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Strategies and new business models in intermodal hinterland transport

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Strategies and new business models in intermodal hinterland transport

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven, op gezag van de rector magnificus prof.dr.ir. F.P.T. Baaijens,

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door

Roy van den Berg

geboren te Maassluis

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“The journey is the treasure”
Lloyd Alexander

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I started with an outline of the article; Peter gave his thoughts on additional topics and the structure of the paper. I wrote an initial literature review. We decided on the methodology and executed the research. I performed the analysis, wrote down the outcome and the preliminary conclusions. Afterwards, Peter made suggestions for: additional literature, conclusions, the use of empirical examples, improvements of the structure, a theoretical framework, or just some general editing to improve the readability. Based on these suggestions I continued with the paper and if we were both satisfied, usually after more than one round of adjustments, we submitted the paper. I very much enjoyed this way of working. One paper on the port of Barcelona was also co-authored by Carles Rua Costa. As employee of the Port Authority of Barcelona, his main contribution was the provision of a significant amount of case study material on the shuttle train between Barcelona and Lyon. He also reviewed the paper to correct any misinterpretations or wrong conclusions. I am very thankful for his time and cooperative stance, especially during my first visit to Barcelona for the case study on Barcelona's hinterland strategy. Chapter 7 is based on a master thesis written by Paul van Zuijlen. Almost 2 years after the publication of the first article on the hinterland strategy of Barcelona, Paul contacted me as he was very interested in the topic. I suggested diving into the two-sided market theory in relation to ports. Together with Peter, I supervised his thesis, a project he worked on with a lot of enthusiasm. I used the core of his introduction on port pricing, the comparison on port pricing and the application of the two-sided market theory, as a starting point for the paper. Afterwards, Peter and I further completed the paper. It was a joy to have such an enthusiastic student taking my ideas for research a step further and I appreciated his contribution very much. During the end of my PhD journey, Jan Fransoo became involved as my second supervisor. I want to thank you for taking up this task at the final stage of my PhD. Additionally, I would like to thank you, and the members of my committee, for the valuable feedback during the final stage.

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Chapter 1

The start of a journey through intermodal strategies and business models

More than 15 years ago a scientific article, titled 'Gateways and Intermodalism', proposed that gateways (i.e. seaports) are in a unique position to stimulate intermodal transport and use intermodal systems as a tool to enlarge their hinterland. It suggested that, as the potentials for intermodalism are not directly exploited by commercial organizations, port authorities should take the lead: have a vision on the hinterland, identify markets to be reached by intermodal transport and bring various parties together to start new connections. Today, the content of this article by Van Klink and Van den Berg (1998) remains, to a large extent, valid. The only difference is that market circumstances have significantly changed. Container volumes have almost tripled, the intermodal transport market has become much more competitive and the attention for the environmental impact of transport has substantially increased. Despite the growth of intermodal transport, there is still a huge potential for further growth because in most (European) ports the share of road transport is still dominant.

Due to this growth potential of intermodal transport, much more has been said about the role of ports and port authorities on this topic during the last 15 years. Still, questions exist on how ports should compete to strengthen their position. For example, Fransoo and Lee (2013) question what role can be played by intermodal hinterland connections as part of specific supply chain characteristics in the competitive position of the port. Notteboom and Rodrigue (2009a) question if there is a growing divide between sea-based and land-based operations, due to the increasing vessel size (massification at sea) and the dominant usage of road transport (atomization on the land side). Intermodal transport could make the divide smaller if it is better integrated by all the players involved. Notteboom and Winkelmans (2001) observed a transition at shipping lines, driven by the door-to-door philosophy, into intermodal logistics organizations offering intermodal bill of ladings to inland locations. However, no further research has been performed on the benefits, potential and implementation of these strategies and value propositions. The goal of the research presented in this dissertation is to provide empirical evidence and theoretical contributions for intermodal strategies and business models which contribute to the competitive position of a port and, more specifically, port authorities, shipping lines and terminal operating companies. These insights also contribute to practice, as they can be incorporated in strategies and business models applied by the three studied players.

To start off the journey through strategies and business models on intermodal transport, this chapter gives a first introduction into the container supply chain and the three players which can take a substantial role in the development of intermodal transport in port hinterlands. Second, the main research questions, research goal and relevance will be introduced. The chapter ends with the research design, which provides an outline for the rest of this dissertation.

1.1 An introduction into the complex world of container shipping

Shipping goods in a container has become a rather complex task due to the many different players which are involved in organizing and executing the total transport chain. In the performance of global supply chains container transport plays a critical role (Fransoo and Lee, 2013). The contract for the international sale of goods between the buyer (i.e. receiver) and the seller (i.e. sender) includes an Incoterm rule which clearly indicates for both the buyer and the seller the tasks, costs and risks associated with the transportation and delivery of the goods in the container. As a result one of these two parties is responsible for organizing the container transport. This company, the shipper of the goods, most often uses a third party (i.e. a freight forwarder) to purchase the transport services. The transport service provider subsequently executes the transport. The shipping line, owner or lessee of the container in which the goods are transported, releases a suitable empty container which must be delivered at the agreed-upon location of the sender. At the warehouse of the sender the container is loaded. In most cases the container is transported directly by truck or indirectly via a truck to an inland terminal and then by barge or train to the terminal at the seaport. This transport involves at least a road haulier and potentially an inland terminal and barge or train operator. The usage of different modes for the transport of a container (e.g. road and inland waterways or road and rail) is called *intermodal transport* (for an overview of definitions of intermodal transport, see Bontekoning et al., 2004 or SteadieSeifi et al., 2014). The usage of intermodal transport is of interest to multiple parties as it can result in, for example, reduced transport costs, increased reliability and a reduction of emissions. Upon arrival of the container in the seaport, the terminal operator unloads the container from the truck, barge or train and loads the container (not directly, as in most cases the container is put in a stack for some time) on a deep sea vessel. The shipping line transports the container to the port of destination, where the container is off-loaded and collected by truck, barge or train for the inland transport, if necessary via an inland terminal, to the warehouse of the buyer. Here, the container is unloaded. The empty container needs to be returned to a depot of the shipping line so that the container is again under control of the shipping line. At the depot the container is inspected and if necessary cleaned and/or repaired so it can be used for the next trip. In some cases an empty container may be directly re-used after the unloading at the receiver for loading at a sender. This transport chain is depicted in figure 1.1.

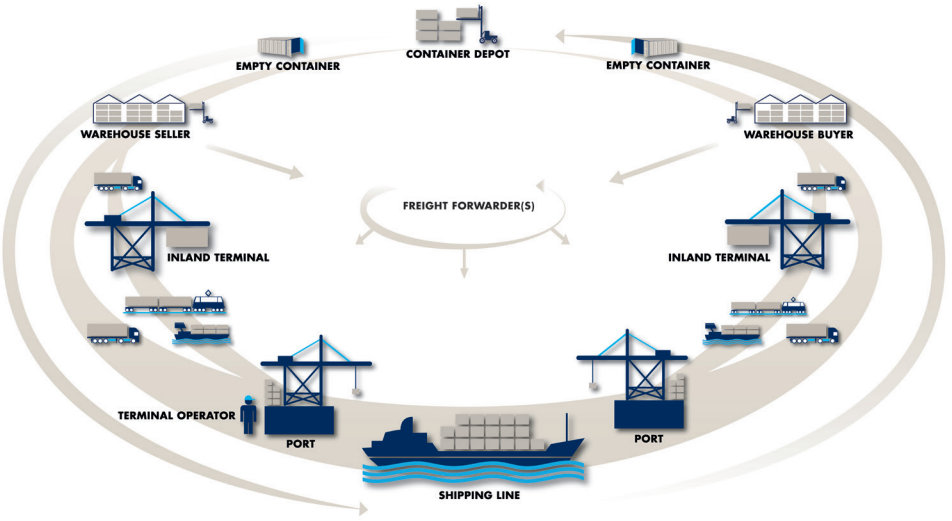

Figure 1.1: the container transport chain

Although the above seems quite straightforward, difficulties arise because of coordination problems between the involved actors, especially on the inland part, due to an imbalance between costs and benefits of coordination, a lack of willingness to invest, strategic considerations of the actors involved, risk-averse behaviour (Van der Horst and De Langen, 2008) and no alignment of contractual and operational relationships (Fransoo and Lee, 2013). These inefficiencies provide a huge potential for improvements and, as a result, a competitive advantage.

1.1.1 A dynamic environment

The container shipping industry, as described in the previous paragraph, has gone through decades of enormous growth with globalization as one of the driving forces (Notteboom, 2004; Fransoo and Lee, 2013). In this dynamic environment the industry has been continuously seeking for ways to gain competitive advantage and improve margins.

Shipping lines

The shipping industry is an asset heavy industry. Therefore, most changes have been aimed at improving margins through cost reductions. The mantra in the industry for realizing cost reductions has been economies of scale. As a result, shipping lines consolidated through mergers and acquisitions (Notteboom, 2004; Fusillo, 2009; Sys, 2009; Fransoo and Lee, 2013) and formed alliances through which they realized global coverage (Slack et al., 2002; Panayides and Wiedmer, 2011). Another outcome of the focus on economies of scale is the rise of the Ultra Large Container Vessels: vessels which can carry more than 14,500 Twenty-foot Containers (the abbreviation for this container size is TEU: Twenty-

foot Equivalent Unit). The largest container ships which are now coming into operation can even carry over 19,000 TEU. Employing these kinds of vessels results in substantial slot costs reduction (Slack and Gouvernal, 2011). Cost reductions have also been realized through the introduction of slow steaming (Maloni et al., 2013) or by improving the repositioning of empty containers (Song and Carter, 2009). Shipping lines have also tried to realize competitive advantage through differentiation. An often used strategy for differentiation is to offer inland transport, realized through vertical integration (Cariou, 2008) in which shipping lines can utilize their scale. However, inland transport (i.e. door-to-door transport) is characterized by responsiveness which is the opposite of the capabilities required for the tightly controlled ocean shipping activities (Haralambides and Acciaro, 2010). To partly overcome these difficulties, several shipping lines have developed their own logistics subsidiaries to provide logistics services (Frémont, 2009).

Shipping lines have realized, most probably due to the consolidations that have taken place, a dominant position over port authorities, terminal operators (Heaver et al., 2000; Tongzon et al., 2009) and, to some extent, freight forwarders (Fransoo and Lee, 2013). When a dominant position is lacking, shipping lines use vertical integration, for example through investments in terminals, to secure terminal handling capacity (Midoro et al., 2005). Despite the dominance of shipping lines, their control over the whole transport chain is rather limited. The percentage of the inland transports that is controlled by shipping lines (carrier haulage) decreased substantially in continental Europe during the last decades. Still, shipping lines can heavily influence the transport and supply chain (i.e. not necessarily with the aim to dominate but to control their own equipment and costs). Slow steaming has already been mentioned as development to cut costs for shipping lines. However, due to the longer transit times resulting from slow steaming shippers face increasing inventory costs (Maloni et al., 2013). In addition, multiple examples exist of shipping lines demanding fees for the reuse of empty containers at inland locations or fees for demurrage (charged when a full, import, container is not collected from the quay after a predetermined number of days) and detention (charged when an empty container is not returned to the shipping line after a predetermined number of days) to maintain control over their equipment (Fransoo and Lee, 2013). These fees hamper efficient supply chains as they force logistics service providers to suboptimal solutions (i.e. transport of empty containers and more expensive modes of transport) in order to prevent these additional fees.

Terminal operating companies

Shipping lines have invested in terminal operations on a global scale, directly or via a sister company. Still, the largest share of terminal operating companies are independent and mainly local organizations (Soppé et al., 2009). Just like the liner shipping industry, the container terminal industry has gone through

a similar consolidation phase (Soppé et al., 2009). Through acquisitions as well as direct investments (Notteboom and Rodrigue, 2012), five global players are controlling almost 30% of the container handling capacity (Soppé et al., 2009). Despite the overlap of the developed liner and terminal networks, no true global partnerships have yet been realized, mainly because the imbalance of maturity and geographical differences between the demand and the supply sides. Furthermore, the strategies of the largest shipping lines are aimed at diversification of their suppliers' portfolio at the global level rather than a close cooperation with a limited number of major, pure terminal operators (Soppé et al., 2009). The position of terminal operators is further improving as terminals are becoming more embedded in supply chains as it imposes constraints in terms of capacity, efficiency and reliability and can act as a buffer. For example, shippers are using terminals as an extended component of their warehouse (Rodrigue and Notteboom, 2009).

Terminals are located in ports, which can be defined as nodes where different players interact with each other to transfer the goods from one transport mode to another. Robinson (2002) altered this rather simplistic view of ports by arguing that ports are elements embedded in value-driven chain systems. As such, ports compete not only on operational efficiency or geographical location, but on their integration in supply chains which offer shippers greater value. In this same line, Carbone and De Martino (2003) propose that the competitive position of a port is not only determined by its internal strengths (efficient cargo handling and hinterland connections) but is also affected by its links in a given supply chain (i.e. the external co-ordination and control of the whole supply chain). Bichou and Gray (2004) developed a framework to assess the port performance from a supply chain perspective. This is an example derived from the new paradigm, initiated by Robinson (2002), that ports are a relevant part of the supply chain. More recently, Song and Panayides (2008) developed parameters to assess the supply chain integration of a port/terminal operator of which technology, value added services, relationship with clients and liner operators, facilitation of intermodal transport and channel integration practices are found to be most critical. Tongzon et al. (2009) applied the above mentioned parameters to assess the supply chain orientation of multiple terminal operators. The results from the survey indicate that ports are not integrated in the supply chain as much as theory preaches, which can be explained by issues regarding the division of costs and gains, different priorities and concern over the loss of control. These issues strongly overlap the issues identified by Van der Horst and De Langen (2008) which result in coordination problems.

