change in the energy sector. The national government forced the separation of the production and distribution of electricity to enhance the efficiency of the energy market. It introduced the energy distribution company (EDC), a new actor in the energy regime, to facilitate the households. The power of the EDCs in the energy regime made the transition to renewable energy possible. Finally the government withdrew from the energy regime and created another actor to supervise the distribution to industrial users. Finally, the EDCs were privatized, introducing a healthy market mechanism that enhanced the quality and efficiency of the energy sector.

The introduction of new actors in combination with liberalization of the market enhanced the quality and efficiency of the energy sector. Guiding principles have been changed, actors have been introduced, technical innovations have been implemented and the market structure has been reformed. This case illustrates the capacity of transition management. It modelled a complex system change with different actors, involving organizational and technical innovations.

Source: Van den Bergh and Bruinsma (2008).

3.4 Concluding

After studying the literature, one can conclude that research mainly focuses on one or two actors when determining the cost of intermodal transport. Most studies conclude, with a lot of comments, that intermodal transport *can* be less expensive and more desirable. However, large scale implementation does not happen. Studies have tried to make decisive factors visible through business related cost economics. But, these studies do not provide an adequate qualitative approach. Explaining the different forces in a transport chain is difficult. Literature on policy measures often uses institutional economics and incorporates cooperation between multiple actors. Including multiple actors becomes important.

Assessment of investment projects in transportation always includes a cost element. The European Commission (2008) provides a suitable analysis through cost and effectiveness. However, the parameter effectiveness must be definable, which proved to be a difficult task. Macharis et al. (2009) and Frémont and Franc (2010) stress the importance of multiple stakeholders and introduce a stakeholder analysis. Van der Horst and de Langen (2008) also emphasize the multiple actors in the hinterland chain. They define coordination problems using a more governance approach.

This thesis aims to be a contribution to current literature by examining the costs and effectiveness of each actor in the hinterland chain. The research is conducted from the point of view of the port authority. Then, the focus shifts from the individual actor to the aggregate cost and effectiveness of the hinterland chain. Often, individual actors justify decisions based on optimizing their own part of the transport chain. Individual optimization often results in a less optimal effectiveness of the total hinterland chain. Operations within the transport chain require good coordination between relevant actors; cooperation is inevitable (van der Horst and de Langen, 2008). The necessity of cooperation in the hinterland chain is supported by theory on innovation through alliances (Tidd et al., 2005) and transition management theory (Kemp & Rotmans, 2004; Bergh & Bruinsma, 2008). These innovation theories can be used by a port authority to coordinate the development of more effective intermodal transport.

The combination of cost, governance and innovation theories defines the theoretical embedding of this thesis (illustrated in figure 1). The most relevant elements of the described theories are used to analyse the hinterland chain. The next chapter formulates the analytical framework based on the above presented theories.

4. Analytical Framework

There is quite a lot of theory available on intermodal transport. But, narrowed down to a multi-actor approach into a hinterland chain, literature becomes scarce. This chapter shapes the reviewed literature into an analytical framework. First, it is useful to put all the used theory into perspective, explaining the function and position of each theory. Figure 3 below gives a brief interpretation of used literature and puts all elements in an analytical framework. The black box represents the analysis of combining the multi-actor effectiveness analysis with transition management theory using available instruments. The analysis is presented in chapter 8 and results into port transition management. Port transition management aims to answer the main research question.

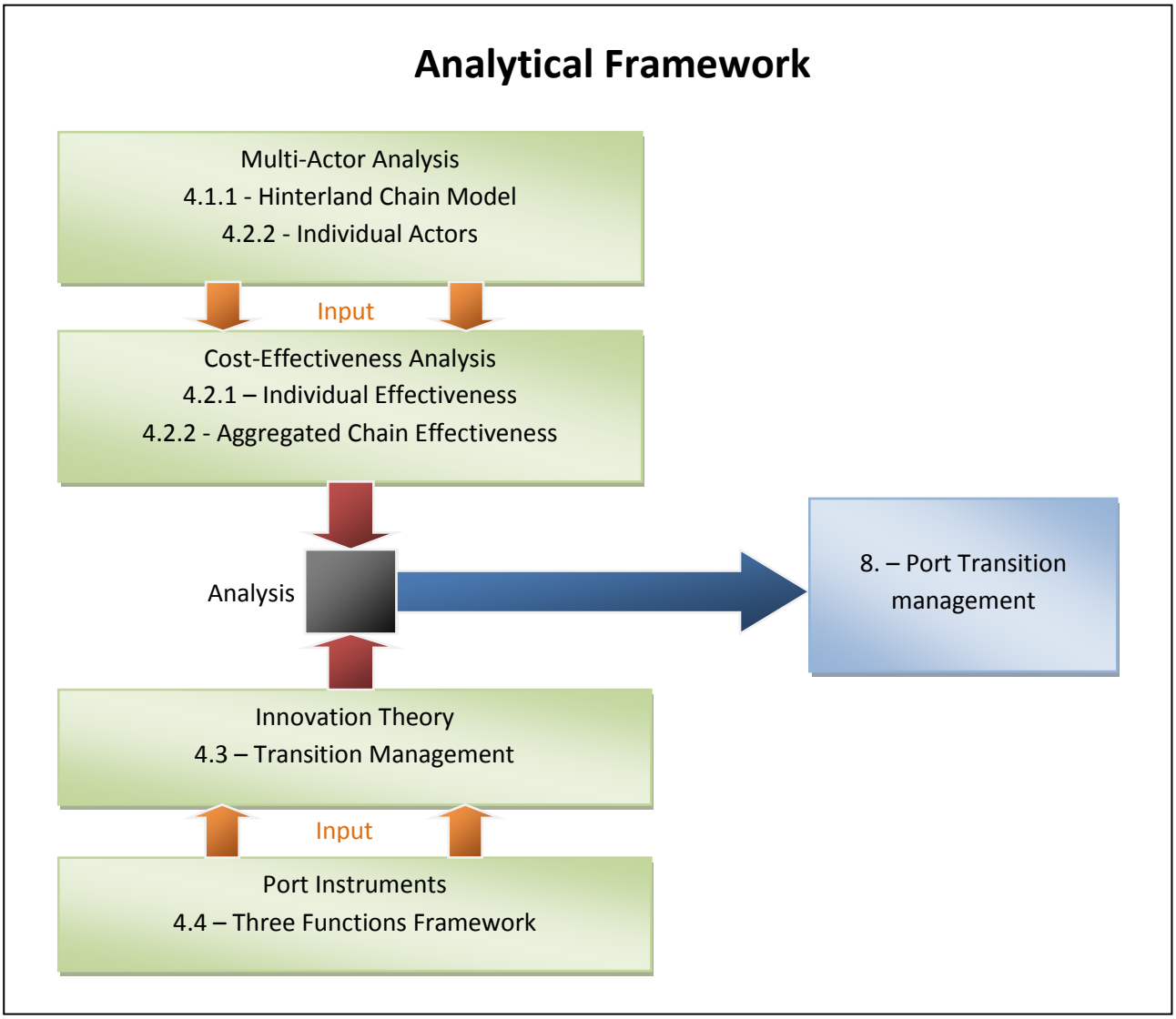

Figure 3: Analytical framework.

4.1 Multi-Actor Hinterland Chain

This section will answer the first sub-question: Who are the important actors of a hinterland chain and how can they be properly displayed into a multi-actor hinterland chain model?

A crucial element for successful implementation of policy is including all relevant actors into the decision making process. The study or analysis will be ignored by involved actors if they disregard their interests (Macharis et al., 2009). A multi-actor approach is an emerging research field in transportation studies (Bontekoning et al., 2004). This implies explicit introduction of stakeholders into the analysis due to the multi-actor characteristic of the hinterland chain. Frémont and Franc (2010) defined all relevant port stakeholders in table 3. For now, this study only considers their defined economic agents because they represent the market of the hinterland transport chain. After the market research, transition management theory will be applied from the view of the port authority, taking the authority as stakeholder into account. The community groups are omitted in this study as they do not contribute to the modelling of the hinterland chain. The hinterland chain model is a visual representation of door-to-door transport.

4.1.1 The Model

The roots of container traffic lie in maritime flows of goods. This study uses a basic form of the model of van der Horst and de Langen (2008) with a few adaptations to simplify the model. First, please note that this study only examines the hinterland part of a maritime transport chain. Second, the studies of Frémont and Franc (2010) and van der Horst and de Langen (2008) are used to identify only the most important actors.

A hinterland chain always starts at the container terminal in the sea-port. Depending on import or export, full containers are transported to the consignee, or empty containers are transported to the shipper. When unloading/loading is done, containers will be transported back to the port. Thus, a container always makes a roundtrip. Generally, containers are transported back to the terminal where the carrier in question calls. This terminal can differ from the initial terminal and can be in a different port. Some containers can be returned to inland terminals where the owner of the container has a depot. This model assumes that containers are always transported back to the port of call to preserve the simplicity. The effects of return cargo and the imbalance between import and export are not addressed. In practice, container owners want their equipment back as soon as possible before sending it to the next costumer[19]. Each roundtrip includes a full and an empty leg, where an empty leg sometimes starts or ends at an inland depot. Thus, inland empty depots reduce the amount of empty container transport.

Figure 4 illustrates the hinterland chain and its different actors[20]. The red boxes illustrate the most important actors in the hinterland transport chain and the black arrows define contractual relationships. The model illustrates the complexity of intermodal chains, especially because the model is a simplistic view of the actual market. Panayides (2002) and van der Horst and de Langen

[19] This is usually done for inspection purposes. Container owners want to know whether the container is still intact and undamaged for the next customer. Otherwise, if the container has been handled by two customers, damage may never be recovered.

[20] Considering a continental case, the chain starts at the shipper using an extra road haulage actor to transport the containers to the port terminal. When integrating this into the model, the shipper should be located at the left of the port terminal with the additional road haulage actor in between.

(2008) illustrated that vertical and horizontal integration may improve the efficiency of transport chains. In practice, actors in the hinterland chain can be vertically and horizontally integrated. Being a logistic service provider and operator for example, or owning a terminal as operator. Contractual relationships are difficult to model, especially regarding the mixed interest of horizontal and vertical integrated parties. The importance of the shipper (or consignee) is illustrated by Blauwens et al. (2006) and displayed by the blue boxes.

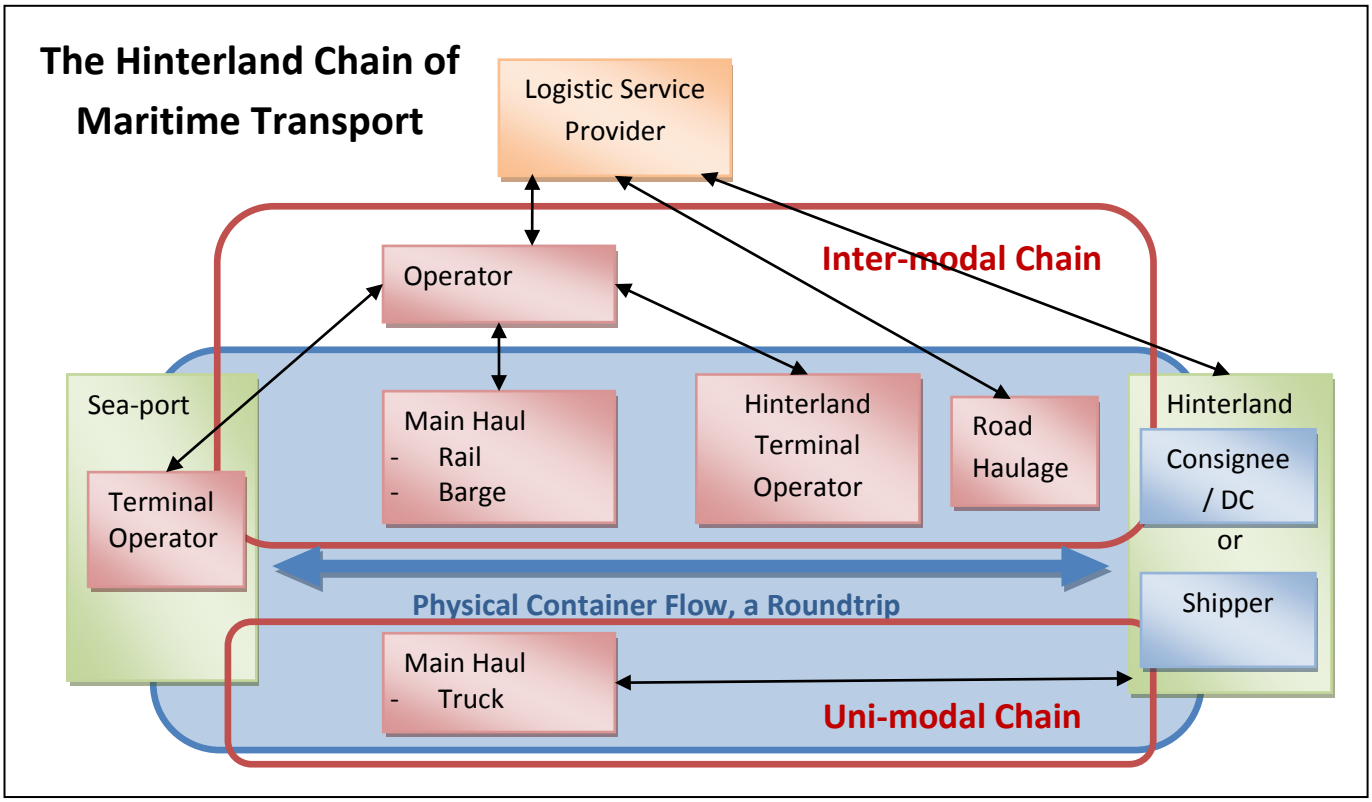

Figure 4: Actors in the hinterland chain, Source; model based on van der Horst and de Langen (2008).

4.1.2 Actors

This section discusses the stakeholder analysis. Only the most important actors are included into the model.

Shipper/ Consignee

A transport flow starts with a *shipper* who produces cargo which has to be transported to the *consignee*. Most shippers will mainly focus on their core business and contract one or several *logistics service providers* to cope with the transport. It is important that the container will be delivered at the right place at the right time and in the right condition. Shippers have logistical requirements which largely depend on the characteristics of the actual goods and impose demands on the used modality.

Logistic Service Provider

A *shipper* can choose to outsource his transport to a party who may, or may not, use multiple modalities. This study defines the *logistic service provider* as the actor that controls and monitors a transport chain. The role of the logistic service provider can be fulfilled by different types of firms,

often a party active in the chain. The intermodal transport market shows three dominant types of firms that compete for the role of logistic service provider. Hinterland transport can be governed by the shipping line (Carrier-Haulage) or by a party that acts for the shipper (Merchant-Haulage). But, recent developments have shown that a third actor has entered the market, namely the terminal (Notteboom & Rodrique, 2008b). Basically, a logistic service provider offers a transportation possibility to the shipper. The shipper, or consignee, can also choose for uni-modal transport by contracting a trucking company who transports containers directly from the sea-port terminal to the destination.

Intermodal Operator

An *intermodal operator* offers a service between two terminals that can be used by *logistic service providers*. There are two different intermodal operators, rail and barge operators. Basically, an intermodal operator commutes between two terminals. The *rail operator* operates according to a fixed timetable. A *barge operator* is more flexible. Depending on the main haulage, traction (pulling unit), wagon sets or barges are acquired by contracting a *carrier* for the main haul. Only a few operators are in the possession of own equipment.

Terminal Operator

This is the operator of the container terminal. The terminal operator handles the transhipment of containers between modalities. Because of tide schedules, the terminal operator must be timely informed of arriving and departing trains and barges that are booked by the *intermodal operator*. The terminal operator also deals with customs.

Main Haulage / Carrier

The *carrier* owns the physical transportation units and provides them to the *intermodal operator*. The occupancy is of no interest for the carrier. He will send his train or barge anyways. Important criteria for an intermodal operator are the reliability, performance and delivery of goods at an attractive price.

Road Haulage

The *road haulage* is the transport by truck from and to a terminal to provide door-to-door transport. Depending on the type of country, *logistic service providers* often use local partners for pre and end haulage.

4.2 Multi-Actor Cost-Effectiveness Analysis

After the stakeholder analysis, the focus shifts to modelling the entire chain. The costs of hinterland transport are a substantial part of the total transportation costs. They occasionally exceed the maritime cost and most bottlenecks are found in the hinterland part of the transport chain. The social cost-benefit analysis is standard practice evaluating transport projects (OEI-guideline). However, this method is not suitable when evaluating the costs and benefits in a transport chain. Narrowing down to the hinterland chain, global effects on society are of less importance. Innovations are cost oriented, but actors clearly indicate[21] that non-monetary benefits are equally important. Benefits in a transport chain like convenience, frequency, time schedule, reliability, punctuality and number of peaks differs per actor. Aggregating to the level of the port authority, the effectiveness of

[21] By means of interviews

the total hinterland chain has other benefits like efficiency, competitive position, accessibility, modal shift and other unique selling points.

4.2.1 Individual Effectiveness

Before analyzing the entire chain, individual actors are studied in more detail. The cost-effectiveness analysis described in the guide of the European Commission DG Regional Policy (2008) is used as starting point to approach the individual actors. Generally, cost-effectiveness analysis solves an optimization problem with a goal not measurable in monetary terms. Every actor has its own cost-structure and investment opportunities. An actor will decide to invest in the business case with the best cost-effectiveness ratio. Interpreting a changing cost-effectiveness ratio requires less data. This study will focus on the ratio of the cost per twenty equivalent unit (TEU) per unit of outcome, presented in the formula beneath.

The determination of one effectiveness parameter for all involved actors proved to be a difficult process. Interviews with market experts of the port of Amsterdam indicate that all actors give a high priority on cost and reliability. The study of Frémont and Franc (2010) confirm that the cost and reliability are important to the economic agents (see table 3 for illustration). Blauwens et al. (2006) focused on the shipper, but also characterized the transport modes. They defined the parameters cost, lead time and variable time as three of the four main characteristics of transportation modes. The fourth factor, loading capacity, is cancelled because this factor is not relevant to every actor in the hinterland chain. Most actors are not concerned with the good's characteristics and mainly focus on the transport services. Nonetheless, time is important to all actors in the hinterland chain; less variable time means a higher reliability and thus a higher effectiveness. The reliability is used to determine the effectiveness parameter in the cost -effectiveness ratio. Specific knowledge about the estimated time of arrival is important, the estimation must be precise[22]. The method used to determine the reliability in the cost effectiveness ratio is presented in chapter 5.

As mentioned in the stakeholder analysis, shippers also have other logistical requirements besides cost and reliability. Other qualitative criteria, considered in decision making, will be specified during the market research (chapter 6.3). It is not possible to incorporate these other criteria into the effectiveness of the total chain. But, these criteria are equally important when formulating policy.

4.2.2 Aggregated Chain Effectiveness

The effectiveness of the total chain is the aggregate of all individual effectiveness measures. In practice, investment opportunities can be beneficial for the total chain but un-economic for the individual actor. Van der Horst and de Langen (2008) explained a number of reasons why actors in the hinterland chain often choose to only optimize their own business (see chapter 3). An individual business case could be negative in terms of individual cost-effectiveness but positive in terms of total chain effectiveness. Cost-effectiveness analyses become relevant when evaluating investment opportunities.

[22] Note that most maritime containers have been on the open sea for three weeks. The impact of an additional fixed time due to a slower hinterland transport mode is therefore relatively small. However, it is important to reduce the variable time as much as possible.

The aggregate chain effectiveness in the presented formula is essentially the sum of all individual cost-effectiveness ratios. It is the fraction of the total chain cost per TEU divided by the reliability of the entire chain.

The port authority has interests in optimization of the total chain effectiveness. The next section discusses a theory describing how to influence individual investment decisions, aiming for optimization of the aggregate chain effectiveness.

4.3 Transition Management

This is a brief section about the innovation theory used to analyse possible actions of the port authority. Innovation is a well known concept and often used in business models. Many firms claim to be innovative. However, there is dedicated theory available on the concept innovation. This study uses delicate theory to study a complex system change with multiple actors involving organizational and technical innovations.

The way current transport is arranged can be characterized as being in a socio-technical regime (Rip and Kemp, 1998; Geels, 2002). Here, a socio-technical regime refers to a multi-actor hinterland transport system with dominant practices and rules. Ensuing logic and its stability guides the decision-making of involved actors. The current socio-technical regime has to cope with several coordination problems as described by van der Horst and de Langen (2008), explained in chapter 3. Being in a socio-technical transport regime, Kemp and Rotmans (2004) developed a theoretical model to manage a transition to sustainable mobility; Transition Management. "*Transition management consists of a deliberate attempt to work towards a transition in what is believed to be a more sustainable direction.*" (Kemp & Rotmans, 2004) It is appropriate to use this theory because it can be applied from the view of the port authority and consider the multi-actor aspect of the coordination problems in the hinterland chain. Van den Bergh and Bruinsma (2008) illustrate that transition management theory is very applicable in studying large transitions.

Transition management theory is a general approach in order to achieve a particular transition. The coordination in the hinterland transport chains is insufficient (van der Horst & de Langen, 2008). This study aims for a transition towards more efficient container transport. The four elements of transition management, described in chapter 3, will be used and adapt to the situation of the port authority, developing port transition management. According to transition management theory, firms have to cooperate and form alliances in order to innovate and manage a system transition. Economic and governance theory confirm the potential of alliances in the form of horizontal or vertical integration. The effects of collaboration can be identified through a multi-actor cost-effectiveness analysis. The port authority can play an important role by showing these effects and give incentives for cooperation through alliances.

The development of port transition management requires good insights and knowhow about the forces in the hinterland chain. Therefore, it is decided to first conduct a market research to acquire more knowledge about the qualitative and quantitative decision criteria of involved actors. Initiatives of other port authorities also could be useful in the development of port transition management. Learning is an important element within transition management. A benchmark study will be

performed looking at other ports to learn from their initiatives. These initiatives will be discussed using transition management theory, providing input for port transition management. Finally in chapter 8, port transition management will be developed, using knowledge acquired during the literature review, market research and benchmark study. This theory will be applied from the view of the port authority and therefore it is needed to first define its available instruments.

4.4 Port Authority Instruments

The next paragraph will examine the available instruments of the port authority and addresses the second sub-question. The function of a port authority changed from a landlord function to a port development company. They are now actively engaged in facilitating harbour activities. Port authorities aim to increase the effectiveness of intermodal transport for reasons described earlier.

The port authority has a limited number of available instruments to steer development. Wiegmans et al. (2010) present an extended framework based on the port-interface of Bird (1963) and describe three functions of the port authority. Bird described the first two functions in 1963, starting with the *port form.* This represents the layout of the port and is the geographical and morphological shape. In the context of market actors, this is the location and the amount of land a firm uses in the port. It also refers to the development of the correct (intermodal) infrastructure. The *port function* is the second instrument and considers the core business operations of the port firms and port authority. This instrument also concerns the interaction between firms and port authority.

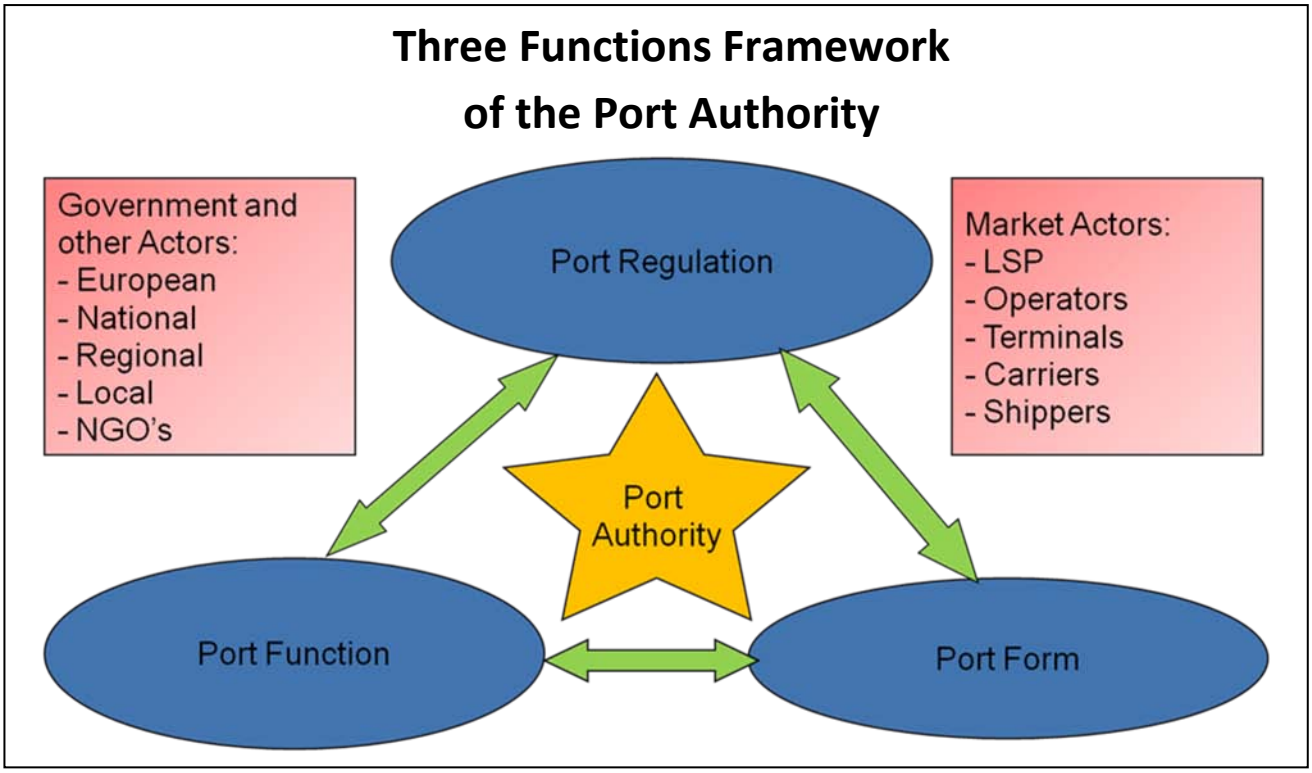

Figure 5: Instruments of a port authority, Source: Wiegmans et al. 2010

Wiegmans et al. (2010) extended this framework with a third instrument to cope with recent developments. They emphasize that, being a port development company, port authorities also use

regulation as an ability to steer[23]. *Port regulation* concerns all sorts of regulation regarding port activities. Firms have to deal with environmental regulations (like noise, fine dust, CO_2, water quality, odour), spatial planning regulations (like land use), transport regulations (modal shift, tons handled per quay) and other regulations considering labour, security and safety. Figure 5 illustrates the relation between port function, form and regulation. These instruments make effective use of all three economic mechanisms discussed in transition management. These economic mechanisms where defined by economic coordination through markets, hierarchy (e.g. planning and control policies) and institutions.

The defined available instruments of a port authority can be used by transition management theory to develop port transition management.

4.5 Into Perspective

It is useful to put all the used theory into perspective, explaining the function and position of each theory. Recall figure 3 presenting the analytical framework earlier in this chapter.

The stakeholder analysis serves as input for the multi-actor cost-effectiveness analysis. Relevant studies helped to identify and examine every important actor in the hinterland chain. An applied form of a cost-effectiveness analysis will help to determine the aggregate chain effectiveness. The port authority has interests in the optimization of the aggregate chain effectiveness. However, the port authority has a limited number of instruments. Cooperation (innovation through alliances) is a prominent element when analyzing this problem. Transition management theory will be used to influence individual investment decisions that will optimize the hinterland transport regime. Chapter 8 combines transition management with all acquired knowledge during the literature review, market research and benchmark study into port transition management. Port transition management will become a tool for the port authority to influence the individual actors, optimizing the effectiveness of the hinterland transport regime.

[23] For example, the port of Rotterdam is contractually forcing a modal split on new terminal operators at the Maasvlakte 2.

5. Multi-Actor Cost-Effectiveness

This chapter describes the methodology used to answer the third and fourth sub-questions. The reviewed literature presents a problem that cannot be answered easily. This research tries to answer this problem by using a different method. The next chapter describes a specific case study to support and test the model. It extends the model described in the theoretical framework with qualitative and quantitative data. The actual market research incorporated much trial and error. The presented methodology has been adjusted several times to fit the market characteristics.

5.1 Individual Approach

Recall the first sub-question previously answered in the theoretical framework: Who are the important actors of an intermodal hinterland chain and how can they be properly displayed into a multi-actor hinterland chain model? Continuing to the third sub-question: What is the cost structure of an intermodal hinterland chain of a sea port? Interviews with experts in the field of governance and interviews with market actors of a hinterland chain helped to obtain relevant quantitative and qualitative data[24].

5.1.1 Cost Parameters

Understanding the cost structures and benefits of the individual actors will give insights in qualitative decision factors. The total annual costs of each actor are examined. The method used has been modified several times. Trial and error ensured a mixed approach of annual cost per TEU and trip cost per TEU. Due to the market characteristics, fixed capital costs are an important element and cannot be missed in any method. Buying or leasing is a high priority decision. Whether or not existing capacity is enough is an important go- or no-go decision factor when deciding to participate in a new project[25]. Optimal use of capital has priority number one in transportation.

Cost Assumptions

It is essential to make a difference between cost and prices. This study tries as much as possible to approach the real cost-price. However, recognize the implications when the tariff charged by a trucking company, is the cost-price for a logistic service provider.

Initially, not all actors measure their product-cost in cost per TEU and assumptions have to be made. Typically, main haul operators charge per trip and could not care less about the occupation. Intermodal operators carry the commercial risk and have to make sure that there is enough cargo to fill the capacity. They charge per TEU, where a logistic service provider charges a specific amount for the total service. For comparison purposes, the costs are eventually calculated per TEU for each actor. But first, the annual cost of a certain cargo flow must be calculated before the cost per TEU can be determined.

Every actor has a fixed and a variable cost component, the elements of these components differ between actors. While calculating the cost per TEU, the model assumes the presence of large volumes, a key prerequisite for intermodal transport. The cost of container handlings at the terminal

[24] Relevant data is obtained through an internship at the port authority of Amsterdam using their privileges and contacts. Questionnaires and detailed interviews can be found in the appendix.

[25] In economic terms, if there is enough existing capacity, we speak of over capacity. Hypothetically, the terminal operator charges a price too high because he must spread the fixed costs over fewer moves.

and the shuttle services are based on a larger volume. The shipper's cargo is a small part of the total cargo[26] handled by the terminal and shipped by the intermodal operator's shuttle.

The most important cost elements are obtained through market research. Economic theory distinct fixed and variable cost elements, also presented as capital and labour. Table 4 below describes the typical costs of each actor.

	Logistic Service Provider / Intermodal operator	Terminal	Main Haul	Road Haulage
Fixed	- Other fixed cost - Harbour dues (Intermodal barge operator)	- Capital - Lease of ground - Other fixed cost	- Capital - Other fixed cost - (Wage when barging)	- Capital - Other fixed cost
Variable	- Lease of services - Wage	- Wage - Fuel - Maintenance - Other variable cost	- Wage - Fuel - Maintenance - Other variable cost	- Wage - Fuel - Maintenance - Other variable cost

Table 4: Fixed and variable costs.

General Model Assumptions

In general, there are a number of standard parameters which influence every actor in the hinterland chain.

1. Every actor bases their cost-price on a specific break/even volume. Thus, a firm operates at break/even level when a certain percentage of their available capacity is used.
2. A cargo flow is measured in twenty equivalent units (TEU) and has a certain fraction of 20ft containers. It is assumed that all used 20ft and 40ft containers are standard. The impact of this assumption is negligible while examining maritime transport.
3. The model calculates with fifty working weeks a year.
4. It is assumed that all containers are transported back to the port unless the container can be delivered back to an empty depot in the hinterland for re-use.