Port authorities

Ports, publicly owned, corporatized or privatized, are governed by organizations, so-called port authorities, which are primarily responsible for the administration and management of the port infrastructures, and the co-ordination and control

of the activities of the different operators present in the port (Verhoeven, 2010). The main strategic objective of port authorities is enabling regional and national economic development (Van der Lugt et al., 2013). Although this can be done by facilitating transport chains on a rather re-active basis, a more pro-active port authority can play an important role in the creation of core competencies and economies of scope, even though the direct impact on cargo flows may be rather limited (Notteboom and Winkelmans, 2001). In operations and services, the direct role of port authorities is expected to (further) diminish. However, port authorities are increasingly acting beyond their role as landlord through more indirect roles, like, for example, in hinterland networks (Van der Lugt et al., 2013).

Shippers and forwarders

As buyers of transport services, shippers and freight forwarders are the main customers of shipping lines and, indirectly, of ports (i.e. terminal operating companies and the port authorities). As such, shippers and forwarders play a crucial role in the decision which port to use. Although transport plays a crucial role in the supply chain of a shipper, transport is often seen as a necessity and not as a part of the core business or a way to create competitive advantage. Therefore, in most cases shippers have outsourced the organization of the transport to freight forwarders. Freight forwarders are often driven by realizing low transport costs. For example, the most important factor influencing port choice by forwarders is port efficiency (Tongzon, 2009). To shipping lines, the freight forwarding industry is rather difficult to grasp. On the one hand it is a fragmented market, dominated by small sized companies (Murphy and Daley, 2001; Lai and Cheng, 2004). On the other hand, more than a quarter of the containers shipped worldwide are controlled by the five largest freight forwarding companies (Parola and Musso, 2007). To become less dependent on forwarders, some shipping lines have tried to incorporate freight forwarding activities within their service portfolio (Frémont, 2009).

1.1.2 Interest by academia

The growth of the industry and its dynamic nature have resulted in a substantial increase of attention by academics for the port and shipping industry during the last decades. Several literature reviews have shown that an increasing number of papers have been published on port related research (see Pallis et al., 2010; Woo et al., 2012; Ng, 2013). The main seaport research topics identified by Woo et al. (2012) are management & strategy, competition & performance, and planning & development. In comparison with these research themes, the number of papers focusing on the role of ports in transport and supply chains is rather limited. However, due to the new economic environment, ports have extensively and structurally transformed themselves. This has triggered the introduction of new concepts for ports to understand their integration in supply chains. And it has

resulted in an increasing number of studies on the role of ports in transport and supply chains (Pallis et al., 2010). Before 2000 only two papers were published on this topic, after 2000 the number of papers has grown significantly, mainly due to the increasing interest in terminal operating companies´ (TOC) strategies along supply chains and inland logistics (Woo et al., 2012).

Also in the area of port geography the focus on port hinterlands has increased during the last decade. Ng (2013) found that an increasing number of papers are focusing on the role of ports in the development of multimodal transport and logistics, the port's inland connections and the functions and operations of inland terminals and the relation with ports. A more specific review by Bontekoning et al. (2004) on intermodal transport showed that this field of research has evolved since the beginning of the 1990s and really took off by the end of the twentieth century. Of the eight identified research categories, intermodal transport policy and planning, rail haul[1] and mode choice and pricing were the most prominent. Finally, within Operations Research significant attention has been given to planning problems within intermodal transport. Caris et al. (2008) and more recently SteadieSeifi et al. (2014) provide a literature review on this topic. Both delivered an overview of the planning problems which are dealt with on a strategic (infrastructure), tactical (optimal utilization) and operational (service design) level.

This increasing attention on ports in supply chains and inland transport can easily be explained. Due to the continuous growth of container volumes and the geographical expansion of port hinterlands, intermodal transport has become a serious option for shippers, forwarders and shipping lines enabling scale economies that translate into lower transport costs (Notteboom and Rodrigue, 2009b). Furthermore, multiple academics have concluded that substantial improvements can be made on the inland part (Notteboom, 2004; Roso et al., 2009; Van der Horst and De Langen, 2008) and as such shipping lines, terminal operating companies and port authorities can considerably improve their competitive position. As a result, shipping lines (Heaver 2002; Frémont, 2009), terminal operating companies (Heaver et al., 2000; Rodrigue and Notteboom, 2009; Veenstra et al., 2012) and port authorities (Van Klink and Van den Berg, 1998; Monios, 2011) have taken initiatives to participate in or take control over inland transport. The current competition between the ports of Antwerp and Rotterdam is a good example of all three players being active in the hinterland (see table 1.1).

1 Bontekoning et al. (2004) only reviewed truck-rail related literature

Table 1.1: overview of players and actions taken in the hinterland of the Rhine-Schelde Delta

Players	*Antwerp*	*Rotterdam*
Shipping lines	MSC controls inland rail connections via their subsidiary Medlog located in Antwerp	Maersk developed an Inland Container Yard proposition mainly through inland terminals in the Netherlands
Terminal operators	PSA developed extended gates	ECT developed extended gates and created a subsidiary European Gateway Services which offers barge and/or rail transport to the extended gates
Port authorities	Investment in inland terminal locations (Beverdonk and Chemelot)	Investment in inland terminal locations (Alphen aan den Rijn and Alblasserdam)
	Online information about the hinterland network (Connectivity Platform)	Online information about the hinterland network (InlandLinks)

1.2 The quest for the competitive edge

With the increasing attention on intermodal transport and hinterland networks by academics as well as practitioners, the question arises how the involved players deal with this? Although initiatives are taken by several players (see for example table 1.1), the general tendency of port authorities, shipping lines and terminal operating companies towards intermodal transport is to maintain a rather arm's length relationship. In most cases, intermodal hinterland transport is not included in their core business. It does, however, increasingly influence their core business.

Several academics have suggested utilizing intermodal transport in order to improve the competitive position of the different players by initiating actions on a strategic level. Notteboom and Winkelmans (2001) suggest that port authorities should foloow the strategy of promoting intermodal services, based on the general notion that the maritime container battle will be won on land and supported by previous findings indicating that shipping lines identified intermodal transport as a key improvement area for ports. Notteboom (2004) advises shipping lines to adjust their business model by focussing on adding value through providing integrated logistics solutions. The analysis of the container shipping industry preceding this advice resulted in the conclusion that adding value through operational efficiency does not hold any longer in the dynamic environment in which shipping lines are operating. However, a

decade later, shipping lines still focus on the economies of scale on the sea-side. Apparently, the container shipping industry is a rather conservative industry or, perhaps, the substantial fines shipping lines received for price and contract fixing (Benacchio et al., 2007) at the moment when the liner conferences still existed have made them cautious about starting similar business practices inland. As regards terminal operators, Song and Panayides (2008) propose that port operators must look beyond the narrow geographical limits of the port by including, for example, facilitation of intermodal transport in their strategies. The argument for this suggestion is based on the outcome of a survey carried out among port and terminal managers on supply chain integration and the notion that port competitiveness is dependent on the integration of ports in global supply chains.

Despite these suggestions, limited empirical research has been carried out on strategies and business models related to intermodal transport from the perspective of the port authority, shipping line and terminal operator. Extensive research has been performed on strategic, tactical and operational models within operations research (Caris et al., 2008; SteadieSeifi et al., 2014). However, the empirical research from a business management and economics point of view is limited. This is supported by the conclusion from Eng-Larsson and Kohn (2012) that more research is needed on novel business models for intermodal transport to grow (i.e. to make a shift in mode of transport). Therefore, the main research question which takes centre stage in this dissertation is:

Which kind of strategies and business models are, or can be, applied by port authorities, terminal operators and shipping lines to realise competitive advantage through intermodal transport?

The main research goal of this dissertation is to provide a better understanding of the strategies and business models applied in relation to intermodal transport. This research deals with strategies and business models of three key players in the port industry: port authorities, shipping lines and deep sea terminal operating companies. Most attention is given to the port authority with its different roles in supply chains: it facilitates and stimulates trade but is not directly involved in the supply chain. However, a port authority can influence the decisions of shipping lines and activities of terminal operators through contracts, policy and/or regulations. Vice versa, shipping lines and terminal operators influence port authorities through their role as customer. Therefore, understanding the strategies and business models of shipping lines and terminals is an important input factor for the strategies and business models of the port authorities. However, it has often been suggested that rather limited research has been conducted on strategies and business models that are or can be applied by these three players. For the understanding of the business

models and strategies of shipping lines the perspective of their key customers (i.e. shippers and forwarding companies) is just as relevant. Previous research by academia often focused on the assets of shipping lines and their utilization. However, shippers and forwarders are often ignored, although they decide in the end which kind of transport service they purchase. So far, scientific research related to shippers or forwarders has been performed on port choice (De Langen, 2007; Tongzon, 2009) or shipping line selection criteria (Brooks, 1990; Kannan et al., 2011), but none have taken both shippers and forwarders simultaneously into account in relation to the services they purchase from the shipping lines. This research does consider both, from a buyer perspective. Therefore, shippers and forwarders are important for the strategies and business models of shipping lines but are not included in the research question.

1.3 Conceptual framework and research questions

This dissertation discusses the strategies and business models related to intermodal transport from different perspectives but is centred around the port authority and its main customers (i.e. terminal operating companies and shipping lines). Strategies and business models address similar problems on different levels. The main difference is that a business model is a more concrete description of the operations of the company than a business strategy. In a business model, the vision and strategy of a company are translated into value propositions, customer relations, and value networks. Consequently, a business model is a suitable test-bed for the feasibility of the strategy (Bask et al., 2010). Here, a definition of a *business model* is in place to provide a better understanding of what it entails. Business models are a popular research topic and multiple definitions and concepts have been proposed (see for example the reviews by Morris et al., 2005 and Zott et al., 2011). A definition which fits very well with a supply chain approach, and therefore fits with this research, is provided by Shafer et al. (2005): 'a firm's underlying core logic for creating and capturing value within a value network'. Although this definition gives an idea of what a business model entails, it is rather abstract. Osterwalder et al. (2005) proposed a framework to better formulate, understand, analyse and share a firm's underlying core logic. This business model framework consists of nine elements: (1) value proposition, (2) target customer, (3) distribution channels, (4) relationships, (5) value configuration, (6) core competency, (7) partner network, (8) cost structure and (9) revenue model. The framework proposed by Osterwalder et al. (2005) has become the standard for describing how a specific business model is designed and is frequently used by practitioners as well as academics. For example, Flodén and Sorkina (2014) used the framework to analyse a specific business model for intermodal transport.

Central in both strategies and business models is competitive advantage, either used within a strategy or the objective of a strategy (Reed and DeFillippi,

1990). A company possesses a competitive advantage when it has implemented a value-creating strategy or business model which is not simultaneously being implemented by a large number of current or potential competitors. It is a sustainable competitive advantage when other companies are not able to duplicate the benefits of this strategy or business model (Barney, 1991). According to Dyer and Singh (1998) there are three different views on how to realize competitive advantage. First of all, the *industry* view (introduced by Porter, 1980) which suggests that above normal returns are primarily a function of a company's membership in an industry with favourable structural characteristics. Second, the *resource-based* view (introduced by Barney, 1991) which argues that differential firm performance is fundamentally due to firm heterogeneity based on resources and capabilities that are rare, valuable, non substitutable and difficult to imitate. Third, the *relational* view (introduced by Dyer and Singh, 1998) which focuses on dyad or network routines and processes. Competitive advantage is created through, for example, relation-specific assets, knowledge-sharing routines and effective governance. This view has similarities with supply chain management practices. Not surprisingly, Li et al. (2006) found evidence that supply chain management practice has a direct impact on competitive advantage. The last two views are particularly relevant in this dissertation as this research focuses on players individually, as well as on a subset of players in the supply chain. These views also fit in very well with the underlying core logic of a business model in which resources and/or capabilities are important components.

Why intermodal transport is still a relevant capability or source of competitive advantage, and as such, an interesting topic of analysis can also be argued based on the characteristics of competitive advantage as defined by Barney (1991). Bharadwaj et al. (1993) developed several propositions regarding competitive advantage within a service industry. One of these propositions states that "the greater the equipment intensity of a service industry, the greater the importance of economies of scale as a source of competitive advantage." As discussed before, this strategy of pursuing economies of scale has been followed by almost all companies involved in the container shipping industry. Therefore, this proposition no longer holds for the container shipping industry. In contrast, despite suggestions by multiple academics, intermodal transport remains as capability or resource not yet implemented by a large number of players which feature in this dissertation. Whether it is a sustainable competitive advantage depends on how well a company is able to realize a service which can´t be duplicated by others.

One way to realize a competitive advantage is by becoming more sustainable than the competitors (Unruh and Ettenson, 2010). Focusing on sustainability can make the supply chain more efficient, stimulate innovation and can even result in new business models (Nidumolu et al., 2009). An important characteristic of

intermodal transport is that it can reduce the environmental impact of freight transport (Lättilä et al., 2013; Kim and Van Wee, 2014). As a result, intermodal transport as a green alternative to unimodal (road) transport to realize a competitive advantage is incorporated in this dissertation.