Individual Assumptions

There are some actor-specific assumptions necessary to mathematically model the cost structure.

Terminal:

1. It is assumed that a terminal bases his cost on a minimum amount of transhipments. Every TEU transhipped consists of two moves. One move for putting the container from one modality into the stack and another to put it from the stack onto another modality.
2. Truck and train moves are cheaper then barge moves due to the usage of less expensive equipment.

Main Haul:

3. It is assumed that an inland carrier can make a limited number of trips a year, owning only one barge, train or truck. The cost per trip is based on the annual total cost and the maximum number of trips a year.
4. Fuel surcharges are directly calculated into the trip cost.
5. The wage when barging is considered fixed due to continuous sailing.

[26] Note that bundling of cargo flows is not a natural process but an opportunity where multiple actors have to cooperate. Most flows in the container market are fragmented and too small to make effective use of economics of scale.

6. It is assumed that a truck carries two TEU, one 40ft container or two 20ft containers.

Intermodal Operator:

7. The intermodal operator has to maintain a minimum required frequency for his service between two terminals. It is assumed that indirectly this frequency implies a large flow of bundled containers. The cost per TEU is based on this large flow.

Logistic Service Provider:

8. An LSP arranges the transport of multiple shippers. The transport of one shipper does not require a full time job. Assumptions are made in terms of wages and fixed costs to ensure that the costs can be explicitly assigned to the flow in question.

5.2 Aggregated Approach

The actors in the hinterland chain maintain different criteria when deciding to invest in a more effective process or product. But recall the fourth sub-question: 'How to model an aggregate effectiveness of the total hinterland chain?' It is not possible to add multiple effectiveness parameters measured with different units. A single measureable variable is created to obtain the aggregate chain effectiveness. As mentioned in chapter 4, the used effectiveness parameter is reliability. The level of reliability is determined by the share of variable time in the total lead time of the service. First, the reliabilities of the individual actors have to be determined before the aggregate chain effectiveness can be calculated. The determination of the individual reliabilities requires assumptions regarding the fixed and variable time.

Effectiveness Assumptions

The method used to determine the reliability depends on the fixed and variable time of a transport chain.

1. It is assumed that every transport chain has a fixed transit time and a variable transit time. The fixed time is the minimal time needed to complete the chain. Additional waiting times, congestion times and time losses due to inefficient operations are variable times.
2. Variable handling times are unreliable and leading to extra cost. Operators will have to incorporate additional time into the schedule to incorporate the might needed extra time. If an operator experiences a half hour delays 1 out of 10 times. Then, it is assumed that the operator will plan an extra half hour, each of the 10 times.
3. Transit times are assumed to be from point to point and do not depend on direction and loading.

5.2.1 Individual Cost-Effectiveness

After determining the costs and effectiveness for each actor, the individual cost-effectiveness ratio can be determined. The next equation presents the cost-effectiveness variable per actor.

The costs are measured in euro per TEU. The annual fixed cost and the annual variable cost are summed and divided by the total amount of handled TEU. The effectiveness is measured by the

reliability of the operation. The level of reliability is determined by the fixed time divided by the fixed time plus the variable time needed to complete the service in question.

These ratios cannot simply be compared because the cost components of each actor are not equal in size. Only the ratios of actors that offer the same service can be compared. For comparison with uni-modal transport, the aggregate chain effectiveness needs to be calculated.

5.2.2 Aggregate Chain Effectiveness

The methodology for calculating the aggregate chain effectiveness essentially is a summation of the multiple actors of the transport chain. It is ensured that the effectiveness variables of each actor can easily be summed to obtain total chain effectiveness. The cost structure indicates that some expenses are directly passed on to the next actor. Specific attention is required when aggregating the costs to avoid double counting.

The next equation represents the total effectiveness of the hinterland chain.

The fraction in the formula presented above is decomposed as follows. The numerator represents the cost part and is a summation of all actors' costs per TEU. The denominator is the effectiveness element and is composed of all variable times divided by the total lead time of the transport chain.

5.3 Concluding

This chapter presented the methodology used to determine the aggregate chain effectiveness. It is now possible compare an intermodal chain with a uni-modal chain by a cost-effectiveness analysis. The difference is based on the ratio of cost and reliability. When interpreting possible innovative investment opportunities, one has to examine the change in cost-effectiveness ratios. This methodology will be used to interpret the case study in the next chapter.

6. Case Study Results & Analysis

Port authorities aim to increase the effectiveness of intermodal transport. Insights into the hinterland chain are therefore important. This case study provides insights that can be verified against the theory. As mentioned in the chapter methodology, qualitative and quantitative decision factors are examined to analyze the willingness to invest.

6.1 Terminal Haulage in Amsterdam

This case examines a hypothetical hinterland chain of a cargo flow from Rotterdam towards Almere. The size of this flow is about 2000 TEU on yearly basis. First, the containers are barged to Amsterdam, being the hinterland terminal. The last part is trucked from Amsterdam to Almere. The logistic service provider of this hinterland chain instructs the terminal operator and provides the road haulage. The terminal instructs an intermodal operator to load the containers in Rotterdam. The intermodal operator leases barges needed for the transport. This structure of contracts is called 'Terminal-Haulage'. In this particular case, all actors are part of the same mother company. Figure 6 elaborates the theoretical model discussed in chapter 4.1 into a concrete example regarding this case.

Strategy of the logistic service provider pursues 'Carrier-Haulage' until the port of Amsterdam. Their intention is to maintain and intensify the use of empty depots in the port of Amsterdam. The difference lies between 'port of discharge Amsterdam' (Carrier-Haulage, now 40%) and 'port of loading Rotterdam' (Terminal-Haulage, now 60%). It is more preferable to return empty containers to the port of discharge Amsterdam. Then, the port of Amsterdam can perform a preferable hub-function in hinterland chains.

The inland terminal costs are incorporated in the total transport tariff of the hinterland transport. Unlike the deep-sea terminal charge, this is simply passed to the shipper. Even though, the deep-sea terminal is also included into the model because it serves a substantial part of the hinterland chain, no matter the used modality.

6.1.1 Flow Properties and Assumptions

It is important to understand the reasoning when interpreting a model. This model incorporates some assumptions which have to be explained. The container flow consists of 1200 – 1400 20ft containers and the remaining containers are 40ft.

When determining the cost of barging, it is assumed that the barge operates under continuous sailing. Based on continuous sailing, a barge requires one captain one steersman and one sailor per week. Then, two teams are needed which run shifts of one week. Thus, wage is based on a six headed crew operating one barge[27].

As mentioned, buying or leasing is an important decision. In ordinary course of business, operators buy the amount of capacity of which they are sure they can occupy and lease the additional capacity for flexibility. Un-utilized capacity imposes high costs on an operator. In this case, the logistic service provider of the chain leases all services.

[27] The Loontabellen motorvrachtschepen 2011 are used to determine the total fixed wage component. This information can be found at the website of Centraal Bureau voor de Rijn- en Binnenvaart; www.cbrb.nl .

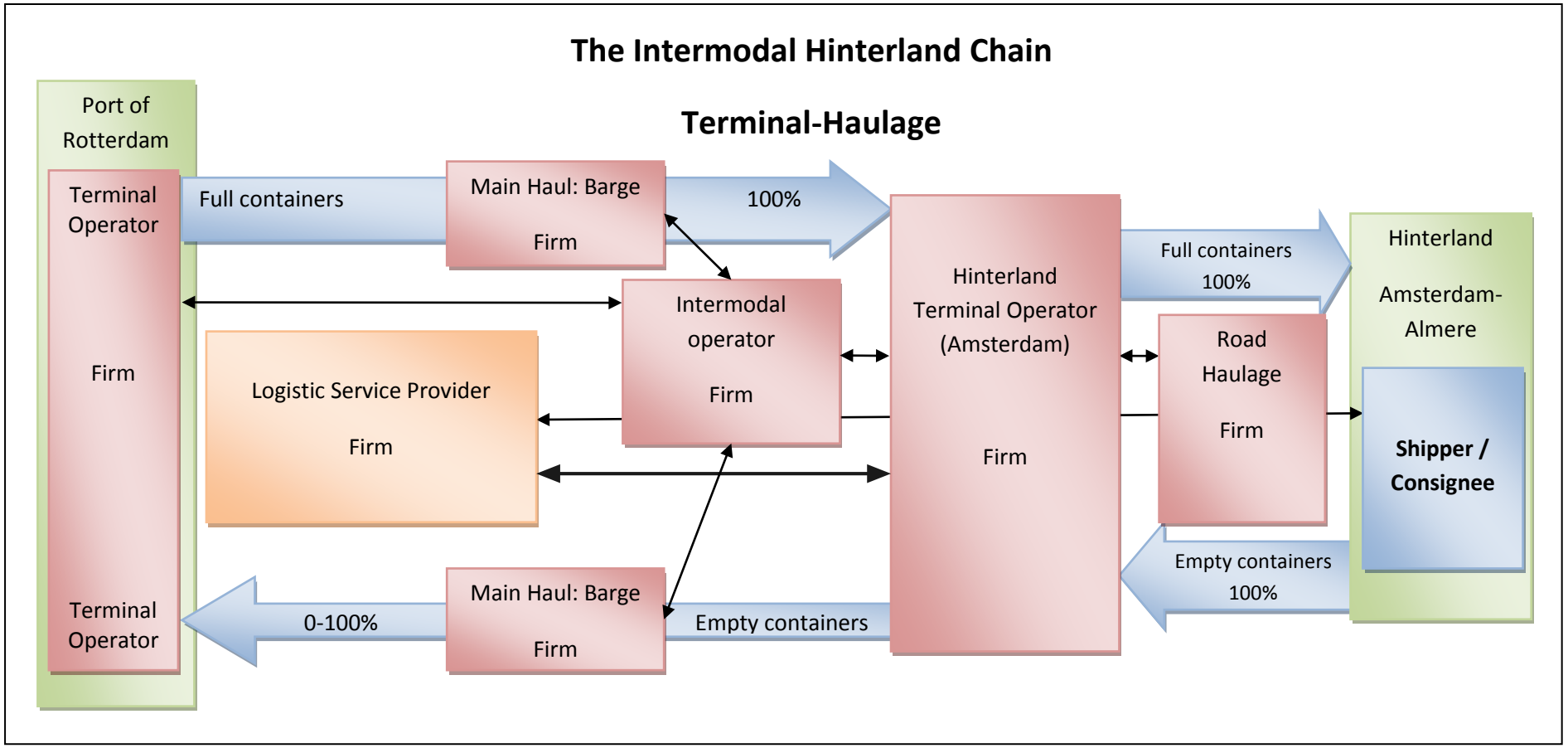

Figure 6: Case specification of the model; Actors in the hinterland chain.

Orange block: The logistic service provider of the chain.
Red blocks: Actors in the intermodal hinterland chain.
Green blocks: The geographical place.
Blue arrows: The physical flow of containers, full or empty.
Black arrows: The contractual relationships between actors.

The actors responsible for barging and trucking focus totally on their core business. Barges and trucks operate continuously, assuming that an effective working day of a truck consists of 11 hours work and a 330 km drive. A barge operates 24 hours a day, where both truck and barge work 6 days a week. One barge can sail a maximum of three round trips between Amsterdam and Rotterdam. Inland harbour dues are based on the annual rates of the ports of Amsterdam and Rotterdam considering a 156 TEU barge with an average of 17 tons per TEU. The taxes are based on an annual subscription where numbers of visits do not matter. These assumptions are needed to calculate the annual cost. The properties and assumptions of the container flow are displayed in appendix I.

6.1.3 Cost

The red blocks in figure 6 represent the actors in the intermodal hinterland chain. All actors have operational costs which they charge the logistic service provider. Some actors do not determine their cost-price per TEU. A Terminal charges per move, where a trucking company will charge per trip, as well as a barging company. Table 5 displays the logistic service provider's annual cost and cost per TEU, charged by each actor[28]. Detailed information about the cost calculations of each actor can be found in appendix I.

Logistic Service Provider Cost components		**Intermodal cost**		**Uni-Modal cost**
Fixed	general fixed cost	€ 20.000,-		
Variable	wage	€ 15.000,-		
	Other variable cost	€ 2.000,-		
	Lease of services:			
	Annual cost intermodal operator	€ 61.000,-		
	Annual cost hinterland terminal operator	€ 99.000,-		
	Annual cost road haulage	€ 185.000,-		€ 338.000,-
Total annual cost		€ 382.000,-		€ 338.000,-
Cost per TEU		€ 191,-		€ 169,-
Annual cost port terminal operator (paid directly by the shipper)		€ 78.000,-		€ 110.000,-
Cost port terminal per TEU		€ 39,-		€ 55,-
Total incurred cost per TEU		€ 230,-		€ 224,-

Table 5: Cost of the intermodal and uni-modal transport chain.

The cost of the intermodal logistic service provider is higher than the cost of the uni-modal logistic service provider. The total costs incurred by the intermodal logistic service provider are approximately 382.000 euro, or 191 euro per TEU, against 338.000 euro, or 169 euro per TEU. These costs do not incorporate the terminal charge at the deep sea port. If the costs of the port terminal are incorporated, than the total incurred cost by the shipper are almost similar, about 224 euro per TEU. Still, this does not explain the choice for intermodal transport, yet. On the contrary, table 5 exactly illustrates the key issue of intermodal transport. There is no significant difference between the prices of intermodal and uni-modal transport. However, intermodal transport is very complex

[28] The figures are rounded and used as an example to further develop the theory. They are not identifiable to a specific case in the port of Amsterdam.

and hardly an advantage. It often has fewer competencies but incorporates more risks and uncertainty. Frémont and Franc (2010) state that intermodal transport prices must be 10 to 20 percent cheaper in order for shippers to consider intermodal transport.

Presented costs are only applicable in the most ideal situation where every intermodal container is re-used. This means that every container can be returned to the empty depot at the hinterland terminal. Another costumer of the intermodal operator pays the transport back to Rotterdam. The terminal operator also charges the last move, putting the container from the returning truck into the stack/ empty depot. It is assumed that the uni-modal logistic service provider (Trucking Company) always makes a round trip. The difference lies in the number of transhipments at the port terminal. Intermodal transport needs one transhipment at the port terminal. Uni-modal transport has lower transhipment costs but have to make two transhipments due to the round trip of the truck. The organization of the container transport has a high impact on the incurred costs.

In this typical case, the intermodal logistic service provider managed to make effective use of the fact that all actors in the chain are colleagues. Being colleagues as part of one big organization has positives advantages. The big mother organization, being a hub, controls large flows to the hinterland, allowing the logistic service provider to arrange very efficient (intermodal) transport. This logistic service provider uses the fact that the shuttle of the intermodal operator sails anyways, with or without the shipper's relatively small amount of cargo.

Normally, the logistic service provider is responsible for the transport back to the port of loading. In this scenario, the intermodal operator takes the commercial risk of unpredictable return cargo. He will probably cover this risk by charging the logistic service provider a higher price than the cost per TEU for a single trip. If the intermodal operator only has 50% return cargo, the cost-price will go up from 191 euro to approximately 215 euro per TEU.

Intermodal – Fixed Time versus Variable Time

fixed	terminal	fixed	barge	fixed	terminal	fixed	road haulage
mooring time	0,25	transit time	8,00	mooring time	0,25	Transhipment	0,32
Transhipment	3,00	mooring time*	0,50	Transhipment	3,00	transit time	1,50
		transhipment time*	6,00			Unloading	0,80
variable		variable		variable		variable	
Inefficient calls	0,25	waiting time port	6,00	Inefficient calls	0,13	waiting time	0,40
		waiting time hinterland	1,50			congestion	0,50
		additional mooring time*	0,38				
total	3,50		15,50		3,38		3,52
effectiveness	93%		65%*		96%		74%

Total fixed time	17,12
Total variable time	8,78
Total lead time	25,90
Total chain effectiveness	66%

* These time factors are already incorporated into the time of the terminal. These factors do not count towards the total time of barging to avoid double counting. However, they do count towards the effectiveness.