Figure 1.2 provides the conceptual framework of the research presented in this dissertation. On the left side the triangular relationship between port authority terminal operator and shipping line is depicted by the blue lines, indicating the influence on one another. The added value of intermodal transport and the potential influence on one another results in a strategy and/or business model for intermodal transport[2], indicated by the orange dotted line. Next to the supply side of the service, the right side of the framework depicts the demand side of the intermodal transport. This involves the relation between the shippers and forwarders with the shipping line and the influence of sustainability.

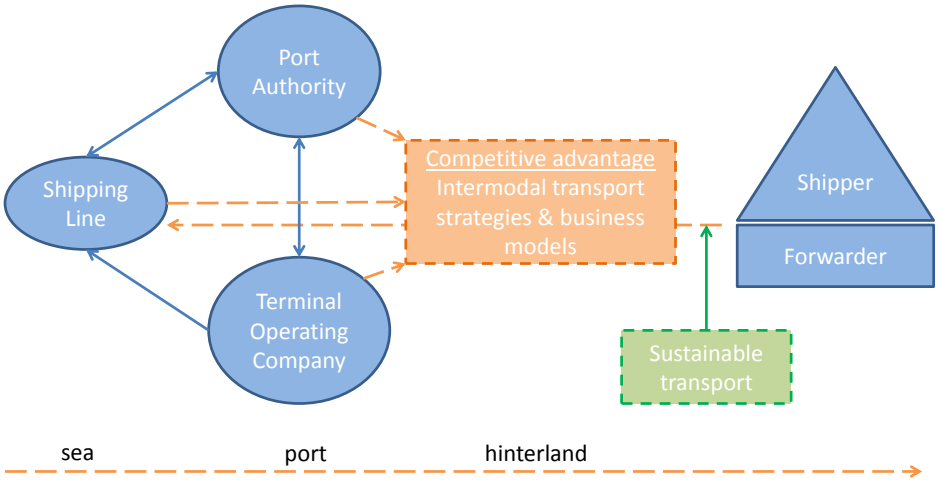

Figure 1.2: conceptual framework

Six research questions are derived from the main research question and the conceptual framework. This covers the perspectives of the different players and the role they can play in (the development of) intermodal hinterland transport. These research questions are dealt with in chapters 2 to 7. Next, all six research questions are introduced.

2 This dissertation focuses on intermodal transport of containers. However, combining different types of cargoes may be possible and sometimes necessary to start intermodal connections. For example, Woxenius and Bergqvist (2011) discussed the potential of expanding the scope of a container shuttle service to the semi-trailer segment. Although this is relevant for intermodal connectivity, it is outside the scope of this dissertation which specifically deals with the strategies and business models related to container transport.

Port authorities can create competitive advantage by increasing their focus on the hinterland of the port to capture additional traffic. The first research question, which is answered in chapter 2, therefore deals with hinterland strategies of port authorities.

Research question 1: What is included in a successful hinterland strategy of a port authority?

Intermodal transport has the potential to create a competitive advantage for a port. A port authority can take measures in the port to influence the share of intermodal transport. The most direct way of influencing port operations is through concession contracts that port authorities have with terminal operating companies. The second research question that will be answered in chapter 3 focuses on the impact of a new clause incorporated in concession contracts to stimulate intermodal transport.

Research question 2: How will terminal operating companies cope with a concession clause aimed at a modal shift towards inland waterways and rail?

Also for shipping lines, the utilization of intermodal transport could create a competitive advantage, either as a resource or a capability. The third research question, centre stage in chapter 4, is aimed at assessing the contribution of incorporating intermodal transport in the service offering of a shipping line. This inclusion of intermodal transport results in a new value proposition, which is one of the key elements in a business model (Osterwalder et al., 2005).

Research question 3: What is the added value of an intermodal value proposition to shipping lines?

A competitive advantage through intermodal transport can only be realized if customers value the service. Therefore, the perspective of the customer (i.e. the shipper and forwarder) needs to be taken into account as the target customers are a crucial part of the business model (Osterwalder et al., 2005). The fourth research question, which will be discussed in chapter 5, deals with this perspective by assessing the interest of both shippers as forwarders.

Research question 4: What is the interest of shippers and forwarders in an intermodal value proposition of shipping lines?

Creating competitive advantage through intermodal transport based on the more environmentally friendly character is, just like in the previous research

question, only possible if customers are interested. The better environmental performance could be an important driver for utilizing intermodal transport and, as a result, for developing strategies and business models for intermodal transport by port authorities, terminal operators and shipping lines. Therefore, the attitudes of shippers and forwarders regarding sustainability in freight transport need to be assessed. The fifth research question that will be discussed in chapter 6 explores the position of shippers and forwarders.

Research question 5: What are the attitudes of shippers and forwarders towards environmental sustainability in freight transport?

A key component of a business model is its revenue model (Osterwalder et al., 2005). In a commodity market, which container shipping has often been labelled as, pricing is crucial. This is not only relevant for shipping lines but also for companies with which they do business (i.e. terminal operators and port authorities) in an environment in which the intermodal hinterland network has become just as important as the maritime network. In chapter 7 the last research question deals with the pricing strategy port authorities can apply, as a resource, to improve their competitive position.

Research question 6: What pricing principles can port authorities apply to attract both transport service providers on the sea-side as well as the land-side?

1.4 Research design

This last paragraph outlines the research design of the upcoming chapters. Per chapter an introduction is given of the theme, theories and methods used.

Chapter 2: Hinterland strategies of port authorities
The role of port authorities is changing, from a focus on the development of the port area towards a more supply chain based perspective which also includes a role outside the port area. This extension of activities into the hinterland, through a so-called hinterland strategy, is the main topic of chapter 2. The enlargement of the scope of port authorities is driven by three developments. First, the hinterland costs are a large part of total door-to-door costs. Efficient hinterland connections, through intermodal transport solutions, are therefore a key determinant of port competitiveness (Fleming and Baird, 1999; Notteboom and Rodrigue, 2005; Van der Horst and De Langen, 2008). Second, the use of intermodal transport in the hinterland has a positive effect on lowering the environmental impact (Kreutzberger et al, 2003). This is important to port authorities as it influences their licence to operate. Third, due to the growing volumes, congestion has become an important issue to port authorities. Through intermodal transport the accessibility of the port can be improved. During the

last one and a half decades, these three drivers have played a dominant role in the discussion about the role to be played by port authorities in the hinterland (see for example Van Klink and Van den Berg, 1998; Notteboom and Rodrigue, 2005; Rodrigue and Notteboom, 2009). Although these drivers may adjust over time and influence the decision of port authorities whether or not to become active, in-depth case studies of port authorities active in the hinterland to improve their competitive position can add to our understanding of the added value of these activities. However, until recently such case studies have not been found in the academic literature.

This chapter contributes to the existing literature by providing a detailed description of the hinterland strategy developed and implemented by a port authority. The applied research method in this chapter is case study research, which includes an analysis of all available documents and face-to-face interviews with the responsible managers at the port authority. The aim of this chapter is to improve our understanding of what is included in a successful hinterland strategy. Case study research is the most suited methodology for realizing this. The Port Authority of Barcelona was selected as a case due to its explicit hinterland strategy aimed at improving the competitiveness and the accessibility of the port. As a result, the port authority has become active in the hinterland in different ways. Furthermore, the Port Authority of Barcelona operates according to the landlord model, the most often used model within the port industry and therefore relevant for a larger community.

Chapter 3: The effects of modal split obligations in terminal concession contracts
In addition to the involvement of port authorities outside the port, port authorities can also use instruments within the port to stimulate the use of intermodal transport. Although several measures have been introduced by public authorities to increase the share of rail and inland waterways at the expense of road (an adjustment of the so-called modal split), little research has been done on the effect of these policies on intermodal transport volumes (Bontekoning et al., 2004). Furthermore, the modal split of ports in the Hamburg – Le Havre range has only changed to a limited extent. Chapter 3 aims to enhance the understanding of a measure taken by the Port Authority of Rotterdam to stimulate a larger share of rail and barge transport.

The Port Authority of Rotterdam is the first to incorporate modal split obligations in the concession contracts for container terminals. Therefore, the Port of Rotterdam was selected as a case. An exploratory analysis of the effects is performed as the modal split obligations become effective as of 2015, which do affect the terminal operating companies in advance as they develop their business model, terminal and strategy prior to the start of the opening. Case study research has been used as a research method because it provides the best

opportunities to explore this new topic and build theory. Furthermore, as this is a new situation hard data is lacking. The case study performed in this chapter includes a description of the instrument implemented by the Port Authority of Rotterdam, supported by the results from a survey among shippers and forwarders. Three terminal cases are developed based on in-depth interviews with the responsible managers. The impact of the concession clause is analysed and positioned in a developed theoretical framework.

Chapter 4: An intermodal value proposition for shipping lines
After the discussion of the strategies of port authorities and business models of terminal operating companies, chapter 4 focuses on the value proposition of shipping lines. It introduces an evolving third value proposition, next to the port-to-port and door-to-door value propositions. This third value proposition is centred around the inland terminal (ILT). The value proposition consists of the maritime leg and the leg to/from ILTs – but not the 'last mile' to the distribution centre or factory gate. Shipping lines can still win on the inland leg as this can still be improved substantially (Van der Horst and De Langen, 2008), whereas the efficiency of the maritime leg has improved over the last decades, due to the increases in ship size and the formation of alliances of shipping lines (Panayidis and Wiedmer, 2011; Ducruet and Notteboom, 2012). The aim of chapter 4 is to assess the potential of this third value proposition to shipping lines.

Chapter 4 provides a qualitative assessment of the value proposition based on an extensive literature review, interviews with relevant players in the supply chain and several empirical examples. The applied research method of this chapter has an inductive approach for defining the concept of the ILT-centred value proposition.

Chapter 5: The perspective of shippers and forwarders on the value propositions of shipping lines
The qualitative assessment of the ILT-centred value proposition, carried out in chapter 4, provides multiple arguments for the implementation of such a proposition from a shipping line's point of view. However, the customer's point of view needs to be considered as well in order to determine the overall potential of such a value proposition. Therefore, chapter 5 focuses on the carrier selection process of shippers and forwarders, with additional attention for the inland terminal value proposition. Previous research on forwarders and shippers has focused, for example, on port choice (De Langen, 2007; Tongzon, 2009) and shipping line selection criteria (Brooks, 1990; Kannan et al., 2011). However, research on the services of shipping lines taking into account both shipper's and forwarder's perspectives has not been found. Chapter 5 does incorporate both perspectives and assesses the differences between them which results in a relevant contribution to the existing literature. The main objective of chapter 5

is to determine the position of shippers and forwarders towards the ILT-centred value proposition.

In contrast to chapter 4, chapter 5 follows a much more deductive approach for testing theory derived from the ILT-centred value proposition. For this purpose, a survey is the most suitable research method. Therefore, a questionnaire was sent to freight forwarders and shippers in the Netherlands with the aim of understanding the differences between forwarders and shippers, which builds on the conclusions of De Langen (2007) and Tongzon (2009) regarding the differences between them. In addition to testing the hypothesis derived from the literature and the ILT-centred value proposition, the survey also incorporated rather general questions to further enhance our understanding of the selection process of shippers and forwarders.

Chapter 6: Environmental sustainability in freight transport
The transport sector accounts for more than one-fourth of global CO2 emissions. Road transport generates the majority of the emissions in the sector. Intermodal transport can play a role in reducing these emissions (Kreuzberger et al., 2003; Lättilä et al., 2013; Kim and Van Wee, 2014). In freight transport, the focus seems to be primarily on costs (Lammgård and Andersson, 2014). However, Molina-Azorín et al. (2009) found that the majority of papers on firm and environmental performance find a significant positive relationship between them. This is not necessarily related to lower costs. Leadership in terms of environmental performance is therefore a potentially winning strategy. The goal of chapter 6 is to determine the attitude of shippers and forwarders, as purchasers of freight transport, with regard to environmental sustainability. This should provide general understanding of the role of sustainability in the demand for intermodal transport.

Based on a literature review, several hypotheses have been developed. To test the hypotheses a survey was carried out. A survey, in the form of an on-line questionnaire, made it possible to receive a high number of responses on standardized questions to test the hypotheses. The responses stem from the same questionnaire as used in the previous chapter. Other questions were, however, taken into account.

Chapter 7: New insights for port pricing
The shift of focus by port authorities from the sea towards the land has been introduced and discussed in the preceding chapters. This shift should also imply that the pricing by port authorities needs to be reviewed, as the current pricing principles might not move customers in the most desirable direction (e.g. towards more intermodal transport). The two-sided market theory, already widely discussed in management literature (see for example Rochet and Tirole,

2003), hasn't been applied to ports yet but could provide relevant insights for port authorities to adjust their pricing strategy. Chapter 2 introduced the idea of a port as a two-sided market, with the sea-side on the one side and the land-side on the other side. Chapter 7 assesses whether the two-sided market theory can be applied to ports.

First, several pricing strategies of different port authorities throughout the world are presented. A within and between case analysis is performed based on hard data retrieved from annual reports, i.e. the financial statements. This exploration through cases provides evidence that port authorities use significantly different pricing strategies. By comparing the two-sided market theory with port characteristics, an assessment is made whether or not ports are a two-sided market. This rather theoretical approach is adequate to subsequently propose pricing principles which support the (potential) goals of port authorities.

Overview dissertation

This paragraph introduced the research design per chapter. Figure 1.3 provides an overview of the applied research design in this dissertation. It includes the topics, methodology, actors involved and the relationships between the different chapters. This dissertation ends with chapter 8 which includes the main findings and answers to the research questions.