Table 6: Effectiveness of the total chain.

6.1.4 Aggregate Chain Effectiveness

The effectiveness of the total chain is determined by the reliability factor. Each actor in the chain needs a fixed time to perform his service. However, he has to plan an additional variable time for (un-)expected delays. Chapter 5 describes the method used to express the reliability using the fixed and variable time. Table 6 presents the effectiveness of the total hinterland chain determined by the fixed and variable time.

Some indicators affect multiple actors which is not directly demonstrated by the model. Higher waiting times in the port increase the total transit time of the total chain. The barge operator can make fewer trips in a year, making the cost per trip go up. The intermodal operator has to deal with longer lead times and lower reliability, making his service less attractive. In the market, waiting times of barges in the port are of no interest to the deep-sea terminals. The port terminal often gives deep sea ships priority which results in barges floating around in the port. The model assigned these time losses to the intermodal operator and barge carrier, this also happens in the market. This complicates the persuasion of port terminal operators to cooperate. But, with the second Maasvlakte there is an over-capacity. Competing terminal operators should worry that long waiting times due to inefficient handling of barges will cause intermodal operators to switch from terminal.

Figure 7 illustrates the relation between the fixed, variable and the total lead time of the intermodal hinterland chain. The small black arrows indicate the fixed and variable times. Note the two sided direction of the arrows after the second terminal. The total time lead time incorporates the single trip barging and round trip trucking.

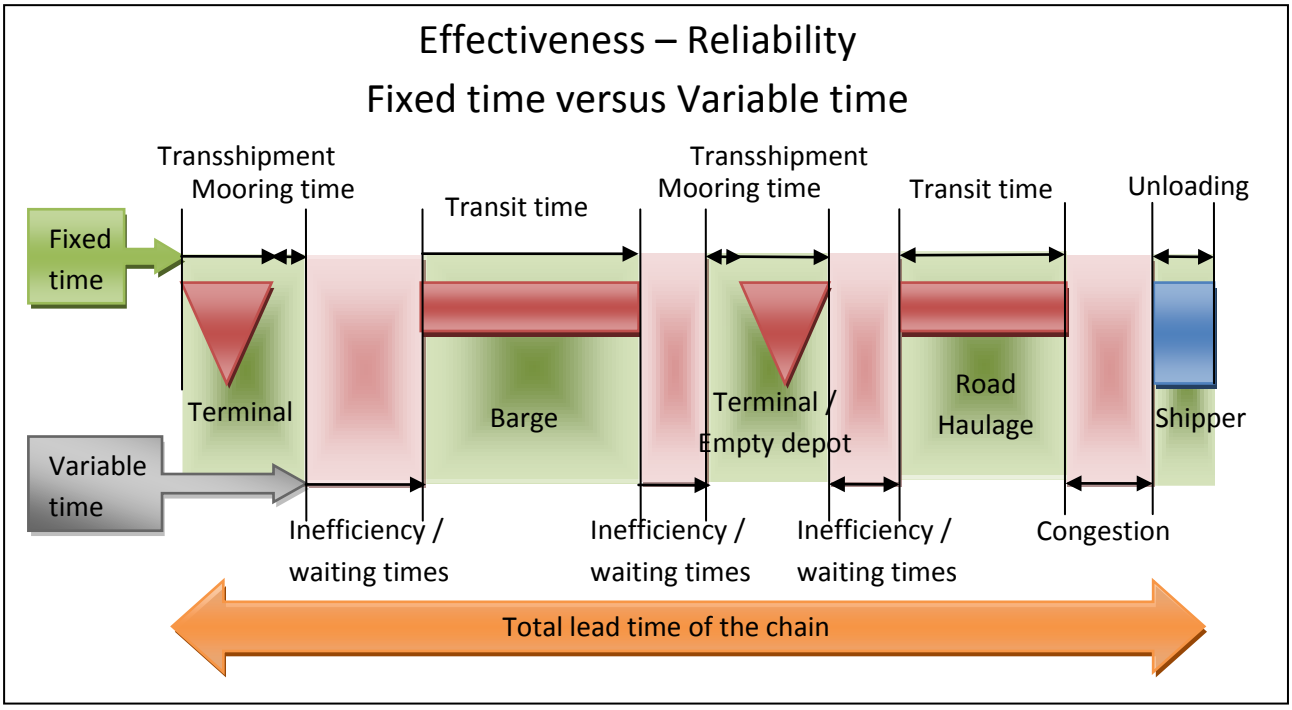

Figure 7: Fixed time versus variable time, in perspective of the total lead time

The effectiveness of the uni-modal chain is about 60%, against 66% of the intermodal chain. However, the total lead time of trucking is significantly lower than the lead time of the intermodal chain. The total lead time of trucking is approximately 6,42 hour per roundtrip which contains 2,3 hour variable time.

6.2 Cost-Effectiveness Analysis

The determined costs and reliability can be used to analyze the cost-effectiveness ratio of container transport.

6.2.1 Results

The results are presented in table 7. Again, these cost-effectiveness ratios are measured in the most ideal situation. This analysis compares intermodal single trip costs and uni-modal round trip costs.

Only the ratios of equivalent services can be compared, for instance, intermodal and uni-modal transport. The uni-modal logistic service provider is more cost-effective than the intermodal logistic service provider. Intermodal transport becomes attractive, only when the port terminal costs are incorporated. The cost-effectiveness ratio of intermodal transport is 332. The ratio of uni-modal transport is 373, meaning that intermodal transport is more cost-effective. In this particular case, plans exist to develop an inland terminal in Almere for further improvement of the effectiveness. Then, the road haulage incorporates a lesser part of the total trip.

The difference in cost-effectiveness ratios of the port terminal operator should also be emphasized. The results show that a terminal operator at the port will benefit from intermodal transport, having a better cost-effectiveness ratio.

Multimodal Actors	cost per TEU	percentage of total trip cost	effectiveness	cost-effectiveness ratio
Intermodal Operator	€ 30,-	13%	65%	n.a.
Hinterland Terminal Operator	€ 49,-	21%	96%	n.a.
Road Haulage	€ 93,-	40%	74%	n.a.
Logistic Service Provider	€ 191,-	8%	66%	288
Port Terminal operator	€ 39,-	17%	93%	42
Total chain effectiveness	€ 230,-	100%	69%	332

Uni-modal Actors	cost per TEU	percentage of total trip cost	effectiveness	cost-effectiveness ratio
Logistic Service Provider (Truck)	€ 169,-	75%	64%	263
Port Terminal operator	€ 55,-	25%	55%	100
Total chain effectiveness	€ 224,-	100%	60%	373

Table 7: Aggregate chain effectiveness

6.2.2 Why Intermodal?

Market research pointed out that the cost-price of a roundtrip trucking from Rotterdam to Almere is between €165 and €175 euro per TEU, excluding the port terminal costs. The first condition of intermodal transport often is that it has to be less expensive than uni-modal transport. This becomes very difficult at small distances. There is not a significant difference between the cost of uni-modal and intermodal transport. If both options are about as expensive, why does the logistics service provider use intermodal transport?

First, the cost-effectiveness ratio of intermodal transport is more cost-effective than transport per truck (uni-modal). The high cost-effectiveness ratio of trucking is caused by the high variable times

for trucks at the trajectory Rotterdam - Almere. Furthermore, a truck needs to make a roundtrip[29]. This takes about 6 hours. If the truck has too much delay, then two round trips a day are not possible. This results in additional costs because the logistic service provider already paid the truck for the whole day. Besides the additional costs, the logistic service provider also has to deal with an extra reliability factor.

Another important aspect is the density of the cargo which sometimes determines the container, 20ft or 40ft. A 20ft container may contain a maximum of 26 – 27 tons and a 40 ft container may contain a maximum of 30 – 35 tons. The cargo in this case often is too heavy to efficiently load a 40ft container. Heavy 20ft containers are often less attractive to truck due to the number of handlings and maximum permitted weight (not incorporated into this model).

The logistic service provider makes efficient use of being part of a mother organization. The intermodal operator, a colleague, probably has enough return cargo to charge somewhere near the marginal cost of a single trip. Thus, the logistic service provider can piggyback on larger flows of the mother company. Moreover, trucked containers usually have less time to be returned than barged containers (depending on the agreements). With the option of empty depots, intermodal containers are more likely to be re-used, which is profitable for the mother organization. The hinterland terminal benefits significantly from being a hub and will pursue this function.

Finally, the most important reason has to do with an additional service. Offering additional services illustrates a trend in the container transport market. The recently introduced extended gate concept[30] essentially is based on offering additional services. Extended gates improve the effectiveness of the hinterland chain by removing barriers. It is a good step towards more synchromodal transport. Offering additional services is a way to differentiate from road transport. In this particular case, the logistic service provider also performs a warehousing function. He is directly involved into the internal logistics of the shipper, thinking along with the production process. In this chain, the warehousing activity is his profitable core business. He is responsible for the direct delivery of intermediate products from the warehouse onto the production lane. The logistic service provider does not aim for significant profit on the transport. However, he benefits from being the owner of the entire chain. He knows exactly where the cargo is and when it will arrive through efficient internal information gateways of the mother company.

Concluding, this transport chain is suitable for intermodal transport because the logistic service provider has control over the entire chain and adds an additional service. One party that owns the entire chain offers potential efficiency gains that otherwise would not be possible, due to the lack of transparency on the market. Warehousing is an example of an additional service which increases the competitiveness of intermodal transport. But, this is very case specific. In this case, containers piggyback on the large flow of the mother company. Just in time deliveries are very hard to

[29] The owners of the container, often the deep sea shippers, want their container back as soon as possible. But, they give intermodal transshipped containers (barge or train) more time to return. This allows re-use of the containers. Containers picked up by truck, however, get little time.

[30] The extended gate concept is developed by European Container Terminals (ECT) and is based on high quality connections between terminals in the European hinterland. ECT provides reliable, frequent and procedurally simple transport between the seaport and hinterland terminals. The biggest advantage against former transport is the ability to transport containers to hinterland terminals without the former needed documents (removing administrative barriers). More information about ECT can be found at www.ect.nl.

accomplish with intermodal transport. The logistic service provider can always fall back on the truck for time sensitive cargo.

6.3 Shipper Constraints

This section deals with sub-question 5: Which qualitative criteria are important in decision making to actors interested in intermodal transport? Blauwens at al. (2006) illustrate that, besides cost and reliability, intermodal transport must also meet other important qualitative requirements. The next section provides insights in go- or no-go factors using a number of practical examples. For example, some shippers require a daily departure for flexibility purposes. Hence, the shipper will contract a logistic service provider that offers a service which meets this requirement. These insights become important in the transition process discussed in chapter 8.

European Container Terminals (ECT) responds rather accurately to the demands of the shipper by introducing 'European Gateway Services' (EGS)[31]. They offer market actors, including shippers, a variety of services that improve the effectiveness of the total hinterland chain, in particular by removing administrative barriers. ECT states that shippers demand on time delivery, against the right tariff and in an efficient manner.

G-Star is a shipper with headquarters in Amsterdam focusing on reliability, safety, time and cost. They emphasize safety because their cargo has a very high value density. They will not cooperate if citizens can enter the terminal unchecked. G-star also works with just-in-time delivery contracts with its distribution points, making intermodal transport difficult.

The flower auction in Aalsmeer is another good example of a failed business case. Some flowers have to be transported to Italy. Initially, these flowers were trucked for speed and frequency. The option to transport the flowers by train was explored through bundling with cargo from Schiphol. The business case was profitable, but Schiphol's cargo was tied to a late departure. This meant for the flowers that they would miss the opening of the market at seven o'clock in Italy. The flower shippers did not cooperate, understandably. Thus, planning is for some shippers also a go- or no-go criterion.

A minimum required frequency and consequently bundling of flows are essential. Point to point cargo is the most suitable for intermodal transport. But, the flower auction case illustrates that bundling alone may not be enough.

6.3.1 Qualitative Decision Criteria

The effectiveness of various actors in the chain are studied and approximated through cost and reliability. Besides cost and reliability, the shipper also has a number of other go-or no-go criteria which a hinterland chain must satisfy. The empirical research revealed valuable knowledge about other qualitative criteria. A shipper will decide to invest if cost and reliability of an intermodal transport chain end up into a profitable business case. This decision also depends on whether the other criteria are met. Table 8 gives insights into the requirements of decision makers interested into intermodal transport. These results will be considered during the adaption of transition management theory to the port authority's situation, discussed in chapter 8.

[31] More information about European Gateway Services can be found at www.europeangatewayservices.com.

Qualitative Requirements	Comments
Reliability	Minimize variable time, Always deliver, being on time!
Cost	Equal or less than uni-modal transport (trucking)
Frequency	Maintain flexibility
Planning	Does it fit into the internal logistic process, transit time, right departure time
Inventory	Strongly related to frequency and planning. Inventory becomes an issue when examining warehousing costs
ICT	Does the ICT systems fit together
Image	CO_2 reduction; Most shippers want to implement corporate social responsibility into their business operations. Sometime they are willing to pay 2% additional costs
Other competencies	Possibility of using reefers, weight permitted etc.

Table 8: Qualitative decision criteria.

6.4 Verification Theory

The presented case is a good example of a successful intermodal hinterland chain. Can found insights and results be explained by the theory?

Market research illustrates that the requirements of the shipper cannot be ignored. Blauwens et al. (2006) also emphasize the requirements of the shipper in their study. The shipper's requirements support go- or no-go decisions. In the end, shippers pay for the transportation, their requirements should be included into the decision making process. This will also improve the acceptance of the selected projects (Macharis et al., 2009).

Transaction cost theory states that in case of high uncertainty, a hierarchical governance structure will be most effective (Williamson, 1975). Moreover, the transport services are highly asset specific. In this case study, a vertically integrated governance structure enabled efficient coordination between all involved actors. Most importantly, it enables sufficient data exchange. This is also illustrated by the studies of Panayides (2002) and van der Horst and de Langen (2008). A vertically integrated governance structure has control over the strategic directions of involved actors and lowers barriers. However, it is not clear whether this particular intermodal transport chain can function by itself, not being part of a larger flow. The volume of 2000 TEU is small, which entails many risks. According to the theory, if firms cannot create a vertically integrated governance structure, firms will probably truck due to strategic risk-averse behaviour. Transition management theory may provide a framework for the port authority to reduce the coordination problems involved with intermodal transport, especially for small volumes.

The importance of the warehousing function, also performed by the logistic service provider, is another result described in literature. Frémont and Franc (2010) stressed the importance of additional services, a way to differentiate from road transport.

One can conclude that many results can be derived from the theory. However, note that this particular case can only be generalized with caution. There are a lot of case specific elements that influence the results. For instance, the impact of the way container transport is organized (considering one-way or roundtrips), also illustrated by Frémont and Franc (2010). The next section will discuss some of the most prominent issues occurred during this market research.

6.5 Case Study Remarks

The results of this case study must be interpreted with caution. Science strives for perfect information gathering which appeared to be rather difficult, especially due to the lack of transparency on the market. There are several biases which affect the outcome of the model.

An important issue is the level of detail in the cost structure. This study used a general approach in order to say something meaningful about intermodal transport overall. Cost elements are determined in general, every individual case needs more detailed examination. Market research raised the impression that even the market actors themselves did not know exactly what and how high the cost components were. Or, they did not want to clarify due to secrecy. It was very difficult to find good, true figures.

6.5.1 Market Characteristics

Many difficulties are caused by the most important characteristic of the market: The market severely lacks transparency resulting in ever negotiable agreements. Prices are not equal for all actors and are never fixed. Emotional aspects severely influence this market causing the omission of rational decisions.