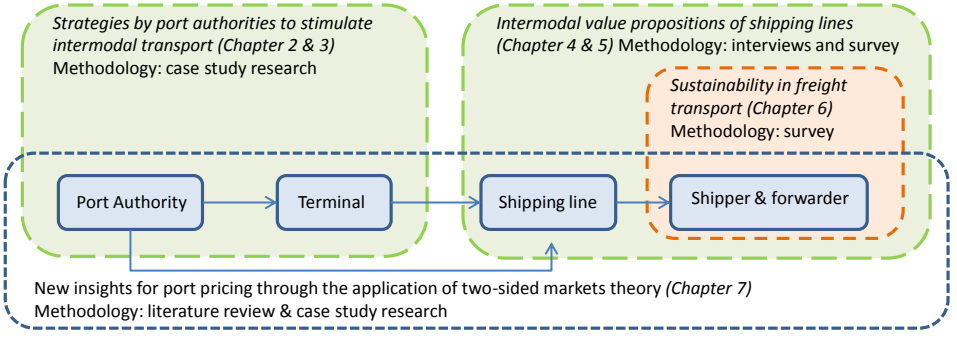

Figure 1.3: Overview, scope and interrelationships research

Chapter 2

Hinterland strategies of port authorities[3]

3 This chapter is based on Van den Berg and De Langen (2011) and Van den Berg et al. (2012). The presented content in this chapter would not be possible without the support of APB. I am very thankful for their time, cooperation and support.

2.1 Introduction

Port authorities increasingly focus on the port's hinterland. The competitive position of the port is increasingly dependent on the connectivity with its hinterland. Intermodal transport plays a crucial role in hinterland connectivity as it has the potential to realize efficient connections (Fleming and Baird, 1999; Notteboom and Rodrigue, 2005; Van der Horst and De Langen, 2008), reduces the environmental impact (Kreutzberger et al, 2003) and improves the accessibility of the port. As a result, it has been argued by several academics that port authorities should become more active in the hinterland (see for example Van Klink and Van den Berg, 1998; Notteboom and Rodrigue, 2005; Rodrigue and Notteboom, 2009). However, in-depth case studies of port authorities taking up an active role in the hinterland, through a so-called hinterland strategy, have not been found in the academic literature. Therefore, such case studies can add to our understanding of the role which can be played by port authorities in port regionalization (Monios and Wilmsmeier, 2013).

The research question that has been defined to address this gap in the academic literature is: "What is included in a successful hinterland strategy of a port authority?" To answer this question, a detailed case study of a hinterland strategy developed and implemented by a port authority is provided in this chapter. This chapter starts with an introduction of the importance of intermodal transport for the development of port hinterlands. The second part includes the case study of the hinterland strategy of the port authority of Barcelona (Autoridad Portuaria de Barcelona, APB in the remainder of this chapter). The final section discusses the main conclusions from the case and their relevance for the port industry at large.

2.2 Intermodal transport and port hinterland development

Unlike the largest ports in Asia, most large container ports in Europe predominantly serve continental hinterlands. Parts of this hinterland, generally the regions in immediate proximity, are captive, in the sense that competition with other ports is limited (see De Langen, 2007). These captive hinterlands provide a substantial volume that has spurred the development of these large ports (Notteboom, 2009a). However, ports compete fiercely in *contestable hinterlands*[4]. Notteboom and Rodrigue (2009b) propose that in the initial phase

4 Captive hinterlands can be defined as all regions where one port has a substantial competitive advantage because of lower generalized transport costs to these regions. The 'generalised transport costs' are not only influenced by the distance of locations in the hinterland but also quality of infrastructure, frequency of services, efficient organization of intermodal transport and natural or political barriers (Van Klink and Van den Berg, 1998). Regions where multiple ports offer competitive services are contestable hinterlands. For instance, De Langen (2007) analyses port competition in the Austrian market, a very contestable market with competition between 'North ports' (Hamburg & Bremen), 'West Ports' (Antwerp & Rotterdam) and 'South ports' (Trieste & Koper).

of port development (i.e. relatively small throughput volumes and destinations within a short distance from the port) trucking is dominant for serving the hinterland. But with the continuous growth of container volumes and the geographical expansion of port hinterlands, intermodal transport becomes more important due to scale economies that translate into lower transport costs. Intermodal infrastructure, either natural (i.e. rivers) or man-made (i.e. canals and railways) are a necessity for intermodal transport. The absence of infrastructure can constrain intermodal services (e.g. Barcelona is not connected to an inland waterway system). However, the availability of infrastructure alone is not sufficient for the development of intermodal services. For example, Ferrari et al. (2011) conclude that for the Italian ports Genoa, La Spezia and Savona the partial interoperability among the national rail networks and the limited development of the Italian logistics market are important reasons for the limited competitiveness of these ports in contestable hinterlands in central Europe. Increasing the intermodal connectivity of ports with inland terminals is centre stage in strategies of terminal operating companies, shipping lines (see Franc and Van der Horst, 2010) as well as port authorities. The key to improving connectivity is the development of new intermodal services. For instance, Frémont and Franc (2010) conclude that for Le Havre, combined transport is the only way forward to guarantee further growth of maritime traffic flows.

2.2.1 Development of inland terminals

Inland terminals play a crucial role in the competitive position of the port in the hinterland. They have become the entrance of the port. Slack already argued in 1999 that the capacity of deep sea terminals could be increased by developing inland terminals with a direct link with the deep sea terminals, so that activities can be transferred to inland locations (Slack, 1999). Building on Roso et al. (2009), Rodrigue et al. (2010) distinguishes three types of inland terminals based on their transport function:

- Satellite terminal, to serve the port terminal by accommodating additional traffic and added value functions;
- Load centre, that serve regions with large volumes of containerized loads;
- Transmodal centre, to bundle freight flows from one port with other rail flows.

The development of port networks, including hinterland terminals, has been called 'regionalization' by Notteboom and Rodrigue (2005). Regionalization occurs for example through linking deep sea terminals more closely to inland terminals and distribution centres with the ultimate aim of developing a strong port network[5].

5 In another paper, the same authors argue that an increasing 'terminalization' of supply chains is unfolding, whereby seaport and inland terminals are taking up a more active role in supply chains (Rodrigue and Notteboom, 2009). Reginalization and terminalization go hand in hand.

2.2.2 Role of port authorities in the hinterland

Port authorities generally focus on the development of the local port area and play a minor role in the development of port hinterlands, whereas shippers, forwarders, barge and rail operators have always been involved in the port-hinterland connection. Different academics (Slack, 1999; Notteboom, 2004; Rodrigue and Notteboom, 2009; Franc and Van der Horst, 2010) have provided empirical evidence of the activities of shipping lines and terminal operating companies in port hinterlands. The role of port authorities in the hinterland has received little attention. Heaver et al. (2000) observed a trend in the maritime and port industries of different forms of cooperation to increase control in the logistics chain, but wonder about the role that will be played by port authorities. Slack and Frémont (2005) conclude that the continuous growth of terminal operating companies and shipping lines limits the possibilities of port authorities to play a significant role in network development. Verhoeven (2010) even states that captive hinterlands are diminishing and port competitiveness has become largely dependent on changes in the logistics environment, which are out of the control of port authorities.

Van Klink and Van den Berg (1998) argue that port authorities should shift their orientation from the seaside to the landside and transform from a landlord into a network 'manager' that initiates the improvement of transport corridors. Notteboom and Rodrigue (2005) have extended this view into a more detailed description of the role that port authorities can play in the hinterland:

'Port authorities can create a platform in which various stakeholders are brought together to identify and address issues affecting logistics performance. A role, which goes beyond the role of landlord, would be the development of strategic relationships with other transport nodes. Just like the private sector, port authorities can strengthen their position in the market through the tightening of the relationships with inland centres, for example, through investments in inland terminals or distribution facilities in inland port areas. A port networking strategy focused on inland terminals might enable port authorities to tackle the problem of diseconomies of scale in the port in the form of congestion, lack of space etc. The corridors towards the inland terminal network, in fact, create the necessary margin for further growth in seaborne container traffic. These inland terminals acquire an important satellite function with respect to the seaports, as they help to relieve the seaport areas of potential congestion' (Notteboom and Rodrigue, 2005, p. 309-310).

Verhoeven (2010) summarized the arguments proposed by different scholars of why port authorities should become active in the hinterland. First, port authorities have an interest in hinterland access both from a port performance perspective and as a revenue driver. Second, port authorities need to focus on

sustainability and accessibility of the port, which both depend on a large extend on hinterland transport. To conclude, various scholars argue for an active role of the port authority in the hinterland. However, port authorities will only take up an active role in the hinterland when there is a clear necessity. A detailed empirical analysis of such an active role of a port authority is lacking.

2.3 Methodology

For a thorough analysis of a specific situation, case study research is a useful research method. As a research strategy it focuses on understanding the dynamics in a specific situation and can be used to provide a description, build and/or test theory (Eisenhardt, 1989). Given the limited amount of research on the roles of port authorities in developing port-hinterland networks, a case study adds to our understanding of this topic and allows for building theories in the field of port research. Even though building theories based on case study research is not always justified (see Dul and Hak, 2008), cases allow for 'theoretical generalisation' (Yin, 2008), as opposed to empirical generalisation, that provides a basis for further, and sometimes more rigorous, research. Case studies are most frequently used for industry-oriented research, when 'hard data' is lacking. Different port authorities in Europe are (slowly) developing hinterland activities. The port authority of Rotterdam is involved in the development of inland terminals in the Netherlands by acting as a landlord in inland nodes. In Hamburg, partially publicly owned companies such as HHLA (terminal operating company), Transfracht, Polzug and Metrans (all rail operators) are deeply involved in developing the rail network. In Hamburg, the port authority itself is not actively involved. In these examples the port authority plays a rather limited role and does not have a clearly communicated strategy. A more active role in the development of intermodal connections has been played by the port authority of Antwerp, in 2005 it took the lead in analysing opportunities for developing new rail shuttles. Through the identification of the existing carrier haulage volumes of shipping lines and agents, the port authority identified a number of destinations to which new rail shuttles could be developed. Together with the shipping lines the port authority developed a costing model and subsequent business cases which resulted in ten new rail shuttles and an increase of frequency to several other destinations (Antwerp Port Authority, 2007). The port authority successfully brought the shipping lines and agents together but was not directly involved in developing new connections. Another example is the Port of Gothenburg which is deeply involved in the so called RailPort-project. Launched in 2000, the hinterland network of Gothenburg has steadily increased from connections with four terminals in 2002 to 26 terminals in 2010. The number of containers transported by rail to and from the Port of Gothenburg increased from over 140.000 TEU (Twenty-foot Equivalent Unit) in 2002 to over 374.000 TEU in 2011 which resulted in a share of rail transport of 42% (more details are provided by Bergqvist and Woxenius, 2011). The aim of the Port of Gothenburg is to increase the rail share to 50% in 2020. Next to

Antwerp and Gothenburg, the port authority of Zeebrugge is active in intermodal transport through its subsidiary PortConnect. As of 2003 PortConnect operates inland vessels from Zeebrugge to Antwerp and in 2010 it also started operations to Duisburg and Neuss in Germany.

The examples provided above have been described in industry and scientific journals, but so far haven´t thoroughly analysed the involvement of a port authority in the hinterland. This chapter provides such a detailed analysis. Barcelona was selected as case due to their explicit hinterland strategy which makes Barcelona one of the leaders in hinterland development[6]. The case is relevant for other ports as it also includes the start-up stage, the most difficult stage, of an intermodal connection. Furthermore, the port authority in Barcelona operates according to the landlord model, which makes the case more relevant for other port authorities as the landlord model is widely used and is becoming the most dominant governance model (Verhoeven, 2010).

The case study consisted of three steps: first, all available relevant documents (annual reports, strategic plans, presentations, and statistics) were analysed. Second, face-to-face interviews[7] with five responsible managers of APB (i.e. the hinterland project manager, the strategic projects and innovation manager, the strategy manager, the deputy general manager and the inland terminal manager) were conducted. These semi-structured interviews were based on a list of predefined questions derived from the literature review and case study documents. The interviews were recorded and used for the description provided in the next section. Third, the analysis and conclusions were checked with APB´s management.

2.4 The case of the Port of Barcelona

The port of Barcelona (Spain) consists of approximately 830 hectares located close to the city and realized a cargo throughput of 46.5 million tonnes in 2009[8]. The port handles four different types of cargo, of which containers is the most

6 There are also other reasons why Barcelona should be selected as a case for analysis. First of all, the port of Barcelona has a clear captive area in Spain (Catalonia), but competes with other Spanish ports in the economic areas in Central Spain (Madrid) as well as in neighbouring countries (France and Portugal). This is comparable to the situation of the ports in North Western Europe. Second, the focus is on intermodal rail transport, a modality that can be developed by all ports.

7 Face-to-face interviews have several advantages. First, the interviewer can adapt the questions as necessary, clarify doubts, and ensure that the responses are properly understood, by repeating or rephrasing the questions. Second, the researcher can also pick up non-verbal cues from the respondent (Sekaran, 2003). The interviews were recorded with a voice recorder to reduce potential observer bias (Voss et al., 2002).

8 The 2009 volumes were equal to the volumes in 2004 and down 30% from 2008, due to the effects of the economic crisis.

important with a share of more than 40%[9]. The other main cargo types are liquid bulk, cars and dry bulk. In addition to cargo, the port of Barcelona also receives more than 2 million cruise passengers per year.

Barcelona is, after Valencia and Algeciras, the third largest container port in Spain. With a volume of 1.8 million TEU, Barcelona is the thirteenth largest container port in Europe (see table 2.1).

Table 2.1: Top 15 European container ports, TEU x 1.000 (source:port authorities)

	Port	*2009*	*2008*	*2007*	*2006*	*2005*	*2004*	*2003*
1	Rotterdam	9.743	10.784	10.791	9.653	9.288	8.292	7.144
2	Antwerp	7.310	8.663	8.176	7.018	6.488	6.063	5.445
3	Hamburg	7.008	9.737	9.890	8.862	8.088	7.003	6.138
4	Bremen	4.565	5.529	4.912	4.450	3.735	3.469	3.191
5	Valencia	3.654	3.602	3.043	2.612	2.410	2.145	1.993
6	Felixstowe	3.100	3.200	3.300	3.000	2.700	2.675	2.650
7	Algeciras	3.043	3.324	3.414	3.257	3.179	2.937	2.590
8	Gioia Tauro	2.800	3.468	3.445	2.938	3.209	3.261	3.149
9	Marsaxlokk	2.330	2.300	1.887	1.485	1.321	1.461	1.300
10	Zeebrugge	2.328	2.210	2.020	1.653	1.408	1.197	1.013
11	Le Havre	2.234	2.450	2.638	2.137	2.058	2.150	1.980
12	Ambarli	1.836	2.262	1.940	1.446	1.186	1.078	755
13	*Barcelona*	*1.800*	*2.570*	*2.610*	*2.318*	*2.071*	*1.916*	*1.652*
14	Genova	1.534	1.767	1.855	1.657	1.625	1.629	1.606
15	St. Petersburg	1.450	1.983	1.970	1.450	1.121	773	650

Two container terminal operating companies are active in the port of Barcelona: Terminal de Contenidor de Barcelona (TCB) and Terminal Catalunya (TERCAT). TCB is part of the Grup TCB which, in addition to the terminal in Barcelona, owns 12 other terminals including terminals in Valencia and Gijon. TERCAT is owned by Hutchison Port Holdings (HPH). Both terminals handle roughly half of the total traffic, and are currently expanding their capacity in the port of Barcelona.

2.4.1 Barcelona's hinterland

Situated along the North East coast of Spain (figure 2.1), the port of Barcelona mainly serves Catalonia: a region with 7.3 million inhabitants (16% of the

9 During the first decade of the 21st century Barcelona focussed on the growth of throughput of high value cargo, meaning that Barcelona has put its efforts onto increasing the throughput of full containers, cars and refined liquid bulk. Barcelona showed high growth numbers in the container segment between 2003 and 2007. The share of containers in the total throughput volume increased to 50% in 2008. The economic developments during 2008 and 2009 have heavily influenced the throughput volume of the port of Barcelona, especially for containers and cars. The economic downturn of 2009 has thrown Barcelona back to below the throughput level of 2004 as can be seen from table 1. A large part of the decrease in volume was caused by a shift of transhipment containers to other ports.

Spanish population) that generated 19% of the GDP of Spain (Eurostat, 2011). Barcelona is well located to serve other parts of Spain as well as the South of France. However, traditionally the port community and the port authority focused on Catalonia. This resulted in limited volumes moved to and from outside Catalonia.

In line with the proposition of Notteboom and Rodrigue (2009b) truck transport has always been the dominant hinterland transport mode to serve Catalonia. The truck transport market was liberalized in the late 1990s but Spanish hauliers are still less efficient than foreign competitors. Barcelona competes with other ports (Marseilles, Valencia, Bilbao) to serve contestable hinterlands in Spain as well as France. Given the distance from Barcelona (mostly > 300 km) rail connectivity is crucial for competing in the contestable hinterland (European Commission, 2011). With rail sidings on the container terminals and a public rail terminal, the port of Barcelona has several facilities to accommodate rail transport. Rail transport is therefore the second most important mode of transport that connects Barcelona with the hinterland. Barcelona can develop its rail volumes as it is connected to four rail corridors:

1. Iberian corridor: Barcelona – Zaragoza – Madrid – Lisboa
2. Ebro corridor: Barcelona – Zaragoza – Northern Spain
3. South of France corridor: Barcelona – Toulouse – Bordeaux
4. European corridor: Barcelona – Lyon – Metz

Three problems have hampered the quality of rail transport. First, containers to/from France had to be transferred to other wagons at the border, due to the difference in gauge[10]. Second, access to the rail market for new operators is difficult. Third, the maximum length of a container train is limited (around 450 metres) compared to other European countries. Notwithstanding these difficulties, in the late 1990s APB realised that in addition to improving operational processes in the port, improving rail quality was crucial for extending the hinterland of the port.

2.4.2 Barcelona's Port Authority

Owned by the national government of Spain, the port authority of Barcelona functions as a landlord and leases its land to privately owned operating companies[11]. In 1993 the management of the port area was split into three parts: the old port area, the commercial port (where cargo handling takes place) and the area where logistics and distributions activities take place (the so-called Zona de Actividades Logísticas (ZAL) or logistics zone). Although the

10 At the end of 2010, a unified gauge rail track with France has been opened. APB actively lobbied for this investment, but was not actively involved in the construction or operations.

11 More details about institutional and regional context relevant for APB can be found in appendix A.

Figure 2.1: largest container ports around Barcelona and Barcelona's main hinterland.

land is owned by APB, the old port and the logistics zone are managed by two subsidiaries: Port 2000 (for the old port) and CILSA (for the logistics zone)[12]. The current organizational structure of APB is depicted in figure 2.2.

Until 1998 APB acted as a traditional landlord port. In 1998 APB developed its first strategic plan together with the port community to become the leading logistics hub for the European continent in the Mediterranean (APB, 1998). The implementation of the plan was a turning point for APB as it became more active and involved in the business community.

12 For their websites see www.portvellbcn.com (Port 2000) and www.zal.es (CILSA)

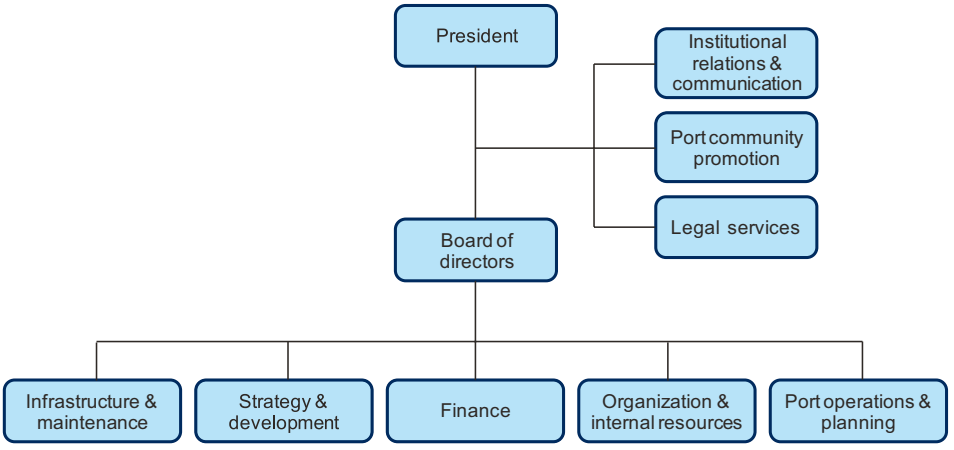

Figure 2.2: simplified organizational chart APB (source: derived from case study mmaterial)

Strategy

Three consecutive strategic plans show how APB extended its scope from port centric into the hinterland.

- 1998: Develop the port area; by creating a platform where cargo can be transferred between different modes of transport in a reliable, fast and efficient way.
- 2003: Develop the port hinterland network, so that the port can differentiate itself from other ports through creating a network of services that connects the hinterland with the port.
- 2009: Develop the port supply chain, so that customers' supply chains through the port can be more efficient by developing infrastructure and services to the hinterland and removing barriers to using the port.

The first strategic plan (of 1998) focused on expansion of the port. Extra capacity was necessary to facilitate larger volumes. APB also came to the conclusion that Barcelona could (or even needed to) attract cargo outside Catalonia. Therefore, the second plan focused on the connection with the hinterland and the third strategic plan proposed a new role of APB in the total supply chain. The change in focus reflects the increasing level of involvement of APB in the logistics chain. Due to the limited volumes outside of Catalonia, in combination with the new container terminal capacity and the limited interest of the port community to develop business outside Catalonia, APB became aware of the necessity for an active involvement after the development of the first strategic plan. APB realised that contact with the port community and at a later stage with shippers was necessary to acquire knowledge about the bottlenecks that needed to be resolved. Visits by APB to shippers in the hinterland led to two conclusions.

First, promotional work needed to be done for both rail transport and the port of Barcelona. Second, APB concluded that if it wanted to increase the quality of rail services to and from the port, it would have to become more deeply involved, because other companies in the chain showed limited interest in developing an attractive rail proposition. APB further concluded that the best approach would be to acquire stakes in rail facilities in strategic hinterland locations. Such a stake in a facility, next to increasing market knowledge, allows APB to influence the development and activities (especially service levels) of the facility and also to demonstrate that the port of Barcelona is willing to make long term investments to improve rail connectivity. This conclusion is the cornerstone of the second strategic plan and subsequent activities of APB. In executing the strategic plans APB had to face several challenges internally as well as externally. Internally, the employees needed to be convinced of the added value of the new strategy. Externally, the private companies needed to be convinced that APB could remain neutral and create value for the port as a whole.

Mission statements

The gradual shift in level of involvement, as portrayed in the strategic plans also reflected in the mission statements. In 2003, the mission of APB was "to contribute to the competitiveness of the port's customers by providing efficient services that respond to their needs for maritime transport, land distribution and logistics services." (Autoridad Portuaria de Barcelona, 2003). Six years later, APB's mission is "to lead the development of the Port of Barcelona, generate and manage infrastructures and guarantee reliable services to contribute to the competitiveness of its customers and create value for society." The latest mission statement is much broader and includes the changing role of APB from a reactive position (contribute to the competitiveness…) into a proactive position (to lead the development…).

2.4.3 Activities of APB

In line with the strategic plans described before, APB invested in the quality of intermodal connections. As a first step, APB started with promotional activities and customer services. As a second step it made investments in logistics facilities (i.e. container depot, rail terminal and logistics zone) and as a third step investments in developing rail shuttles. The aim of these activities and investments in the hinterland has always been focused on attracting additional traffic to Barcelona. These three levels of activities are described in short in the next section, and discussed in more detail in the following sections.

Promotional activities

APB invested in people that could promote Barcelona in the hinterland. They acquired knowledge about the difficulties, help resolving difficulties and providing information regarding customs procedures, logistics service

providers, use of port information systems and other logistics related aspects. The representatives working in the hinterland act as a customer service centre to support companies with problems they might encounter and provide information e.g. regarding customs procedures, logistic service providers and use of port information systems. These investments provide APB with valuable knowledge about the bottlenecks in freight flows between the port and the different hinterland locations. The representatives are located in Barcelona, Madrid, Zaragoza, Toulouse and Lyon. The customer services in Burgos are provided from Madrid, in Vitoria from Zaragoza and in Perpignan from Barcelona. The representatives also conduct studies to review potential new geographic markets. For example, during the end of 2010 a study was performed on Pamplona.

Logistics facilities
In the period of the first business plan, APB discovered that in several cases the market did not initiate new activities that would seem to be beneficial for the port and would seem to be commercially viable. Nevertheless, the relevant firms would not take initiatives because of risk, capacity constraints or lack of management attention. As a consequence, APB realized that it had to take a leading role. This is expressed in the investments made by APB in the rail terminal in Zaragoza, in a new intermodal terminal close to Figueras and the logistics zone in Perpignan. These investments provided a platform to start developing logistics services that attract maritime cargo flows. The development model used by ABP has been labelled by Wilmsmeier et al. (2011) as Outside-In where inland terminal development is driven from the sea side (i.e. port authorities, port terminal operators and/or ocean carriers). Opposite of the Outside-In approach is the Inside-Out approach where the development of inland terminals may be driven by an inland carriage company (e.g. railroad, barge, logistics service provider) or a local public body.

Rail shuttle
APB developed its hinterland network with terminals, and is also active in developing rail shuttles to increase connectivity with the port of Barcelona. Rail services are necessary to be able to compete with other ports that are closer to a specific hinterland region. Therefore, in 2009 APB decided to invest in a rail shuttle to Lyon, outside the traditional hinterland of Barcelona, together with Renfe (Spanish rail operator) and Naviland (French rail operator).

2.4.4 Inland terminal Zaragoza

Zaragoza was the first location in which APB participated actively (previously different port authorities were jointly involved in the rail terminals in Madrid and Azuqueca). Zaragoza has now become a central node in the hinterland network of Barcelona. The participation in Zaragoza has therefore been crucial

to their strategy and it provides insight in to how APB increased it activities in the hinterland.

Between 1997 and 1999 the port authority started initial meetings in the hinterland. Soon Zaragoza became one of the points of interest due to its location in between the economic centres of Barcelona, Madrid, Bilbao and Valencia. Therefore, Zaragoza has become a logistics hub and houses multiple distribution parks of which Platform Zaragoza (PlaZa) is the newest. In 2000 APB started in Zaragoza with one of its first projects in the hinterland. Together with other organisations (see figure 2.3) APB started with a small investment in a container depot, called Terminal Marítima de Zaragoza (tmZ), situated next to an existing logistics zone (MercaZaragoza). The container depot would provide forwarders and hauliers the possibility to combine traffic and increase productivity. The container depot was operated by a private operator (CDA). During the first years traffic increased with a peak of more than 23.000 movements in 2003. Due to problems with the operator the volumes decreased to less than 14.000 movements in 2006. However, the market share of Barcelona, which was around 25% at the start, increased to approximately 50% in 2006. APB decided that in order to maintain the rail traffic, increasing its role in decision making and improving Barcelona's competitiveness; a substantial APB investment would be made in a rail terminal in Zaragoza. Initially, APB aimed to take over the existing, inefficiently run, public terminal but this turned out to be impossible. Thus, together with MercaZaragoza and the regional government APB decided to make additional investments in tmZ to develop a new rail terminal. As the investments were converted into shares, APB increased its stake in tmZ (figure 2.3). The existing operator (CDA) was bought out and a new neutral operator, called tmZ services, was developed.