Figures found are case-related and do not always apply in general. Concrete projects will provide concrete figures. Figures are probably outdated and incorrect because firms do not show the back of their sleeve. Another point of bias is the inconsistency of information. The market research sometimes had to cope with conflicting information from different actors.

These factors complicate the modelling of the actual market.

6.5.2 Model Implications & Sensitivity

The numerous assumptions and high sensitivity are weaknesses of the model. However, these assumptions are required to compare intermodal transport with uni-modal transport.

The assumption having the most impact is the fact that flow cost is based on a single trip barging. The logistic service provider will probably contract a trucker if the intermodal operator experiences difficulties and has to charge a round trip. This flexibility is possible due to the fact that both are colleagues. Table 9 illustrates the differences in cost due to the trip factor.

Logistic service provider + Port terminal operator	**Intermodal**			**Uni-modal**
	Single trip cost	1,5 single trip cost	Roundtrip cost	Roundtrip cost
Total annual cost	€ 460.000,-	€ 550.000,-	€ 640.000,-	€ 448.000,-
Cost per TEU	€ 230,-	€ 275,-	€ 320,-	€ 224,-

Table 9: Trip factor sensitivity.

It is assumed that a truck always has to return to the deep sea port and therefore incurs additional port handling where intermodal transport can make use of empty depots. This indirectly means that containers which have to be returned to the port of loading are trucked more easily. It also assumes that a shipper has to pay more for trucked containers, due to the second handling. These are agreements made between different actors and may vary case by case. The barging element in the

model also implicates large volumes. The model assumes a large flow of 20475 TEU[32] roundtrip containers between port terminal and hinterland terminal. A single container flow of 2000 TEU is not large enough to initiate intermodal transport.

Another shortcoming of the model is that it cannot be used to determine the impact of the fraction of 20ft containers. The model assumes a perfect loading factor where a truck always carries two TEU. Changing the parameter of fraction 20ft containers gives unrealistic results. The model should indicate that the decision to truck becomes less attractive for handling a 20ft container.

Overall the model provides a representative approximation of the market, but it is based on significant assumptions.

6.6 Case Summary

Sometimes intermodal transport cannot meet the demands of the shippers, yet. Intermodal shuttles are focused on reliable services and are willing to invest into increasing reliability. After investing into the total chain effectiveness it might be possible for a shipper to transport a part of his cargo in an intermodal manner.

This case study provides a good example of an effective intermodal hinterland chain using terminal-haulage. Intermodal transport at a distance of 150 kilometres is rare. In this particular case, intermodal transport is possible because the logistic service provider managed to cooperate efficiently with all actors. The logistic service provider managed to obtain high aggregate chain effectiveness by efficient cooperation between actors and successfully averted individual optimization. He can maintain a helicopter view at operational level of different actors. He will accept losses at one particular actor if the total chain benefits. This is possible due to the fact that all actors in the logistic chain are colleagues. This case illustrates that the logistic service provider owning an entire chain has the advantage to improve the effectiveness of intermodal transport. Another important conclusion is that decision makers interested in intermodal transport consider qualitative logistical requirements equally important to cost and reliability.

Overall, the model is an adequate representation of the container transport market from which many useful conclusions can be drawn. Most of the case study results can be confirmed by the presented theory. However, substantial assumptions were needed to support the results. Unfortunately, the results do not enable the port authority to develop an action model to increase the effectiveness of intermodal hinterland transport. But, found insights and knowledge about the hinterland chain will be used to adapt the theory of transition management to the situation of the port authority. Subsequent chapters will examine whether transition management theory can help to increase the effectiveness of hinterland transport.

[32] See appendix I for specific calculations.

7. Inventory of Innovative Initiatives

This chapter examines some innovative opportunities by means of web search. Sub question 6 states: Where are the opportunities to enhance and facilitate the effectiveness of intermodal chains? Chapter 3 illustrates the main coordination problems in hinterland transport chains. Involved actors, who are willing to invest, attempt to pursue the correct direction. It will be useful to make an inventory of initiatives of other port authorities. The purpose of this benchmark study is to learn from other ports initiatives. These initiatives will be discussed using transition management theory, providing input for 'port transition management' in chapter 8. Mutual learning is an important element within transition management.

7.1 Benchmark Innovative Port Initiatives

This brief section presents intermodal initiatives of other ports in the world associated with the WPCI. Appendix II provides an overview of trends in intermodal innovation in significant international ports. Websites of worlds' busiest WPCI associated ports are studied to determine innovative initiatives. Though, consider the probable deliberate lack of information on several ports' websites.

A number of conclusions can be made studying the websites of port authorities[33]. European ports have nice dedicated internet sites on which they present their intentions on stimulating intermodal behaviour. They describe many incentives and investment programs on their sites. Some American ports show a similar trend but focus on sustainability and pay less attention to intermodal transportation. This trend is probably due to the considerable amount of land still available in America. Only the ports of Los Angeles and Long Beach region have a strong focus on intermodal rail capacity.

Another important conclusion is the insignificant role of intermodal transport in Asian ports. From the studied WPCI ports, the port of Singapore is the only Asian port that has a clear website. The world's busiest container port has a very neat description of research and development where they present a lot of intermodal initiatives. Other Asian ports do not have a website or do not present any information on development plans. Secrecy can be a motivator for the lack of information on the websites. Failed recognition of the necessity of intermodal transport can be another explanation. Their sites indicate a low environmental awareness and focus mainly on high capacity.

The ports of Durban and Antwerp introduced the Green Lane concept which is a noteworthy initiative. This project regards bilateral agreements for some goods made by the Customs, supported by appropriate technology. For these goods, customs move the green light: containers are not checked, thus resulting in time and money profits. This shows the willingness of the port of Durban to cooperate with the European ports and the intentions of the port of Antwerp to establish relations with other relevant actors. Much can be learned from the port authority of Antwerp. Studying their website shows that many initiatives can be associated with transition management.

7.2 Transition Management Applied

Some ports already have successfully implemented initiatives that are similar to transition management. Much can be learned from other port authorities by examining their implemented

[33] See appendix II for detailed information on the studied websites.

activities considering the four elements of transition management theory. Two examples will be discussed in which transition management emerges.

7.2.1 Hinterport - Antwerp

The port authority of Antwerp initiated a project called Hinterport[34] in which several elements of transition management can be revealed. A project like Hinterport has a number of key characteristics that ensure successful implementation.

The Hinterport project includes all relevant stakeholders and is a good example of sufficient arena building. The project involves 17 important actors representing port authorities, logistic service providers, intermodal operators, hinterland terminal and port terminal operators, rail freight companies, infrastructure managers, research associations and logistic and transport consultants. By involving all relevant stakeholders, they include all the necessary organizational and technical competences needed to realise the desired results. It also includes the proper management skills to efficiently allocate the resources. The selection of projects in the agenda process are more likely to be accepted if relevant actors are included into the decision making process. These actors represent the total market of the hinterland transport of the port of Antwerp.

The Hinterport project uses a wide variety of advanced ICT possibilities. ICT is used for implementation and communication of selected projects. ICT also promotes the use of new projects and maintains contact with users in order to gather valuable feedback. The Hinterport project stresses the importance of exploiting networking capabilities. Besides the direct partners, they create a community with members who use the projects. They establish an ICT-forum to facilitate and coordinate effective cooperation. This forum presents a possibility for the Hinterport community to share their experiences and give feedback. The establishment of the forum also illustrates the importance of evaluation and monitoring. Within the Hinterport project, monitoring and evaluating also involves meetings with relevant actors. Results and acquired information from executed projects are then discussed.

The 'Hinterport Blueprint' is an experiment portfolio in which all projects are well documented. The Hinterport Blueprint presents good practices that increase the efficiency of hinterland transport. This portfolio also provides a guideline to extrapolate the business models, operational features, organizational models, technical implications etc. to other business cases.

The Hinterport project has several similarities with transition management theory. Important conclusions can be drawn from the examination of this project. First, a platform including all relevant stakeholders must be created and maintained. The project requires well coordinated cooperation between involved actors. Another important lesson is the development of an experiment portfolio. Much can be learned from the Hinterport Blueprint. A portfolio documents found knowledge and results and puts all the projects in context. It structures the transition process and enables coordination (agenda building) and program management (priority setting, no duplication of research). The project also stresses the importance of monitoring and evaluating. Meetings on a regular basis are needed to recapitulate latest developments and learning objectives. It also pays attention to the users and builds a user-community (ICT-forum) to support the arena. Finally, ICT proves to be an important tool during the key activities like coordination, promotion,

[34] More information about the Hinterport project can be found at www.hinterport.eu.

implementation, monitoring and evaluation. It is expected that ICT-innovations will ease the transition to more effective hinterland transport. A limitation of the project is that it does not involve the shippers in the decision making process. This way, shippers are not able to stress their logistical requirements.

7.2.2 Maritime R&D framework - Singapore

Singapore has currently the world's biggest port. The maritime and port authority of Singapore (MPA Singapore) presents a framework on their website[35] that aims to develop a leading international centre of excellence. Despite other factors, being world's biggest port illustrates that their policy is quite successful. Like the Hinterport project, their framework also reveals several elements of transition management.

The arena of MPA's research and development framework stresses the importance of partnerships with tertiary research institutions (TRIs) and the maritime industry. Their website illustrates a structured approach considering the selection of research areas: the transition agenda. The Third Maritime R&D Advisory Panel (3MRDAP), created in 2007, coordinates all initiatives and determines in which areas research must be focussed. Their aim is to become a global maritime knowledge hub.

The selection of projects is commissioned from above by 3MRDAP. The panel recognizes that a two-way flow of ideas and information is required to develop efficient innovations in new products and services. It emphasizes the interaction and interdependency of three important clusters (Port, Shipping and Offshore & Marine Engineering) and includes their stakeholders into the arena. Research and experiments are developed and executed by stakeholders. This illustrates the combination of top-down and bottom-up elements in the policy of MPA.

MPA established the Maritime Innovation & Technology (MINT) fund to support the selected research and development programmes. Specific emphasis is laid on acquainting external knowledge from local and overseas partnerships. An important element of the MINT fund is a platform offering the possibilities to execute projects and facilitate further research and development. The website of the MPA fails to indicate the results of the projects. However, they do present a research and development showcase, which can be considered as an experiment portfolio. This showcase again illustrates the importance of advanced ICT possibilities. For this thesis, it is unfortunate that inland water transport has no distinct priority and is but a small part of the total framework. However much can be learned from MPA's framework and policy.

The framework presented by the maritime and port authority of Singapore is less illustrative than the Hinterland project. MPA did not develop such an explicit portfolio of experiments like the Hinterport Blueprint. Still, some important features can be defined. The framework of MPA illustrates that it is important to include external knowledge into the arena from tertiary parties like universities and other research institutions. A top down approach is used to build the agenda and efficiently structure all research and development programmes. The framework of MPA also incorporates bottom-up elements as innovations have to be developed by interaction with multiple market related stakeholders. The lack of an explicit experiment portfolio may decrease the capability of efficient evaluating and monitoring.

[35] More information about the Research and Development framework of the port of Singapore can be found at www.mpa.gov.sg under the header research and development.

Transition management theory appears to be an appropriate method to examine the developing port authorities. Both examples illustrate the potential of advanced ICT applications. The next section presents several leading ICT-projects.

7.3 Supportive ICT Projects

As mentioned before, costs and reliability are not the only criteria when deciding for investment opportunities. Almost every transport innovation requires a good ICT system for efficient operation. The Hinterport project illustrates that ICT systems fulfil a number of functions like marketing, tracking and tracing, customs documentation, billing, back office, booking of services, etc.

The European Commission also recognized the importance of ICT and funded a number of projects. Some projects are listed below: e-Freight, INTEGRITY and EURIDICE. This is just a small selection of all currently executed projects to show the importance of ICT. ICT developments are likely to present a solution to the coordination problems in a hinterland chain, presented in chapter 3.

e-Freight[36] This project aims to develop a single transport document. They also want to introduce liability regimes promoting intermodal transport.

INTEGRITY[37] INTEGRITY stands for Intermodal Global Door-to-door Container Supply Chain Visibility. The key objective of the project is to develop an ICT system called 'Shared Intermodal Container Information System' (SICIS) allowing firms to use proactive planning when acquire real-time information about transports. They aim to enhance the reliability and predictability of door-to-door transport chains.

EURIDICE[38] This project aims to build an information platform with services for the individual cargo item and its interaction with the user and surroundings. An important main objective is the development of intelligent cargo infrastructure by collaborative business models.

The port authority can play a dominant role in the development of ICT. The presented ICT-projects illustrate the importance of data and information exchange. This is often problematic on the market for container transport. The presented case study in previous chapter showed a vertically integrated governance structure to cope with this problem. The ICT-projects aim for better information availability to every actor in the transport chain, reducing uncertainties that withhold cooperation. Then, firms would have to rely less on vertically integrated governance structures. This will give firms more incentives to cooperate.

7.4 Concluding

Literature presents a number of different coordination problems in hinterland transport chains (see chapter 3). This chapter aims to learn from other ports by examining their initiatives that aim to cope with these coordination problems. The benchmark study gives an overall impression of many investments in orgware projects and ICT. Hence, the studied port authorities consider synchromodal transport as an important objective. Much can be learned from the two presented port initiatives in which several elements of transition management can be revealed. Proper structuring of the total

[36] More detailed information about e-Freight can be found at: www.efreightproject.eu .
[37] More detailed information about INTEGRITY can be found at: www.integrity-supplychain.eu .
[38] More detailed information about EURIDICE can be found at: www.euridice-project.eu .

transition process and involvement of all relevant stakeholders are key elements. The Hinterport project illustrates that the development of an experiment portfolio is a necessity. The maritime R&D framework in Singapore illustrates that the port authority has coordinating responsibilities and must take a leading role during the transition process. The benchmark study also illustrates that ICT developments are most likely to solve the coordination problems.

8. Port Transition management

This chapter addresses the sub-questions regarding the port authority's capability to apply transition management. The first section will examine and adapt the theory to the situation of the port authority. Acquired knowledge during the literature review, case study and benchmark study is used to support this process. The second section discusses the input of brainstorm sessions with practitioners to determine the practical capability of implementing transition management to the port authority's policy. The third section adjusts the theory to practice.

8.1 Framework Development

Sub question 7 states: What does the theory suggest when implementing transition management to the policy of the port authority, using the available instruments? Transition management is an iterative and cyclical process that consists of four main activities using three types of mechanisms for economic coordination. This section aims to adapt this theory to the situation of the port authority considering the available instruments, as described in chapter 4.

8.1.1 Adaptation of the Theory

Policy strategies evolve continuously to cope with the developments in a changing society. Table 10 illustrates the general changes in policy by describing the differences between traditional policy and the transition management approach (van den Bergh and Bruinsma, 2008). The third column illustrates the general application of transition management to the situation of the port authority.

	Traditional policy (from short-term to a maximum of 10 years ahead)	**Transition approach** (several decades ahead)		**Port Transition Management** policy applied to the port authority
Approach	Top-down: determined by The Hague/EU	Stakeholders and the government jointly determine the objectives		Both bottom up and top down elements
	Technology-driven	Technology yes, but social context at least as important		'Modal shift' = 'Mental shift'
	Blue-print: 'this is how it has to be done…'	Learning-while-doing and doing-while learning, by means of (experimental) projects		Continues learning throughout the whole process
	One-dimensional: a single objective	Multidimensional: more than one objective, more than one result		Multi-actor approach
	Prospective: where can we be in 2015, according to 2007 knowledge?	Back casting: where can we be in 2015, according to a view of what is desirable in 2050, and what do we have to do in 2007 to achieve this?		Back casting: using a challenging scenario of 2050 as a framework for short term policy
Result	Incremental change Innovation 'inside the box'	System change Innovation 'out of the box'		System transition Open source innovation

Table 10: Differences between traditional policy and transition approach applied to port transition management; Source: van den Bergh and Bruinsma (2008)

The illustrated adjustment to the situation of the port authority will be elaborated in more detail in the next section. The goal is to formulate a concrete transition framework defining the four main activities of transition management. All insights and information acquired during this research are used to expand the transition management theory.

8.1.2 Situation Specific Inputs

The determination of concrete policy is supported by literature and market research presented in earlier chapters. The benchmark study in chapter 7 illustrated several situation specific elements. First, some important elements need to be emphasized before presenting a transition approach.

Including the Shipper

All relevant stakeholders, as defined in the analytical framework, must be included into the transition process. A cost-effectiveness analysis can help evaluating a profitable case or investment opportunity in terms of costs and reliability. However, in the end, a shipper pays for the operation and chooses his partners to do business with. A shipper also has several other logistical requirements, besides cost and reliability, which a transport chain must satisfy. It would be useful to include shippers in the decision making process to increase the acceptance of selected projects. Then, shippers are able to stress their logistical requirements and it is more likely that they will cooperate.

Qualitative Criteria

Chapter 6 summarizes the most important qualitative requirements taken into account when deciding for intermodal investment opportunities. The port authority benefits from optimal aggregate chain effectiveness and will try to increase it. However, the qualitative logistical requirements, imposed by the shippers, cannot be ignored.

The container market is characterized by many small fragmented shippers which do not have sufficient volumes to maintain an intermodal operation. Intermodal transport often requires bundling of shippers. But, the various shippers focus on different criteria which prevent the development of possible alliances. It can be useful to match certain shippers with similar requirements; they will probably have a higher incentive to cooperate.

Port Authority Instruments

The function of a port authority has changed from a landlord function to a port development company. Chapter 4.4 describes the instruments of a port authority based on the three function framework. Some concrete examples of these instruments are feasibility studies, subsidies, pilot projects, promotion of intermodal transport, lease contracts, intermodal infrastructure in port area, lobbying for national infrastructure etc.

During the transition process, it is priority for the port authority to define the appropriate role, the correct activities and the exact responsibilities. Transition management theory should provide guidance for the port authority to properly exploit its instruments.

8.1.3 Theoretical Transition Approach

Van den Berg and Bruinsma (2008) examined the transition to renewable energy in the Netherlands. Their findings will serve as input for the development of the transition management framework. Note that a port authority is an institutional body with a limited number of instruments with no control over cargo flows. Fortunately, transition management does not intent to control, “but rather

influence the direction of a complex, adaptive system." (van den Bergh and Bruinsma, 2008). All acquired information is used to develop the transition management theory into the following four main activities:

First activity: Transition-arena process

The port authority should create, maintain and facilitate a transition arena. The purpose of the arena is to be a platform with visionaries that use 'out of the box' thinking. They provide innovative visions to organizations 'willing' to innovate. Participants must discuss problem perceptions, transition paths and long term goals.

When creating the transition arena, actors are selected on the basis of their willingness to invest time and money to play a role in the transition-arena process. Ideally, arena participants are chain actors who are forerunners with open minded visionaries pursuing 'Corporate Social Responsibility entrepreneurship'. An appropriate saying states: 'A modal shift is a mental shift'. In practice, it is likely that a port authority has to convince actors to cooperate by giving them incentives. It is important to include all chain actors into the arena, including the shippers.

Maintaining the process implies a continuous supply of new and up to date information. The port authority should include external knowledge into the arena from tertiary parties like universities and other research institutions. This activity also implies monitoring and evaluating the arena, described in activity four further on.

The port authority also has the task of facilitator in the transition arena. Development of alliances is an important objective in the arena. The port authority should facilitate interactions within the transition-arena. When forming alliances, it would be useful to lay some emphasis on the qualitative criteria defined in the case study. Then, more suitable alliances are formed who can cooperate more efficiently.

Second activity: Transition-agenda process

The purpose of the transition agenda process is designing a joint transition-agenda. This agenda should contain a common problem perception with objectives, action points and projects agreed upon.

Sharing the same visions is important in the transition process. Transition visions should be used to formulate programs and set short and long term objectives. Goals and objectives should be determined using back casting. The European Commission formulated these goals and objectives in the White Paper of Transport. The port authority of Amsterdam developed these into the 'havenvisie'. Evaluation of these sustainability goals and objectives with the arena-participants could provide useful insights. Hence, goals and objectives also represent the broader social setting. The White paper on Transport will guide the process of developing shared visions.

Based on shared visions and a common problem perception in the arena, the port authority should design a joint transition-agenda. They have to consider the lessons learned from completed projects with high importance. The agenda is dynamic, changes over time and helps to translate long term thinking into short term objectives. Hence, the agenda is an action program which defines all activities, objectives and responsibilities of each actor. Every program must also contain learning objectives; learning is a policy objective in its own right.

A well known problem in the transport chain is the unequal distribution of costs and benefits. The costs and benefits of innovations often end up at a single party in normal business models. Business models should indicate who incurred the costs and who will get the benefits of a potential project. The port authority has the important task to make a project attractive to all parties in the intermodal transport chain.

The selection of projects must be supported by profitable business cases which also incorporates the qualitative criteria defined in chapter 6. Both aspects should be examined simultaneously. Initiation of projects will go easier when supported by shippers with similar qualitative requirements. Niches can play an important role due to their experimental capabilities. A port authority can select niches by including shippers with similar qualitative requirements

An adequate transition agenda can be used by the port authority to coordinate the transition process using economic mechanisms (markets, hierarchy and institutions).

Third Activity: Transition-experiment process

The third activity regards the execution of the selected experiments. During this process, the port authority should coordinate the experiments and monitor them.

The experiments should be strategic and time limited, designed to learn about system innovation. Niches, like a particular intermodal transport chain, can play an important role in strategic transition experiments. The selection of innovative experiments is a key question for the port authority. Preferred technologies are partly covered in the White Paper of Transport and other policy documents. These policy documents partly select the correct technologies that create a pathway to a new socio-technical system and prevent lock-in. It is important to determine in what respects these experiments contribute to the overall sustainability goals. Experiments may reinforce each other. The port authority should maintain a total system view, putting all experiments into perspective. They have to ensure that the experiments linkup with ongoing innovation, using their outcomes and learn from them.

The benchmark study illustrated the importance of creating an experiment portfolio. A portfolio of transition experiments helps to structure the transition process and maintain a total system view. This portfolio should contain the results of the experiments with significant and measurable contribution to sustainability objectives. It should also document which experiments reinforce each other and which learning objectives are accomplished. Lessons learned from experiments may change the transition visions, keeping options open.

Fourth Activity: Transition-monitoring process

The port authority plays a leading role in coordinating the fourth activity. This task includes monitoring, maintaining, evaluating and learning through the entire transition process. Monitoring not only refers to the transition cycle but also to the developments outside the transition-arena.

Policy should also be oriented towards learning. Therefore, it is important to formulate explicit learning goals which can be monitored.

Elements that need to be monitored in the arena are: behaviour, network activities, alliance forming, and responsibilities. Monitoring the progress of the joint agenda is an important task of the port authority. Participants must be controlled in keeping appointments, conducting activities and the

achievement of targets. During the experiments, the monitoring process focuses on the actions themselves like the barriers, prospects, points of improvement, etc. Here, learning-by-doing is the overall strategy. The port authority should also ensure that negative outcomes of a particular experiment do not block future research by external policy.

Concluding

According to transition management theory, the port authority should take a leading role in coordinating the transition process, starting with the development of a transition arena. The actual transition should be developed through cooperation between all involved arena-participants. Innovations through alliances become an important feature implementing continuous learning in an open minded process. The port authority should coordinate the activities using the transition-agenda. A total system view can be maintained by creating a portfolio of experiments. Monitoring and evaluating is of high importance during the total transition process.

According to the theory, the four key elements enable a port authority to increase the effectiveness of intermodal transport.

8.2 Practitioner Input

Sub question 8 states: What do practitioners think about the implementation of transition management into the policy of the port authority? This section presents the comments to the theory by experts[39] of the port authority of Amsterdam. There are several complications that cause difficulties when implementing the theory. Hence, every theory needs some adjustment before applying to the practice.

8.2.1 A Problem in the Future

From the problem description we can see that the problem has an economic and operational driver. The market must cope with the enormous growth in container handlings. However, partly due to the crisis, up to now, there are no serious growth problems in the market. The port authority experiences difficulties convincing hinterland actors to cooperate and work on the upcoming problem. Practitioners of the port authority of Amsterdam indicate that actors are prepared to cooperate, only if problems actually arise. Only big firms, who are capable of looking 5 to 10 years ahead at strategic level, are working on the problem. But, the container market is rather fragmented and very little action is taken. Long term contracts could be a possible solution to the short-sighted nature of entrepreneurs in the hinterland chain.

8.2.2 Lack of Transparency

The experts of the port authority of Amsterdam are convinced that the nature of the problem lies within the availability of information on the market. The transport market for containers severely lacks transparency. Various chain actors often have a limited amount of inconsistent information. This results in variable, and sometimes, lucrative pricing agreements. Consequently, it is nearly impossible to determine the cost-structure of a multi-actor hinterland chain. Experts regret the non-existence of a freight index for container transport. The lack of transparency allows various actors to make good money. Hence, they are unwilling to cooperate and open the market.

[39] Brainstorm sessions with experts of the port authority of Amsterdam provided relevant input. Attendees were: Jan Egbertsen, Michael van Toledo, Micha Hes and Koen Overtoom.

8.2.3 ICT

ICT plays an important role in the globalization of today's society. It provides indispensable communication possibilities like the internet. The benchmark study already illustrated the significance of advanced ICT applications. ICT platforms can serve as useful information gateways that can help to open the market.

In the current situation, most actors have their own ICT-systems which often are incompatible. The port authorities of Amsterdam and Rotterdam jointly forced the implementation of a single ICT system called Portbase. Portbase is a neutral and reliable hub for all logistical information in the ports of Amsterdam and Rotterdam[40]. All firms and governments in both ports can exchange information more efficiently and more easily. Obtaining relevant and recent market information is a key objective of Portbase. The first step to an open market is providing everyone the same information.

8.2.4 Main Priority

The port authority should focus on three key elements as determined by the experts of the port authority of Amsterdam. Self-evident, it should build sufficient infrastructure to provide enough capacity for the growth in transport. Incentives for intermodal concepts are another key element. DIHA[41], a sustainability fund of the port of Amsterdam, is an example of a financial incentive. Other non-financial incentives are also important when stimulating intermodal transport, see appendix II for other examples. The third element is the most important part of facilitating intermodal transport. Experts are convinced that port authorities should mainly focus on ICT projects, which is also illustrated by the benchmark study. Developments in ICT are most likely to provide the solution for a more transparent and open market. As mentioned above, the implementation of Portbase is a valuable step towards transparency. The port authority should maintain close contact with the market and concerned actors during these projects.

Opening up the market will be a laborious process with much resistance. Involved actors should be willing or convinced to make a mental shift. Failing to create a more transparent market, where everybody shares the same information, will have negative consequences for the transport sector.

8.3 Port Transition Management – An Action Model

The theory of transition management is thoroughly examined. Experts of the port authority of Amsterdam have given relevant feedback on the theory and the problem. The last sub-question states: 'What are the proper actions of the port authority, putting theory and practice together, in order to stimulate intermodal transport?' This sub-question is answered in the development of 'port transition management'.

8.3.1 Reviewed Transition Approach

It is necessary for a port authority to operate more commercially. Projects must be well structured and coordinated, supported by a profitable business case with explicit goals. Overall the transition management theory provides a good guide for an action program.

[40] See more information about Portbase at www.portbase.com .

[41] In 2009, the port authority of Amsterdam established the Sustainability and Innovation Fund of the Port of Amsterdam (DIHA). DIHA offers various opportunities for financial support for innovative projects. One of the basic principles is that the project is an important contribution to achieving the objectives of the 'Havenvisie' (Port strategic guide) and connects the themes of 'sustainability' and 'innovation'.

The port authority should facilitate the transition-arena and use the transition-agenda to coordinate the transition-projects. Projects need to be supported by a proper business case. The business case should estimate the cost and effectiveness, as specified in chapter 5, but also look at the other qualitative criteria, as defined in chapter 6. The port authority's task is to influence the actor's decision whether or not to cooperate by giving incentives. The ability to steer decisions depend on the available instruments of a port authority. These instruments are based on the three function framework of the port authority and make use of three types of economic coordination; markets, hierarchy and institutions (see chapter 4.4). An important task of the port authority is monitoring and ensuring that the learning objectives can be measured and that they are accomplished. Acquired results and obtained knowledge during projects should be documented into an experiment-portfolio.

The next section presents a number of activities implementing port transition management. Good practices learned from other ports during the benchmark study are also included.

8.3.2 Transition Activities

This section presents an action model with possible activities guided by port transition management. These activities are developed according to transition management theory with input from interviewed market experts. Note that the activities are developed considering the available instruments of a port authority. The bold words characterize the activities for back referencing in the next chapter.

I. *Transition-arena process; Activities:*

- Development of an intermodal international **network** with:
  - Stakeholders in the region and market parties in general (terminals, industry, cargo owners, logistic service providers, transport companies (barge, rail, road and short sea))
  - Stakeholder in the hinterland (dry ports, regions with inland waterways harbour, other seaport for short sea shipping)
- Develop a regional logistic and intermodal **platform** and involve relevant stakeholders (market, universities and governments). This platform provides opportunity for intermodal analyses and developments of new ideas for innovative intermodal projects. Sharing visions is an important aspect.
- Develop close **partnerships** between other nearby seaports or dry ports (WPCI). For instance, co-develop an intermodal seaport ICT system.

II. *Transition-agenda process; Activities:*

1) Development of a sustainability **fund** for innovative projects improving intermodal transport connecting the port region to the hinterland.
2) Help with innovative or sustainable private investments in intermodal terminals by **subsidies** or grants.
3) The development of new infrastructure connecting the port with the hinterland is usually not the direct responsibility of the port authority, but the responsibility of regional and national

authorities. Then, the port authority's task is more dedicated towards **lobbying** for timely development.

4) Develop a regional or national **promotion** agency promoting the possibilities of intermodal transport towards relevant market parties. ICT can be a meaningful tool.

5) Provide necessary coordination as an **independent** party to develop new intermodal solutions together with market actors. During the realisation of shuttles for example.

III. *Transition-experiment process; activities:*

1) The port authority is directly responsible for infrastructural investments in the port area itself like quays, rail, inland waterways and short sea. She can provide the proper **infrastructure** but cannot dictate the modal choice. Sharing intermodal visions can help to influence the modal choice.

2) Help **private** parties (the market actors) develop new intermodal shuttles (rail, barge and short sea) by. The port authority can help with research, market studies, feasibility studies or providing subsidies and grants. Projects must be based on feasible business cases (executed in the transition-agenda process) with sufficient return on investment.

3) Development of **ICT** systems that help to improve intermodal transport (planning, tracking and tracing, green lanes and cooperation with e.g. customs).

4) **Pricing** policy can help to improve intermodal transport. For instance by lower harbour dues for short sea shipping or use of inland waterways and rail.

5) Special **targets** can be added in the land lease contracts concerning the use and development of intermodal transport (e.g. modal shift targets).

IV. *Transition-Monitoring process; Activities:*

1) Develop an experiment-portfolio of all executed projects with achieved results and obtained knowledge. The **portfolio** helps defining objectives and goals of projects by providing up to date knowledge.

2) **Monitor** and, where needed, control the involved market actors to ensure proper progress of the transition process.

3) Take a leading **role** during the transition process and ensure that learning objectives are met and documented.

These activities are a guide and may differ for each situation and port region. Note that the total transition is a complex process that may take many years. The next chapter describes the implementation of port transition management in the port of Amsterdam as a business case example and emphasizes the development of some key activities.

9. Application of Port Transition Management

Chapter 8 developed a framework, shaping transition management into 'port transition management' using acquired knowledge. This framework aims to increase the effectiveness of intermodal container transport towards the hinterland. Different activities have been identified to increase the effectiveness of hinterland transport. This chapter applies this theory to a business case of the port of Amsterdam. The port authority of Amsterdam already implemented a number of activities in which port transition management can be revealed. After examination of already initiated activities, future challenges can be determined.