In 2007, the new rail terminal came into operation and a contract was signed between the owner of the terminal (tmZ) and the new terminal operating company (tmZ services), with a different shareholder structure (figure 2.4). TmZ services pays a fixed and variable fee (based on the volume) for the operation of the terminal to tmZ (the owner of the assets). In addition to the ownership of the terminal, tmZ also acts as promoting agency for the terminal. Furthermore, tmZ monitors if the operator complies with the service standards set by tmZ. The main reasons for splitting the ownership of the terminal from the operating activities are the required returns on investment. The largest part of the investments in tmZ is done by public organisations which have a longer planning horizon and do not aim for high returns on investments. The resulting fees demanded from the operating company make it possible to offer services against competitive prices. With an expected return on investment rate of 2%, tmZ can be labelled as a not for profit operation, while the operator (tmZ services) aims for a return on investment of at least 12%.

Shareholders tmZ (2000)	Share	Shareholders tmZ (2005)	Share
MercaZaragoza (logistics area)	15%	MercaZaragoza (logistics area)	56%
APB (port authority of Barcelona)	15%		
DGA (regional government)	5%		
Ibercaja (local bank)	10%		
CAI (bank)	10%		
Private 1	9%	APB (port authority of Barcelona)	21,55%
Private 2	9%		
TCB	9%	DGA (regional government)	20%
Tercat	9%		
Cargo Depot Aragona (container depot operator)	9%	Others	3,45%

Figure 2.3: previous and existing shareholder structure tmZ

Shareholders in tmZ services (2009)	Share
tmZ	40%
TCB (terminal operating company)	25,5%
Renfe (rail operator)	24,5%
Comsa (developer rail infrastructure)	10%

Figure 2.4: shareholder structure tmZ services (terminal operator)

The investment made by tmZ in the new rail terminal was not based on contracts with rail operators. During the first years the operator made losses, because in the first few months hardly any trains were handled at the terminal. In 2008, the new Adif (the national infrastructure manager of Spain) rail terminal in Zaragoza next to PlaZa came into operation. Despite the additional competition tmZ was able to attract the rail shuttle of TCB Railways (a daughter company of TCB). In 2010, the number of trains using the terminal exceeded the forecasted number of trains in the business case of tmZ services. Table 2.2 provides an overview of the development of the traffic between Barcelona and Zaragoza.

The rail terminal in Zaragoza has also become a hub for trains going to Madrid and additional services have developed from Zaragoza to the northern destinations of Burgos and Vitoria. Furthermore, Zaragoza also serves as a hub for repositioning empty containers from Madrid. Additional, expansion plans for the terminal are in execution as Barcelona almost doubled its traffic on Zaragoza within two years (table 2.2).

Hinterland development

The role of APB in Zaragoza was of strategic importance for the future development of the network in Spain (figure 2.5). Zaragoza is an example for the other activities of APB in Spain and France. Hence, APB tried to apply this

concept at other locations. However, it became clear that it was not possible to implement the full concept, due to already existing facilities or other local issues. Thus, APB has decided to be flexible regarding the precise type of involvement in hinterland nodes. As a result, the growth of the network of Barcelona in which APB participates, directly or via its subsidiary CILSA, follows a clear strategic logic, but is flexible regarding the role of APB, which differs according to the market demand and the local context.

Table 2.2: container volume in TEUs between Barcelona and Zaragoza (APB, 2007, 2008, 2009)

Volumes Barcelona – Zaragoza	*2007*	*2008*	*2009*
Total	25,782	27,912	45,894
Rail	2,287	6,553	23,864
Share of rail volume	9%	23%	52%

Figure 2.5: the hinterland network of Barcelona (source: derived from case study material)[13]

Although the stake of APB in hinterland nodes is valuable from different perspectives, APB is willing to sell their stake to, for example, the terminal operating companies in Barcelona. Two requirements should be met before APB withdraws:

13 The overview of the services is based on the rail connections starting from the container terminals in the port of Barcelona and does not included the rail connections from the Morrot rail terminal which is mainly used for continental cargo.

- An efficient, stable and large container flow between Barcelona and the hinterland location;
- Recovery of APB investments. This is necessary to be able to make new investments in which private parties are not willing to invest in due to high uncertainties.

APB regards the terminal operating companies in Barcelona as key partners in investments in the hinterland. Thus, APB has included a clause in the concession contract of the new TERCAT terminal that obliges TERCAT to invest in the quality of the hinterland network.

2.4.5 Rail shuttle Barcelona – Lyon

In 2008 Naviland Cargo, a subsidiary of France's national state-owned railway company SNCF, proposed to APB to start a rail shuttle between Lyon and Barcelona. The interest of APB was triggered as Lyon, an important logistics centre in France, was located outside Barcelona's traditional hinterland and not connected to Barcelona. A competitive service, i.e. satisfying costs, transit time, frequency, and reliability, was necessary to be able to attract cargo from other ports that serve Lyon. APB discussed the proposal with the port community but despite the interest of the port community none of the companies was willing to participate in the shuttle. One of the reasons for this is the infrastructural bottleneck between Spain and France (a difference in rail width) which was a barrier to the free movement of goods between both countries in 2008. APB had recognised this bottleneck and the decision had been taken to connect Barcelona to the European rail network, but at the time this bottleneck was still not resolved. This pushed APB to invest in the project together with Contren (Spanish national rail operator, before branded as Renfe Mercancías) and Naviland Cargo. Both rail operators were interested as the shuttle was in line with their internationalisation strategies. APB positioned the service as a more attractive alternative than road transport between Barcelona and Lyon[14] and a more attractive alternative compared to rail services via the Northwest European ports (see table 2.3 for an overview of rail connections between Lyon and the different ports). The rail connection enables a modal shift of shippers and freight forwarders that already transport to Barcelona (or Catalunya) as well as a port shift from other ports to Barcelona. The involvement of APB in the development of the shuttle is aimed at becoming a trusted solution for port users in the hinterland. During the first three years of its operation the shuttle received funding of the European Union for shifting transport from road to rail. APBs decision to invest in the shuttle was made prior to the application for these subsidies.

14 The rail service has an imported advantage over road transport in relation to empty repositioning. Shipping lines demand that the containers transported by road need to be returned empty to Barcelona. This obligation does not apply to transport by rail, where shipping lines allow return of empty containers in inland depots.

Table 2.3: Competitive position of Barcelona (January 2012, sources website Naviland Cargo, Rail Link Europe, port of Marseille, port of Antwerp, port of Le Havre)

Port	*Marseille*	*Antwerp*	*Le Havre*	*Barcelona*
Distance to Lyon (km)	300	750	650	600
# weekly connections by rail	13	8	8	3
# weekly connections by barge	5	-	-	-
Logistics Service Providers	Naviland Cargo Rail Link Europe	Naviland Cargo Rail Link Europe	Naviland Cargo Rail Link Europe	Naviland Cargo
Terminal	Lyon Terminal	Vénissieux	Lyon Terminal	Vénissieux

Management & role of APB

The three companies made an equal investment in the establishment of the service through an agreement which is renewed every two years. The agreement includes the equal sharing of the costs and profits of the rail shuttle. Although the companies are equally involved, at the start of the service the three companies all had separate commercial channels, which caused (operational) problems. The problems were solved by establishing one commercial policy and by appointing a joint team of three persons for the management of the service: two are responsible for the general management and marketing of the shuttle and one is in charge of the operation. The operations manager (planner) is paid by APB and located in the office of APB. APB gained valuable knowledge through the in-house planner as APB was directly confronted with infrastructural and organisational problems. This provided crucial input for APB in discussions with the policy makers, the Spanish railways and the Spanish rail infrastructure manager.

Promotion

Naviland and Contren promote the shuttle as part of their network, but with a limited focus on this specific service. However, more effort is required in the start-up phase of a shuttle. In 2008 APB started to actively promote Barcelona in the Lyon area to shipping agents (for import cargo) and freight forwarding companies (for export cargo). The promotion activities were introduced under the term 'Service Centre for France', and presented the rail option to Barcelona. The services included free, tailor-made support in the physical and documentary operations regarding the movement of the container through the port and help to set up efficient logistics chains through Barcelona. Their experience shows that for many potential users of the rail shuttle 'shifting' (either from another port or from another transport mode) is not as straightforward as one may think. It requires a substantial effort in learning new procedures, customs requirements and information systems. An 'offering' that reduces the barriers to shift cargo may be required to make new services a success. In Barcelona, APB is promoting

the shuttle to freight forwarders. The terminals in Barcelona (TCB and TERCAT) support the development of the shuttle by promoting the service to the shipping lines; containers from both container terminals in the port of Barcelona can use the rail shuttle.

Operational development of the shuttle

In February 2009 the shuttle started as a multi-client service open for maritime as well as continental cargo. The shuttle had to overcome several start-up problems. The train had to be cancelled various times as connections at the French/Spanish border could not be met (to a large extent due to strikes). The shuttle also faced low occupancy rates and transported a high percentages of empty containers. However, the number of transported containers as well as the percentage of full containers increased (see table 2.4). Also the type of traffic changed from mostly continental traffic to traffic with a maritime origin.

An important improvement of the service took place at the end of 2010 when the UIC standard gauge from Barcelona to the French border, including new railway infrastructure, came in operation. This made it possible to use the same type of rail wagons between Barcelona and the rest of Europe. By avoiding the container exchange between trains at the border of France and Spain, the transit time could be reduced by approximately six hours while reliability of the service increased because chances that the train path in France was missed were reduced. A positive effect of the new route was that it enabled increasing the train length. In Spain the maximum length of a container train is limited to around 450 metres compared to 750 metres in other European countries. The shuttle started with length of 450 metres, of 20 wagons with a capacity of 3 TEU per wagon. When the demand increased the maximum length of the shuttle was extended to 630 metres (30 wagons), which reduces the slot costs for the service. It was necessary to change from the Naviland Cargo terminal to the Novatrans terminal (Vénissieux) in Lyon to handle these longer trains. Even though the border crossing bottleneck has now been removed, bottlenecks remain. First, the UIC standard gauge track is designed for (and mainly used by) high speed trains. This track includes relatively steep slopes which require the use of two locomotives, adding to the operational costs. Furthermore, three different voltages are used along the track. In the existing situation a change of locomotive and driver is still necessary. Special locomotives could handle the different voltages, but also lead to increased operational costs. APB lobbies for the development of a separate freight track from Barcelona to the French border. This will further reduce operational costs and enable a more competitive service in terms of transit time and price. Another bottleneck that has become apparent is the limited rail infrastructure in the port of Barcelona. Complex shunting operations are required to visit both container terminals in Barcelona. These are too costly. Therefore containers are (un)loaded at one of the two terminals. Transport between the terminals is done by truck. This adds costs and reduces

sustainability. To improve the situation, i.e. make direct transport via rail possible, APB started a rail infrastructure upgrading project.

Volumes and utilization
The initial idea at the start of the rail shuttle was to begin with a service three times a week and have a daily service within five years. This scenario changed as the start of the rail shuttle coincide with the beginning of the economic crisis which strongly impacted the demand. Therefore it was decided to start with one shuttle per week instead of three. Within the first three years of operation the volumes developed enough to operate three rail shuttles per week.

The shuttle faces an imbalance (the import volumes are larger than the export volumes) therefore different prices are quoted for import and export traffic with the aim of promoting the export traffic. In 2011 the capacity of the rail shuttle significantly increased due to the longer trains and addition of a third weekly roundtrip. This additional roundtrip increases the quality of the product, but also increases the gap between the capacity and the actual utilisation.

Table 2.4: Traffic evolution per year in TEU (source: derived from case study material)

Year	*# TEU*	*Full containers*	*Maritime containers*
2009	1,066	8%	43%
2010	3,022	33%	90%
2011	7,238	75%	88%

To decrease costs the rail shuttles is operated as flexible as possible. When the occupancy of the train is below a certain rate, the train is cancelled and the containers are transported by truck or put on the next train, when longer lead times are acceptable for customers. Partly due to this approach, the occupancy rate in 2011 was around 65%. Since beginning of 2012, the first year without subsidies, the shuttle operates around the break-even point. Despite this positive development, the economic situation in 2012 with declining volumes and pressure on trucking companies which have resulted in reduced prices, it is expected that the original forecast for a daily service within five years will not hold.

Exit and new initiatives
APB regards the rail shuttle as a long term investment and accepts that it takes time before the rail shuttle has attracted sufficient cargo to become a profitable business. Such new service development requires long term commitment: unless the operators can convince potential users they are in it for the long term, users cannot be expected to use the service. APB was a crucial player to set-up the shuttle. The involvement of APB in the rail shuttle is in line with their vision and strategy. With a return on investments after 20-30 years, the shuttle is unlikely

to be developed by private firms alone, but at the same time, APB thinks the shuttle is economically feasible and adds to the competitiveness of Barcelona. In principle, APB is willing to withdraw from the service once it operates profitably. APB argues that it is still too early to withdraw from the service and leave it to the rail operators. Furthermore, APB its participation is necessary as the current infrastructure is not sufficiently competitive to allow sufficient returns for private operators. Current conditions (requiring two locomotives, changing drivers and locomotives near the border, etc.) require public participation so that services can be provided on equal terms against other alternatives in Europe. When the infrastructure is sufficient and services can be provided based on competitive conditions, APB will consider the transfer of its shares in the project.