9.1 Business Case of Amsterdam

Port transition management can be revealed in already performed activities, described in the 'Port strategic guide' (Havenvisie). Desk research and interviews with employees of the port authority of Amsterdam also provided useful information about recent initiatives. Port transition management already seems to be applicable to some of these initiated activities. After determination of the already performed activities, points of interest can be defined to cope with future challenges. Points of interest are determined by a brainstorm session. Port transition management is used as a guide during this process. Table 11 illustrates the results of the business case of the port of Amsterdam.

I Arena	**Already performed initiatives**	**Challenges in the future**
1) **Network**	- Member of European Sea Ports Organization (ESPO) - Development of network of shippers in the hinterland through 'circle lines' project[42]	- Introducing WPCI into ESPO. - Implement a similar program to rail transport
2) **Platform**	- Member of 'platform regionale havenstrategie' with Schiphol and the flower auction - Economic Development Board Amsterdam (EDBA) has a logistic workgroup focusing on three priority area: Circle Lines, seamless logistic networks (sychromodallity), smart service hub (airport seaport) - Cooperation between Dutch ports	- Continuing process of binding relevant stakeholders - Platform building with ALL relevant actors. - Further develop cooperation between ports and hinterland
3) **Partnerships**	- Close relationships with port of Rotterdam (Portbase, Key-rail) - Foundation ECOPORTS, partnership between 9 ports considering environmental issues	- Connect Portbase to the hinterland - Improving partnerships with dry ports like Lelystad and Almere

Table 11a: Future challenges of the port authority of Amsterdam, Transition-arena process

[42] Circle Lines is a new logistics concept in inland shipping. The logistic system consists of three 'Circle lines' with the port of Amsterdam as the central hub. The three circle lines correspond to three regional scales, namely national (Amsterdam-Rotterdam), regional (Amsterdam-Kampen) and local (Amsterdam-Zaanstad). Within these three rounds, transport services will be offered on a regular basis, cargo can be transported within the same service or can be moved to another scale via the Port of Amsterdam (performing a hub function). Fixed sailing schedules and accurate delivery times at fixed rates are key characteristics. This concept enables easier bundling of flows. This logistic system will be coordinated by a trusted, independent third party.

II Agenda	Already performed initiatives	Challenges in the future
1) **Fund**	- Establishment of DIHA	- Use DIHA more for intermodal projects - less focus on the region and more on the hinterland connections
2) **Subsidies**	- Investments in intermodal port terminals like the Ceres Terminal - Development of the AMSbarge	- Also focus on inland barge terminals like Lelystad and Almere with extensions to rail terminals
3) **Lobbying**	- Own area, own responsibility for lobbying - Participant of the organization Key-rail (operator of the Betuweroute)	- Convince relevant actors to make a 'mental shift'
4) **Promotion**	- Connections with national information offices considering short sea, rail and inland shipping	- More implementation to the region.
5) **Independent**	- AMSbarge[43] - Circle Lines	- Continuing implementation - Keyrail might operate on a national level servicing rail freight on the total national network

Table 11b: Future challenges of the port authority of Amsterdam, Transition-agenda process

III Experiment	Already performed initiatives	Challenges in the future
1) **Infrastructure**	- Done and in progress	- Establish more contact with relevant stakeholders to acquire feedback and points for improvement.
2) **Private**	- Done and in progress	- More focus on rail, develop a circle lines concept for rail transport
3) **ICT**	- Development of Portbase	- Extend to the hinterland - Implement regional, national, international data exchange
4) **Pricing**	- Ongoing research on the possibilities of harbour dues for sea shipping, inland shipping. Rail and road transport is not (yet) charged.	- Finding a more efficient way to price transport
5) **Targets**	- Currently a tryout with added special targets in contracts	- Implementing the results - Based on rewards or sanctions?

Table 11c: Future challenges of the port authority of Amsterdam, Transition-experiment process

[43] See appendix II for explanation.

IV Monitoring	Already performed initiatives	Challenges in the future
1) **Portfolio**	- Only documentation of separate projects	- create a structured portfolio of executed projects and programmes. Illustrate the context of programmes and prioritize
2) **Monitor**	- Monitoring activities are ad hoc but is in development	- Structural implementation of key performance indicators (KPI) - Effective use of Portbase might increase market transparency - Pro-active account management, maintain better relations with relevant stakeholders focussed on intermodal transport (more visits)
3) **Role**	- The port authority attempts to take the leading role during the transition process	- Coordinate the transition process - Propagate more involvement - May need further research into what extend the port authority can take a leading role

Table 11d: Future challenges of the port authority of Amsterdam, Transition-monitoring process

9.2 Results

Table 11 illustrates that the port authority of Amsterdam is well on its way to become a sustainable port. A fair amount of activities have been implemented to increase the effectiveness of hinterland transport. The future challenges can be considered as recommended points of attention according to port transition management. Policy makers are recommended to use back casting as a key element when developing objectives and goals at a strategic (5 to 10 years ahead), tactical (1-5 years ahead) and operational level (1 year ahead).

One can conclude that several areas require proper attention. Using the port transition management framework, a brainstorm session with experts from the port authority of Amsterdam assigned areas in which further development is needed. Overall, evaluation and monitoring are lacking. The introduction of key performance indicators (KPI) may provide a method to determine whether objectives are achieved. The development of an experiment portfolio will structure the transition process and enables the port authority to coordinate and take a leading role. The Hinterport initiative of Antwerp provides a good example by the Hinterport blueprint. The port authority should explore and exploit all the possibilities of information communication technologies. Developments in ICT are the most important and stress the potential capabilities of Portbase. Portbase must provide efficient exchange of information and data. This is the key to better coordinated synchromodal transport. Another useful application of ICT is the creation of a digital community. The port authority already is connected to several relevant national and international organizations but it should also focus on local and regional actors in the hinterland (especially shippers). One should prevent that different groups of actors are engaged in similar projects. The establishment of one single transition arena is therefore a necessity. This poses an important challenge for the future: the introduction of WPCI into the ESPO. Price related activities suffer from the lack of transparency on the market. The presented case study in chapter 6 aims for more insights in cost related aspects of the market but still has several remarks. Further developments of Portbase aim to increase the market transparency.

9.3 Concluding

The business case of Amsterdam's port authority illustrates that the framework of port transition management is a suitable way to structure the transition process. It puts all individual experiments and actions in a clear context and helps to coordinate and manage the total transition process. The importance of ICT is illustrated by the benchmark study and the literature review. The advanced possibilities of ICT applications can support almost every activity and are an indispensible tool (see Antwerp's Hinterport project for illustration). The framework stresses the necessity of including every relevant stakeholder into one single arena. However, the framework is still missing an important aspect in the arena-process. The framework pays no attention to the internal coordination and information exchange within the port authority. It is useful to share information and knowledge about activities performed by other employees regarding the transition process. A common problem perception and shared visions will probably improve the collaboration and productivity of employees and enables mutual learning. This will result in better internal coordination. Therefore, it is necessary to add an additional activity to the arena process:

- *Create a transition board within the port authority with all involved employees.*

Internal gateways of knowledge and information become important. An example is the development of Intranet, a private computer network for data exchange and communication. Intranet enables employees to easily contact the total network of the organization but also provides the distribution of knowledge and information. Intranet could be an applicable tool to create and maintain a transition board.

The port transition management framework enables a thorough analysis of a port authority's activities concerning the development of intermodal transport. This analysis concludes that the port authority of Amsterdam should focus on the following key elements in order to induce intermodal hinterland transport:

- Take a leading role and coordinate the total transition process
- Develop an experiment portfolio and introduce strategic KPIs
- Create, facilitate and maintain one single transition-arena with all relevant actors, including actors from the hinterland
- Explore and exploit the possibilities of advanced ICT applications

10. Conclusions & Recommendations

This paper has attempted to provide a solution for sea ports that have to cope with the increasing growth in container transport. Acting like a port development company, port authorities aim to increase the effectiveness of hinterland connections that have a lighter environmental footprint. Transition management theory is used to examine this problem and provides a guide to a possible solution. This paper intent to answer the research question: 'How can transition management theory help a port authority to improve intermodal transport by increasing the effectiveness of intermodal hinterland chains of its sea port?'

10.1 Conclusions

This paper illustrates the complexity of intermodal transport due to the many actors involved with different agendas. The enormous economic growth in 2008 showed significant coordination problems in the hinterland transport. However, there are no serious problems present in the actual market. Market actors do not see the necessity of investing in expensive sustainable transport. Unlike most market actors, a port authority incorporates a long term strategy and aims to prevent these already encountered coordination problems in the future.

Intermodal transport is very complex and hardly an advantage. It often has fewer competencies and incorporates more risks and uncertainty. The case study emphasized the importance of additional services as a way to differentiate from road transport. However, actors have to cope with a market which severely lacks transparency. They hesitate to cooperate in a market where every transaction is negotiable and comes with many uncertainties. The case study illustrated that the effectiveness of the total chain increases when the logistic service provider controls and owns every actor in the chain. The vertical integrated governance structure is an efficient way to cope with these market specific uncertainties. It does not permit individual optimization but stimulates cooperation to achieve the most cost-effective and efficient logistical operation. This paper advances the knowledge about important criteria considered by decision makers interested in intermodal transport. There are multiple criteria which support go or no-go decisions besides cost and reliability. The used analytical framework emphasizes a multi-actor approach with a combination of bottom-up and top-down elements and stresses the involvement of shippers. The port authority can only play a role if it has good insights and understanding of the forces in the hinterland chain. The greatest bottleneck to overcome is the lack of market transparency. Advanced ICT applications like Portbase can play a significant part in increasing the market transparency.

After examining the theory, analyzing the results of the case study and benchmark study and implementing the input from interviewed market experts, the main research question can be answered. Transition management theory helps a port authority by providing a guide that enables the port authority to coordinate the transition to more effective hinterland transport. The business case of Amsterdam illustrates that the framework of port transition management is an appropriate analysis, structuring the transition process. Port transition management emphasizes the coordinating, leading role which the port authority should fulfil and defines four core elements: arena, agenda, experimental and monitoring elements. The port authority has to use its instruments to pursue the actors to make a mental shift and convince them to cooperate breaking the current course of business. It should facilitate cooperation to increase the effectiveness of the total chain. It is expected that the shippers are eager to collaborate as market transparency results in a more

optimal price quality level. Proper activities, according to port transition management, have been developed for optimal use of the port authority's available instruments. The advanced possibilities of ICT applications support almost every activity and are an indispensible tool.

10.2 Recommendations

The port transition management framework enables a thorough analysis of a port authority's activities. The business case of the port authority of Amsterdam resulted in a number of recommendations to increase the effectiveness of intermodal hinterland transport.

Based on this study, several points of interest can be defined. The port authority should focus on the entire chain in which the logistic service provider is the most significant actor. It is important to involve the shipper who can play a sufficient part in the transition process. Lack of market transparency is the biggest bottleneck in the hinterland transport chain. Port authorities should mainly focus on incentives to open up the market. New Information Communication Technologies are promising developments for realizing a more transparent market. Port transition management structures the transition process and provides a useful guide for the port authority. The theory advises to create a single arena with all relevant actors and use the transition-agenda to coordinate the transition-experiments. Investment projects should be well supported by multi-actor business cases. The port authority of Amsterdam appears to pay insufficient attention to the evaluation and monitoring activities. It is recommended to develop an experiment portfolio which keeps track of the results and the implications of projects. It should also document the progress of learning objectives and impact on other projects.

The most important recommendations for the port authority of Amsterdam can be summarized in the following bulletins:

- Take a leading role and coordinate the total transition process.
- Develop an experiment portfolio and introduce KPI's.
- Create, facilitate and maintain one single transition-arena with all relevant actors, especially involving actors from the hinterland.
- Explore and exploit the possibilities of advanced ICT applications.

10.2.1 A Possible Solution

According to port transition management theory, coordination is the task of the port authority during the transition to sustainable transport. In my opinion, the port authority should introduce a new actor into the market. This actor should be an independent intermodal logistic service provider that opens up the market. This measure is derived from the introduction of the energy distribution company during the transition to renewable energy (See box 2).

To my understanding, the ultimate solution for a port authority is an ICT-platform that contains all relevant market information, available to every actor. The introduction of one independent intermodal booking agency should be realized. Transport companies can present their services at a fixed price with a fixed quality. Qualitative requirements, as determined in the case study, should be indicated in advance. Shippers can present assignments with the required competencies whereupon logistic service providers can tender. The most important elements are market transparency and easily obtained information. Every service must be delivered against a predetermined price and stated quality. This eliminates the emotional relation with other firms and helps rational decision

making. The port authority could create and facilitate this platform by efficient use of the available instruments, guided by the port transition management framework.

This potential platform emphasizes the future possibilities of ICT and stresses the importance of synchromodal transport. Similar agencies already exist in other markets, like the market for private tours.

11. Discussion

This chapter briefly discusses this thesis and defines areas for further research.

11.1 Discussion

This thesis searched to define the different forces in the market of container transport to the hinterland. The aim was to find a method for enhancing the effectiveness of intermodal hinterland chains. The results are supported by a case study. Most objectives aimed for are achieved. However, there are several shortcomings and blind spots in this model which should be taken into account, as defined in chapter 6. The gathering of market figures turned out to be very difficult. Assumptions had to be made because figures were not available, either by omission or due to secrecy. The case study illustrates the complexity of the hinterland transport system. The results must be generalized with caution because they derive from one hypothetical case. However, the case study does present results matching relevant literature.

Overall this paper illustrates how the market for container transport is put together. There are numerous case specific elements each having its own restriction on the feasibility of a potential business case. The logistic service provider in this particular case owns all involved actors. The results will probably be different when not all actors are in the possession of one owner. Another case specific element is the fact that the logistic service provider also provides other services and makes his profit with warehousing.

Moreover, the method used in the case study, fails to implement multiple qualitative criteria into the model. Instead, one criterion is selected to do the analysis. The alternative is a multi-actor multi-criteria analysis, as presented by Macharis et al. (2009). However, there probably will be some difficulties assigning the weights. Each actor considers his own criteria equally or more important than criteria of other actors. The defined qualitative criteria in the case study are not neglected but included in the port transition management framework.

The case study results did not enabled the development of an action model for the port authority that might increase the effectiveness of intermodal hinterland transport. Therefore, the complex socio-technical system of the hinterland transport has been examined by transition management theory. The benchmark study led to useful insights by learning from other port authority's initiatives. Transition management theory proved to be applicable to the situation of the port authority, enabling the development of the port transition management framework. A brainstorm session at the port authority of Amsterdam confirmed the framework to be a proper guide to structure and coordinate the available instruments. However, the framework still lacks at the arena process. It pays no attention to the internal coordination and information exchange within the port authority. Therefore, the development of an additional activity in the arena process is suggested:

- *Create a transition board within the port authority with all involved employees.*

This research is conducted from the view of the port authority. They consider the lack of market transparency and the availability of information on the market the biggest problems. Port transition management led to the formulation of a possible optimal solution. The recently introduced concept 'synchromodal transport' confirms the potential of this solution. Some market actors will probably not experience the lack of transparency as a problem. It is to imagine that they would rather not

participate in projects that lower consumer prices. However, many economics believe that an open transparent market is preferable.

11.2 Further Research

This thesis contributes to current literature by combining applied research with governance theory. It can serve as a starting point for a thorough logistic chain analysis. The findings are partly based on a case study regarding hinterland transport using barge. New applicable methods to include multiple qualitative criteria from different actors would significantly improve the approximation. Further research should determine the applicability of the model to other hinterland chains using other modalities. The case study illustrated the complexity of the way container transport is organized. Further research is recommended about the organization of container transport and in particular into the way a hub should function in the hinterland chain.

This thesis emphasizes cooperation in the hinterland chain. In practice, the port authority will probably have to convince relevant actors to cooperate by giving them incentives. Further research exploring methods to convince or force involved actors to cooperate would be useful. Emotional aspects severely influence the market which obstructs rational decisions. Money still is a strong incentive, but must be applied correctly. Finding a correct method to apply proper incentives should also be a learning objective during the transition process.

The framework of port transition management proved to be useful to structure the activities of the port authority of Amsterdam. However, it is rather difficult to determine the effects of not yet implemented policy. Empirical analysis will be necessary to evaluate the effects of the recommended activities. The framework has been studied for the port authority of Amsterdam and is supported by an internship which enabled brainstorm sessions with practitioners. Knowledge of other ports is limited to benchmarking and desk research. The applicability of this framework to other ports needs to be verified by further empirical analysis.

The potential solution presented in chapter 10.2 raises a significant question for the port authority: Can the port authority itself develop into an independent intermodal network coordinator? Can the port authority be a link between individual market parties and shippers? As yet, there are no concrete plans to realize this platform. At all times, port authorities have to be careful that they do not compete with their own costumers. Further research on this subject would be very interesting, assuming it will induce intermodal transport dramatically.

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Appendix I – Cost Calculation

Appendix II – Benchmark Innovative Port Initiatives

European Region

Port of Amsterdam – www.portofamsterdam.nl

Name Initiative	Type initiative	Involved parties	Website	Year
AMS Barge	Hardware	Bargeoperators Mercurius Scheepvaart Group and MCT-Lucassen, Damen shipyard	www.mercurius-group.nl	2006
Short description: The AMS Barge is a container barge with its own container crane. Making container movement more flexible due to the possibility to move containers to inland terminals without cranes.				
Portbase	Software	Port of Rotterdam	www.portbase.com	2011
Short description: Port Base is a joint Port Community System of the ports of Rotterdam and Amsterdam. Companies and governments in both ports exchange information more efficiently and easily.				
Betuwe route	Hardware	Port of Rotterdam, Prorail, Keyrail	www.kennis.betuweroute.nl	2007
Short description: The Betuwe route is a railway totally committed to freight heading to the German hinterlands.				
Expansion of rail facilities	Hardware			2010
Short description: Incentive to make transport by train more attractive by developing rail facilities in the port.				
Walradar	Software/ Hardware	Rijkswaterstaat		N.A.
Short description: This system will provide safer and more efficient guiding of ships in the North Sea. Rijkswaterstaat develops, in collaboration with the Port Authority, a complete radar and traffic system.				

Hamburg Port Authority - http://www.hamburg-port-authority.de

Name Initiative	Type initiative	Involved parties	Website	Year
HHLA	Orgware	Hamburg Hafen und Logistik AG (HHLA)	www.hhla.de	N.A.
Short description: The Hamburg Hafen und Logistik AG is a very important company in the port of Hamburg continuing to expand their intermodal rail services. They highlight important success factors such as: frequent train services, optimizing equipment to maximize efficiency, eliminating shunting where possible, providing a high capacity hub and technical innovation.				
Port Telematics Masterplan	Orgware	EU		N.A.
Short description: This EU-subsidized plan aims to optimize traffic and logistic processes in the seaport by using intermodal transport and logistics data.				
Inland terminal network	Hardware	Eurogate Group and Hamburg Hafen und Logistik AG (HHLA)	www.eurogate.de www.hhla.de	N.A.
Short description: This is a joint venture to develop an inland terminal network. The emphasis of this initiative will be on full-service hinterland terminals, underscoring the importance of economies of scale and the availability of terminal facilities.				
Hamburg Port Railway Master Plan	incentives			N.A.
Short description: Key objectives in this ongoing investment program include reducing congestion and increasing port capacity.				

Port of Antwerp – www.portofantwerp.com

Name Initiative	Type initiative	Involved parties	Website	Year
Trilogiport Luik	Hardware	Port Autonome de Liege	www.portdeliege.be/nl/pages/trilogiport.aspx	2006
Short description: This is an economical alliance to attract investors to the port of Liege. It is a new area with an intermodal container terminal (15 ha), Port lands (14,7 ha), Logistics zone (40 ha) and service zones (1,8 ha).				
Hinterport	Orgware	17 parties	www.hinterport.eu	2010
Short description: Hinterport is an information platform which aims to: “enhancing the knowledge in the intermodal freight logistics sector and fostering advanced methods and procedures of co-operation for sea ports and hinterland integration”.				
Antwerp Intermodal Solutions (AIS II)	Orgware	Logistic service providers and operators		2007
Short description: The AIS II program stimulates collaboration between logistic service providers and operators on European scale. The modal split of rail in the port of Antwerp was in 2008, 11 percent. The ambition is to raise this share to 15 percent by 2020 and take of another 340,000 containers of the road. To support the growth of rail transportation, the Port of Antwerp will be expanded the rail infrastructure in and around the port. The Port Authority also stimulates a higher proportion of modal split in inland shipping.				
Green Lane Concept	Hardware/ software	Port of Durban, VIL		2010
Short description: The project regards a transportation lane from Durban, South Africa to Antwerp. Customs made bilateral agreements for some goods, supported by appropriate technology. For these goods, customs move the green light: containers are not checked, thus time and money profits. Because every container has it’s own Container Security Device (of EDC), Customs can check the movements using the VeLP+ Platform (created by VIL).				

Port of Rotterdam – www.portofrotterdam.com

Name Initiative	Type initiative	Involved parties	Website	Year
Portbase	Software	Port of Amsterdam	www.portbase.com	2011
See port of Amsterdam for short description.				
Maasvlakte 2	Hardware	Terminal operator DP World, shipping lines APL, Hyundai, MOL and CMA CGM		2013
Short description: The Maasvlakte 2 is a large capacity addition to the container sector of the port of Rotterdam. It is a new area of terminals build into the North Sea with many intermodal facilities.				
Traffic Management Company	Orgware	The Metropolitan Area of Rotterdam and the Municipality of Rotterdam		N.A.
Short description: The aim of this program is to reduce congestion on the A-15 by removing the administrative fragmentation associated with road management and mobility.				
Development of inland terminals	Hardware		www.containertransferium.com	N.A.
Short description: The realization of one or more highly integrated container hubs outside the port.				
Betuwe route	Hardware	Port of Amsterdam, Prorail,	www.kennis.betuweroute.nl	2008

		Keyrail		
Short description: The Betuwe route is a railway totally committed to freight heading to the German hinterlands.				

Ports of Bremen/Bremerhaven - http://www.bremenports.de

Name Initiative	Type initiative	Involved parties	Website	Year
Container Terminal 4	Hardware		www.bremenports.de	2008
Short Description: The construction of Container Terminal 4 extents the riverside quay by 1681 meters and raises the total port area with approximately 90 ha.				
JadeWeserPort	Hardware	Eurogate	www.bremenports.de	2011
Short description: The so-called JadeWeserPort is a deepwater port in Wilhelmshaven which offers an premium service for mega-container vessels.				

Asian region

Maritime and Port Authority of Singapore - http://www.mpa.gov.sg

Name Initiative	Type initiative	Involved parties	Website	Year
Alliance Hubbing System for Shipping Lines	Software	PSA, MINT Fund		N.A.
Short description: The program is called ALLIES^{TM} and aims to enhance efficiency in alliances through standardization of business processes.				
Asset Tracking via Satellite	Hardware	MINT Fund, SingTel		N.A.
Short description: Real-time asset tracking and pre-alerts during security breaches by attaching compact satellite tracking devices to assets and personnel.				
Intelligent Bunker Management System –Barge (iBMS-Barge)	Software	MINT fund, BTS Pte Ltd		N.A.
Short description: iBMS helps to increase efficiency and profitability by optimizing business processes. It centralizes all business activities in a single integrated platform that handles activities like sales enquiry, quote, confirmation, scheduling, contract management, inventory management, risk management, delivery, invoicing and management reporting. In addition, the barge-module provides two-way data communication between back office operations and the barge carrier.				

Port of Hong Kong - http://www.mardep.gov.hk

Name Initiative	Type initiative	Involved parties	Website	Year
There is very little knowledge of recent initiatives, probably because of a very high level of secrecy.				

Nagoya Port Authority - http://www.port-of-nagoya.jp

Name Initiative	Type initiative	Involved parties	Website	Year
Developments of the port, found on the website, mainly focus on the (deep) sea-side of the port. They present no initiatives that enhance the intermodal connectivity.				

Bureau of Port and Harbor, Tokyo Metropolitan Government - http://www.kouwan.metro.tokyo.jp

Name Initiative	Type initiative	Involved parties	Website	Year

Website is lacking information.

North America

Port of Long Beach/Port of Los Angeles - http://www.polb.com / http://www.portoflosangeles.org

Name Initiative	Type initiative	Involved parties	Website	Year
Inland Port Feasibility study	Study	The Tioga Group, Inc. Railroad Industries, Inc. Iteris		2008
Short description: This is a study that explores many intermodal plans, especially plans for inland ports. However, this study only contains proposals which lack detail and would require considerable analysis to verify.				
Intermodal infrastructure	Hardware		www.portoflosangeles.org/facilities/rail_intermodal_yards.asp	N.A.
Short description: The port of Los Angeles has invested $200 million in rail and highway infrastructure improvements. They successfully enhanced the cargo delivery system and increased the port's cargo-handling capacity.				
Centralized Traffic Control (CTC)	Software	Pacific Harbor Lines		N.A.
Short description All the on-dock rail yards of the port are linked to the CTC System that manages all train movements with the highest level of efficiency and safety.				

Port Authority of New York & New Jersey - http://www.panynj.gov

Name Initiative	Type initiative	Involved parties	Website	Year
There are currently no initiatives to encourage intermodal transport.				

Port of Oakland - http://www.portofoakland.com

Name Initiative	Type initiative	Involved parties	Website	Year
Trade Corridor Infrastructure Fund (TCIF)	Orgware	California transportation commission	www.portofoakland.com/maritime/tcif.asp	2006
Short description: This fund includes $2 billion available for infrastructure improvements along corridors that have a high volume of freight movement. The commission must give his approval where efficiency and sustainability are key factors.				

Africa

Transnet National Ports Authority, South Africa

Name Initiative	Type initiative	Involved parties	Website	Year
Green Lane Concept	Hardware/ software	Port of Antwerp, VIL		2010
See port of Antwerp for description.				
The port has no website.				

South America

Port of Santos Port Authority - http://www.portodesantos.com

Name Initiative	Type initiative	Involved parties	Website	Year

No translation for the website available.				

Appendix III – Performed Interviews

Interview met experts van de haven autoriteit

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1. Wat is precies uw functie binnen het havenbedrijf?
2. Waar houdt u zich mee bezig?
3. Wat zijn de trends binnen uw werkgebied?

4. Hoe zit de kostenstructuur in de keten in elkaar? Reflectie op het model? Wat zijn kwalitatieve beslisfactoren?
5. Lopen er op het moment nieuwe innovaties binnen uw werkgebied?
6. Welke rol speelt de haven in deze fase van deze innovatie?

7. Wat zijn uw ideeën over inter-modaal vervoer?
8. Zijn er op het moment interessante ontwikkelingen binnen logistieke ketens?

Interview met Verladers

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1. Wat is precies uw functie binnen dit bedrijf?
2. Waar houdt u zich mee bezig?

3. Hoe zitten de koststructuren in een logistieke keten in elkaar?
    - Hoeveel verscheept u in TEU's per jaar?
    - Hoe groot moet een basisstroom zijn voor een intermodale operator?
4. Uit welke componenten zijn de transportkosten per TEU opgebouwd?
    - Wanneer wordt er gebruik gemaakt van een intermodale logistieke dienstverlener?
    - Wanneer wordt er gebruik gemaakt van een uni-modaal logistieke dienstverlener?
    - Zelf transport regelen of laten regelen?
    - Aan welke kwalitatieve eisen moet transport voldoen? Voorraad beheer vs. Frequentie etc.?
    - Beperkende factoren (Tijdsvenster en intensiteit etc.)?
    - Verschil in kosten en gebruikerspercentage van container, wissellaadbak en huckepackers?
    - Hoe worden de kosten van douane handeling in rekening gebracht?
    - Hoe zit het met de kosten van het equipement? Retour containers?

5. Wat zijn de trends op transport gebied waar u mee te maken heeft?
6. MVO beleid, wat mag intermodaal vervoeren globaal kosten?
7. Zijn er innovaties op het gebied van transport waar u mee te maken heeft?
8. Wat is uw visie over havenautoriteiten? Welke functie moeten zij vervullen?

Interview met Intermodale Operators

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1. Wat is precies uw functie binnen dit bedrijf?
2. Waar houdt u zich mee bezig?

3. Hoe zitten de koststructuren in een logistieke keten in elkaar?
    - Welke functies vervullen jullie allemaal in de logistieke keten (welke blokken)?
    - Hoe groot moet een basisstroom zijn voor een intermodale operator?
4. Uit welke componenten zijn de handeling kosten per TEU opgebouwd?
    - Capital (lease etc), variable (terminal handling etc)?
    - Verschil in kosten en gebruikerspercentage van container, wissellaadbak en huckepackers?
    - Hoe zit het met de kosten van het equipement? Retour containers?
    - Hoe zit het met overhead en mark-up?

5. Overige competenties naast shuttleservice tussen 2 punten?
6. Wat zijn de trends binnen uw werkgebied?

7. Lopen er op het moment nieuwe innovaties binnen uw werkgebied?
8. Welke rol speelt de haven in deze innovatie?
9. Wat is uw visie over havenautoriteiten? Welke functie moeten zij vervullen?

Interview met Terminal Operators

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1. Wat is precies uw functie binnen dit bedrijf?
2. Waar houdt u zich mee bezig?
3. Wat zijn de trends binnen uw werkgebied?

4. Hoe zitten de koststructuren in een logistieke keten in elkaar?
    - Welke functies vervullen jullie allemaal in de logistieke keten (welke blokken)?
    - Hoe groot moet een basisstroom zijn voor een operator?
    - Hoe zit het met overhead en mark-up?
    - Doen jullie ook aan terminal-haulage?
    - Hoe zit het met de kosten van het equipement? Retour containers?
5. Uit welke componenten zijn de handeling kosten per TEU opgebouwd?
    - Hoe worden de kosten van douane handeling in rekening gebracht?
    - Verschil in kosten en gebruikerspercentage van container, wissellaadbak en huckepackers
    - Verschil in kosten tussen binnenvaart, rail, truck (aantal moves per modaliteit gemiddeld)

6. Relatie overhead en mark-up met verticale integratie in de keten?
7. Hebt u functies naast overslag? Opslag?
8. Lopen er op het moment nieuwe innovaties binnen uw werkgebied?
9. Welke rol speelt de haven in deze innovatie?
10. Wat is uw visie over havenautoriteiten? Welke functie moeten zij vervullen?

Interview met Transporteurs (Truck)

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1. Wat is precies uw functie binnen dit bedrijf?
2. Waar houdt u zich mee bezig?

3. Hoe zitten de koststructuren in een logistieke keten in elkaar?
    - Welke functies vervullen jullie allemaal in de logistieke keten (welke blokken)?
    - Betrokkenheid in Intermodaal vervoer?

4. Uit welke componenten zijn de handeling kosten per TEU opgebouwd?
    - Capital (lease etc), variable?
    - Verschil in kosten en gebruikerspercentage van container, wissellaadbak en huckepackers?
    - Wat zijn de kosten om de container te laden/lossen bij de verlader/geadresseerde? (verschil in containers)
    - Hoe zit het met de kosten van het equipement? Retour containers?
    - Hoe zit het met overhead en mark-up?

5. Overige competenties naast transportservice tussen 2 punten?
6. Wat zijn de trends binnen uw werkgebied?
7. Lopen er op het moment nieuwe innovaties binnen uw werkgebied?
8. Welke rol speelt de haven in deze innovatie?
9. Wat is uw visie over havenautoriteiten? Welke functie moeten zij vervullen?