The experience with the Lyon shuttle –an uphill battle but leading to a break even service in 2012 with a positive outlook- strengthened APBs conviction that its involvement in developing new services is in line with its port development goals. Consequently, it has invested in developing another new rail connection. Since June 2011 a weekly connection links the port of Barcelona with Toulouse and Bordeaux. APB expects a faster development of rail volumes, as the port is better positioned vis-à-vis Marseille as both ports are located at approximately 400 kilometres from Toulouse and 650 kilometres from Bordeaux and there is virtually no competition from other ports. The frequency of the service is increased to two per week as of January 2012.

2.4.6 Results

The activities in the hinterland have contributed to a modal shift from road to rail (table 2.5). Despite the difficulty for new rail operators to access the Spanish rail market, clearly indicated by the reduction of the number of rail operators in Barcelona to only one (the Spanish publicly owned rail operator Contren) in 2011, and the decrease of hinterland volume[15], rail transport increased substantially between 2007 and 2011.

APB justifies its deep involvement in the hinterland through pointing out the inactivity of private firms. The private sector has neglected to invest in improved intermodal connectivity, although the market potential was there, as demonstrated by the huge growth of rail transport.

Four reasons may explain why, even if private operators are not willing to take the risk of developing new services, it may be appropriate for a port authority to do so. First, improved intermodal connectivity will lead to increased competitiveness, which in turn leads to more port dues and higher land values for port land. These effects are not relevant for the rail operator, but they are

15 In 2009, volumes in almost all major European ports dropped significantly due to the financial and economic crisis.

relevant for the port authority. Second, faced with untapped potential for new intermodal connections, an active role of the port authority may be in the interest of port users. In this sense, improving intermodal connectivity can be regarded as a collective action problem (Olson, 1971): various firms such as port users, shipping lines, the port authority and port service providers benefit from improved intermodal connectivity, but they do not have incentives to contribute to collective efforts to improve intermodal connectivity. The port authority is well positioned to play a key role in investments with collective benefits (see De Langen and Visser, 2005). Third, better intermodal connectivity may lead to reduced congestion on the port access roads. This can be considered an 'external effect' that is not relevant for a rail operator, but is relevant for a port authority. Fourth, improved knowledge on rail bottlenecks enable better port planning and strengthen the lobby for infrastructure improvements. In the Barcelona case, all these reasons are relevant.

Table 2.5: statistics container traffic Barcelona in TEU (source: derived from case study material).

Container throughput Barcelona	*2007*	*2008*	*2009*	*2010*	*2011*
Total container volume	2,610,099	2,569,477	1,800,213	1,946,434	2,033,549
Transhipment volume	988,972	959,225	606,235	633,866	666,518
Volume, excl. Transhipment	1,621,127	1,610,252	1,193,978	1,312,568	1,367,031
Total rail transport	41,770	52,562	59,544	103,898	146,685
% rail transport of total hinterland volume	2.6%	3.3%	5.0%	7,9%	10,7%
% annual growth rail transport		25.8%	13.3%	74,5%	41,2%

2.5 Discussion and conclusion

Ports have become dependent on intermodal transport networks to maintain or extend their competitive position. The example of Barcelona shows that reliance on road transport restricts chances to gain market shares in contestable hinterlands. APB recognized that it needed intermodal transport to extent its hinterland into new regions, also argued by Van Klink and Van den Berg (1998). Furthermore, the strategy of APB focuses on all elements in the port supply chain, meaning that APB's scope extended into the hinterland by facilitating shippers' supply chains through the port utilizing improved intermodal transport services. ABP hasn´t become directly involved in the supply chains itself. APB experienced that only investing in a hinterland terminal does not provide additional traffic. The logistics community needs to be informed about the possibilities, and needs to be supported to understand requirements and procedures in the port. The services provided within the port and between the

inland terminals need to have high quality standards and infrastructure needs to be in place. To realize this, the participation and operational involvement of APB in the rail shuttle has been crucial for a thorough understanding of operations in the rail market. This gave APB a strong position in discussions concerning the development of infrastructure and removal of bottlenecks outside the port. In addition, it provided APB with an overview of the necessary improvements in the port to realize further growth of rail transport. Only then the port can attract shipping lines to use the port for more distant markets and only then customers in the hinterland will see a port as one of the possible options. Although the signs are positive, it has to been seen if the followed strategy results in a competitive advantage over other ports in the region. What has become clear from the case is that one approach for connecting different hinterlands won´t work. APB acquired substantial knowledge and capabilities to connect hinterlands in different ways. Even though these intangible assets might not all be necessary to realize connections with new hinterlands, they will be hard to duplicate. So if the strategy results in a competitive advantage, it will be a sustainable one.

The sequential strategic plans developed by the port authority of Barcelona have a strong overlap with the development of a port as described by Notteboom and Rodrigue (2005). Monios and Wilmsmeier (2013) identified three topics related to intermodal transport which can influence port regionalization, the last phase in port development model of Notteboom and Rodrigue (2005): inland terminal development, inland logistics and collective action. The detailed hinterland strategy of Barcelona indicates that, especially in the area of inland terminal development, a port authority can play a significant role in port regionalization. This case study also answers the call by Rodrigue and Notteboom (2009b) for further research into this issue.

The operational involvement of a port authority in hinterland transport operations, as done by APB, goes a step further than proposed by Van Klink and Van den Berg (1998) and Notteboom and Rodrigue (2005), as these scholars study the role of port authorities in port networks, but do not specifically describe operational roles of port authorities in intermodal chains. Further research is suggested on the scope of port authorities to include an 'organisational learning' perspective (see the seminal paper of March, 1991, for the concept of organisational learning), as the APB case clearly shows how its involvement in rail operations triggered learning processes with unforeseen consequences. Port authorities have, by nature, a longer planning horizon than private organizations operating in the port. The required return on investment is often lower and does not have to be realized within a relative short period of time. Due to the shorter planning horizon, private organizations are reluctant to initiate new activities which require a large investment without a high direct positive return on investment such as the inland terminal in Zaragoza. De Langen (2007) shows that new infrastructure, which make new areas better accessible, will not

immediately result in a strong increase of market share in these areas. This also suggests that port authorities can play a role to enhance the use of intermodal infrastructure, like APB did with participating in a rail shuttle. In this case, APB as port authority acts beyond its traditional scope when it becomes a partner in rail services. A port authority, as was the case of APB before its involvement, has no track record regarding operating rail shuttles. However, the case study proves that a port authority can make important contributions to the realization of new intermodal services. Developing rail shuttles in new markets also requires long term commitment. The growth rate of the rail shuttle between Barcelona and Lyon shows that even though the market may be substantial, companies are reluctant to shift volumes overnight. In combination with the high start-up costs of new rail services, private initiatives for new services development may be limited. Contrary to other industries, where it is widely understood that a substantial part of all new services will fail, rail operators are cautious in their approach to the development of new rail services. This suggests that more attention for new service development (see Johne and Storey, 1998) in intermodal transport is required.

A port authority as a self-sustaining but not-for-profit organisation with the aim to develop a vital port, may be one of the few actors that is truly committed to a specific port and consequently intermodal connectivity of this port. Thus, faced with untapped potential for new intermodal connections, an active role of the port authority may be in the interest of port users. Apart from the direct return, new intermodal connections have important indirect benefits for port authorities, including increased competitiveness and port dues, reduced congestion on the port access roads and improved knowledge on rail bottlenecks that enable better port planning and strengthen the lobby for infrastructure improvements. In the Barcelona case, all these indirect benefits are relevant. However, cases from other ports would be required to understand the conditions in which port authorities can create value through developing intermodal services.

To summarize the above, two key characteristics, i.e. the longer planning horizon and commitment to improve the local community, of the port authority have influenced the decision to become operational involved. This resulted in strong learning curve which have been beneficial for the development of the port. Such a learning principle through operational involvement could be of added value to other (local) governmental institutions as well. For example, infrastructure development (hardware as well as software) on a local or regional level as well as public transport (whether or not privatized) are influenced by rules, regulations and policies. Although they are well thought over, they might not always result in the most optimal situation for users, operators or customers. Operational involvement of policymakers (albeit for a short period) leads to an improved understanding of the situation which can result to better decisions and more

efficient solutions. In the end this should benefit civilians and the industry as a whole.

The case shows the changing strategic scope of APB, where investments in inland terminals and operating rail shuttles have become instrumental to achieving the goals of APB. However, while one may 'analytically' generalise that lack of private initiatives may justify port authority initiatives in this area, more research on this role and its underlying logic in terms of effects on port competitiveness is required, to 'empirically generalise' the case results. Comparative analysis of cases as well as research into the financial performance of new rail services can increase the understanding of the port authority involvement in hinterland operations and the effects of institutional structures, routines and capabilities of this involvement.

As a final conclusion, this case suggests that landlord port authorities that provide a platform where cargo can be transferred between different modes, by connecting maritime networks with hinterland networks, may be able to create additional value for port users by enlarging their scope through developing the hinterland network.

In strategic management terms, the investments in the hinterland of port authorities create network effects. Network effects occur when services (for example, a rail network between the port and multiple inland destinations) are used by an increasing number of users (shippers). Due to the increasing number of users services become more valuable to users because quality increases (for example, higher frequency of rail connections through the network) and prices decrease. Indirect effects might also occur as additional services are developed which are connected to the original service, for example, information systems to increase efficiency and transparency. These effects further increase the value of the service (Katz and Shapiro, 1985). Network effects which occur in a two-sided market , and could be applied to ports with the sea and hinterland side representing the two markets (e.g. shipping lines might be attracted to a port due to its extensive hinterland network), are further introduced in chapter 7. The most important strategic question in relation to two-sided markets that needs to be discussed here is related to pricing (Eisenmann et al., 2006): which side of the market should be subsidized? APB has chosen to invest in the land side to make the port better accessible from the hinterland in order to realize a return on investment on the new and existing port area by attracting additional shipping lines and volumes. Other port authorities may implicitly be subsidizing the landside of the platform, as they charge port dues to shipping lines and invest part of these resources in rail access. This platform perspective on ports will be discussed in chapter 7 which analyses whether port authorities have their pricing of the platform right, or alternatively, that changing the pricing structure

(provocatively, say by allowing ships to enter the port for free, but charge trucks, trains and barges) may actually enhance the competitiveness of the platform.

Limitations

Although we are confident that we have been able to provide a thorough analysis, the data has been obtained from APB and all interviews were conducted with APB or affiliated companies. Other stakeholders play additional roles in developing hinterland networks and constrain the strategic choices of APB or have another perception of the activities undertaken by APB. Furthermore, the case has some specific characteristics which might not apply in other cases, for example the dominant position of a state owned incumbent rail freight operator or countries where rail tracks are owned by specific rail companies (such as in the US). Finally it is important to stress that this case suggests that port authorities may have reasons for developing new intermodal services when private firms are reluctant to do so, even when this leads to losses in the initial years of these services. The case does not suggest it is sensible for port authorities to spend the revenues they receive from port users in financially not viable intermodal connections.

Chapter 3

The effects of modal split obligations in terminal concession contracts[16]

16 The content of this chapter is also presented in Van den Berg and De Langen (2014a)

3.1 Introduction

The previous chapter introduced the added value of intermodal transport to the competitive position of a port. With relative low throughput volumes ports can depend on unimodal road transport between the port and its hinterland. When volumes increase unimodal transport becomes less attractive (Notteboom and Rodrigue, 2009b) because of capacity issues (e.g. limited road capacity as well as limited availability of truck drivers). The realization of a shift towards other modes of transport (the so-called modal shift) can be realized through an active hinterland strategy (as discussed in chapter 2). However, previous studies have also shown that public policies to realize a modal shift not necessarily lead to the expected results (Bontekoning et al., 2004; Tsamboulas et al., 2007; Macharis and Pekin, 2009).

The Port Authority of Rotterdam has introduced a new instrument, within the boundaries of the port, to realize a modal shift. More specifically, it included modal split obligations in the concession contracts of the terminal operating companies, with the aim to realize a modal shift towards rail and inland waterways. The Port Authority of Rotterdam (PoR) has been the first port authority to include such obligations in concession contracts for container terminals[17] (De Langen et al., 2012b). The effects of this instrument have not yet been analysed. Since the modal split obligations in Rotterdam will only become effective as of 2015, an analysis in retrospect is not yet possible. An exploratory analysis of the effects is possible, as the terminal operating companies are planning ahead. The research question that will be answered in this chapter is: "How will terminal operating companies deal with a concession clause aimed at a modal shift towards inland waterways and rail?" By answering the research question, this chapter aims to enhance the understanding of more commercially driven initiatives by port authorities to realise a modal shift in ports which is currently lacking both in theory as well as in practise.

This chapter starts with a further introduction of the importance of a modal shift and the challenge which exist for port authorities. Second, the instrument implemented by PoR to stimulate the use of intermodal transport is described. Afterwards, an overview is given of the potential effects of the modal split clauses in concession contracts on terminal operating companies. Based on in-depth interviews with the three terminal operating companies, this chapter analyses the impact of the modal split obligations, including the potential impact of the terminal operating companies' hinterland strategies on the business

17 To our knowledge, no other port has mentioned the use of such criteria. The port authority of Barcelona has also included items on intermodal access in concession contracts, but more open, stating that the port authority of Barcelona and the operator are open to joint involvement in hinterland connections.

model applied to specific terminals. The chapter finishes with a discussion and conclusion.

3.2 Modal shift

At least three arguments substantiate the importance of a *modal shift* for ports, especially to ports in the North-western part of Europe. First, intermodal transport helps to reduce road congestion, which becomes more problematic when container volumes grow. Given a lack of space to expand roads as well as limited societal acceptance of more roads, road accessibility can often only be maintained through an increase in intermodal transport. In addition, this shift from road to rail and/or inland waterways will reduce the gap between increasingly large vessels and call sizes at ports and fragmented inland transport systems because these modes can handle large container volumes; in Europe trains up to about 100 TEU and barges up to 1000 TEU. Second, increasing intermodal transport is important for ports because their competitive position in the hinterland is largely based on intermodal transport networks (Notteboom and Rodrigue, 2005). As intermodal transport becomes more attractive over longer distances (Van Klink and Van den Berg, 1998), a modal shift will make the port more attractive to companies situated further away from the port (i.e. those in the contestable hinterland, see De Langen, 2007). It is important to note that in many ports there is sufficient infrastructure capacity for rail and barge transport, often in part due to large public investments in rail and inland waterway infrastructure. The relatively low utilization levels of this infrastructure create opportunities for modal shift strategies. Third, society increasingly focuses on the environmental impact of transport. The transportation sector is an important contributor to air pollution (Coyle et al., 2006). Increasing the percentage of intermodal transport can decrease the impact of the transportation sector on the environment as intermodal transport achieves better environmental performance, including lower energy use and reduced CO_2 emissions (Kreutzberger et al., 2003). Despite the positive effects of intermodal transport on environmental impact, a literature review by Meixell and Norbis (2008) on transportation mode choice and carrier selection indicates that environmental considerations and energy use are (still) not important factors in the decision making process. However, various recent initiatives of both governments and companies, such as the "Clean Cargo Initiative" and the "EU Green Paper on Transport", provide new steps towards becoming greener. Such initiatives send clear signals concerning the need for a modal shift. For many port authorities, including those of Rotterdam, Antwerp and Hamburg, permission to develop port infrastructure will only be granted in cases where environmental impact is minimized.

For these reasons, port authorities are starting to implement instruments to stimulate the use of intermodal transport. For example, as discussed in chapter

2, the port authority of Barcelona actively invests in an intermodal network of inland ports and connections, the port of Goteborg also invests in rail connections to inland ports and the port authorities of Los Angeles and Long Beach co-invest in rail infrastructure (e.g. the Alameda corridor). Government investments (i.e. railways and inland terminals) frequently aim to improve the modal split towards rail and inland shipping (see Tsamboulas et al., 2007 for an overview of potential improvements and policy proposals to stimulate the modal shift). However, little research has been done on the effect of public policies on intermodal transport volumes. Bontekoning et al. (2004) argue that a lack of insight into the effectiveness of policies in stimulating intermodal transport is a serious problem. In addition, Macharis and Pekin (2009) show through simulations that subsidies do not necessarily stimulate intermodal transport. Also from an operations research perspective, more research is needed to realize a better insight in the cost structure of intermodal transport chains for developing effective modal shift policy actions (SteadieSeifi et al., 2014). Thus, while public policies in Europe have supported intermodal transport for decades, their effects are unclear. Still, there is a need for a substantial modal shift from a port authority perspective which will be introduced in the next paragraph.

3.2.1 The challenge

In 2008, approximately 50% of all the containers in Europe were handled in one of the ports in the Hamburg – Le Havre range (Notteboom, 2009a). The four largest container ports in Europe (Rotterdam, Antwerp, Hamburg and Bremerhaven) are all situated in this range (figure 3.1) and together handled more than 35 million TEU in 2011. All of these ports are facing congestion problems that are partially caused by the handling of large container volumes[18]. Given the previously discussed reasons, Rotterdam and Antwerp have communicated modal split targets (respectively for 2035 and 2020) and aim for a shift towards rail and inland shipping. These ambitions are in line with the European Commission's white paper which foresees the use of multimodal transport for all freight transport over 300 kilometres (European Commission, 2011) as well as initiatives of national/local governments to introduce road pricing. Hamburg has also stressed its commitment to intermodal transport, mainly by utilising rail, and has communicated a forecasted modal split for 2025 based on its strategic plan of 2012.

Table 3.1 provides an overview of the development of the modal split for the ports of Antwerp, Bremerhaven, Hamburg and Rotterdam between 2003 and 2010. Antwerp and Rotterdam are very well connected to inland waterways. Therefore, transport by barge has always been important for both ports. In

18 The actual cause of most congestion, even around port areas, is in fact commuter flows, with clear peaks around 8:00 and 17:00. Still, the large amount of trucks does contribute to congestion. Trucks are also often regarded by the public at large as one of the main reasons for congestion, leading to a negative impact on the societal acceptance, and thus growth, of port activities.

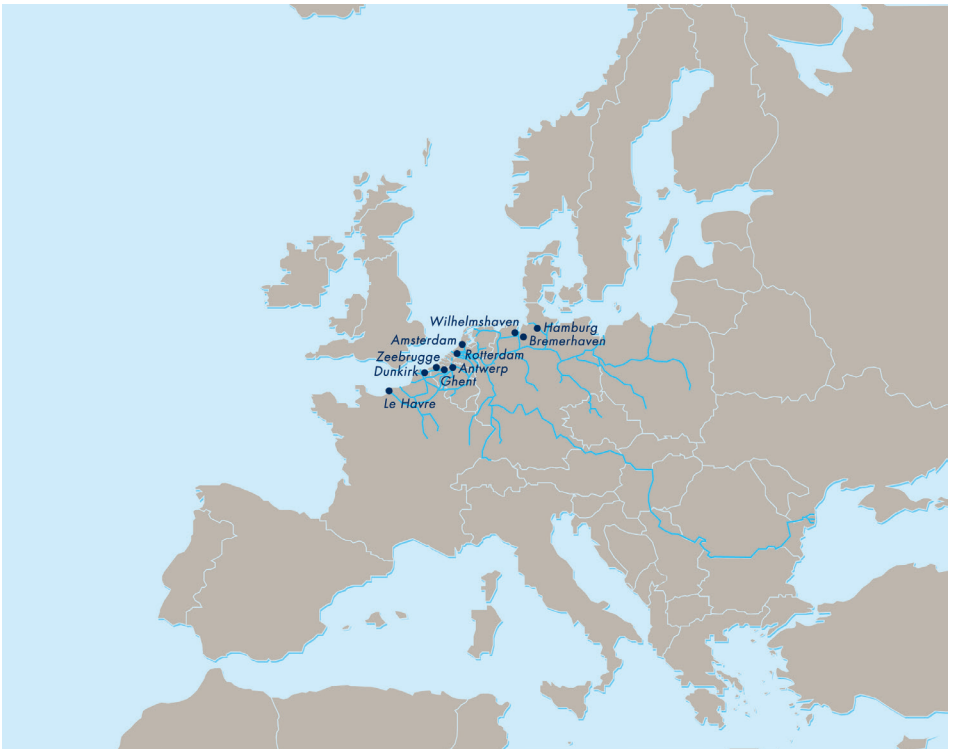

Figure 3.1: container ports in the Hamburg – Le Havre range (source: Port Authority of Rotterdam)

contrast, the German ports have had fewer possibilities to use inland waterways and have historically focussed on rail transport. Table 3.1 shows that, while the modal split has improved in both Bremerhaven and Hamburg, changes have been rather limited in Antwerp and especially Rotterdam. Although it is out of the scope of this chapter to provide a detailed analysis of the reasons behind these differences, one important reason is worth mentioning. The terminal operating companies in Bremerhaven and Hamburg, which are closely connected to the local authorities and government, have stakes in rail operators and have been able to develop and increase connections between destinations in Germany and Eastern Europe. In Antwerp and Rotterdam, such vertical integration is more limited for both barge and rail. In all ports, volumes of all modes of transport have grown between 2003 and 2010, as total throughput volumes have grown.

Table 3.1 also shows the modal split targets of Antwerp (for 2020), Rotterdam (for 2035) and Hamburg (for 2025). Table 3.1 suggests that the targets set by Antwerp and Rotterdam are challenging: a disruption of past growth patterns is required. To put the modal shift challenge further in perspective, the expected growth of total container volumes is also relevant. The Dutch research institute TNO and PoR have developed long-term growth scenarios for the Hamburg – Le

Table 3.1: modal split of largest container ports in Europe and communicated targets (sources: port authorities)

Modal split	*Antwerp*			*Bremerhaven*			*Hamburg*			*Rotterdam*		
Year	Road	Rail	IW	Road	Rail	IW	Road	Rail	IW	Road	Rail	IW
2003	61%	9%	30%	63%	35%	2%	70%	28%	2%	59%	10%	31%
2004	60%	9%	31%	61%	36%	3%	69%	29%	2%	60%	9%	31%
2005	59%	9%	33%	60%	37%	3%	68%	30%	2%	60%	9%	31%
2006	59%	9%	32%	56%	41%	3%	66%	32%	2%	59%	11%	31%
2007	57%	10%	33%	54%	43%	3%	65%	33%	2%	59%	11%	30%
2008	57%	11%	32%	53%	43%	3%	64%	34%	2%	57%	13%	30%
2009	55%	10%	35%	51%	44%	3%	63%	35%	2%	56%	11%	33%
2010	56%	10%	34%	50%	45%	4%	62%	36%	2%	57%	10%	33%
Target	*42%*	*15%*	*43%*	-	-	-	*57%*	*41%*	*2%*	*35%*	*20%*	*45%*

Havre range as well as specifically for Rotterdam (see De Langen et al., 2012a). As an example we have used the modal split ambitions of the port of Antwerp in table 3.2 and calculated the necessary volume growth per mode of transport in two scenarios: the moderate growth scenario, with a 2.8% growth rate per year, and the high growth scenario, with a 4.2% growth rate per year. Table 3.2 shows that the volumes for rail and barge transport (almost) need to double while the volume of road transport should remain roughly stable. This example shows the magnitude of the challenge. Given past modal shift developments, a 'business as usual approach' may not be good enough.

Table 3.2: calculation of volume growth per mode of transport for the port of Antwerp per 1 million TEU

Modal split Antwerp	*2010 (base year)*		*2020 (2,8% growth rate)*		*2020 (4.2% growth rate)*	
Transport mode	%	TEU	%	TEU	%	TEU
Road	56%	560,000	42%	553,580	42%	633,762
Rail	10%	100,000	15%	197,707	15%	226,344
Inland waterways	34%	340,000	43%	566,761	43%	648,852
Total	100%	1,000,000	100%	1,318,048	100%	1,508,958

3.3 Terminal concessions and port development

Terminal concessions in seaports have only recently attracted academic attention (see e.g. Notteboom, 2006b; Pallis et al., 2008 and the special issue in Maritime Policy and Management, 2012 on terminal concessions). The allocation mechanisms used for granting seaport concessions, the determination of the concession term and fees and the inclusion of special clauses aimed at assuring that the terminal operator will act in the interest of the port authority and the

wider port community (cf. throughput guarantees and environmental clauses), are interesting issues both for academics and the port industry.

So far, efforts by port authorities to use concession clauses to align the goals of the terminal operator with overall port development goals have not been analysed. Performance targets in concession contracts are instruments to align these two sets of goals. The most common performance target is cargo throughput. The port authority can indicate upfront a minimum throughput to be guaranteed by the concessionaire, incentivising the operator to attract maritime trade. In the event that the terminal operator does not meet the objectives as set in the concession agreement, he will either have to pay a penalty to the port authority or, in the most extreme case, forfeit the concession altogether. Terminal concessions are generally granted for several decades and the contracts reflect the economic situation at the time of signing the contract. Unforeseen developments, such as the economic downturn of 2008-2009, may lead to renegotiation between the port authority and the operator[19].

Port Authority of Rotterdam has been the first port authority to put *modal split obligations* in concession contracts for container terminals[20]. Although concession contracts often have performance indicators to realize a certain quality or service levels (see for example Notteboom 2006b; Ng and Loosemoore, 2007; Marques and Berg, 2010), the concession clause incorporated by the Port Authority of Rotterdam is rather special because the concessionaire cannot influence the realization of the clause directly. Of course, concessions contracts, which mainly occur in the water and transportation sector (Marques and Berg, 2010) and deal with economic or social infrastructure, more often deals with risks which cannot be influenced like, for example, traffic risks on toll roads (Vassallo, 2006). However, these risks are often covered in mitigation mechanisms and not transferred to the concessionaire. Given this characteristic and the previous discussion of the importance of a modal shift, the effect of this approach may be of interest to other seaports , for both new concession contracts and renegotiations, as well as other industries like public transport, toll roads and power generation.

3.3.1 Approach by the Port Authority of Rotterdam

In the request for a concession contract proposal for a large container terminal on Maasvlakte 2, candidates were asked to indicate what modal split they could

19 For instance, the two major container terminal operators in Antwerp did not meet their volume thresholds in the years following the economic crisis of 2008-2009. According to their contracts, penalties will be incurred, in sum over 50 million euros for both operators and various years. Given the crisis, Antwerp Port Authority has expressed willingness to renegotiate these penalties, but a decision has yet to be taken (De Tijd, 2012).

20 Appendix A provides some additional regional and institutional context which explains,to some extent, how the Port Authority of Rotterdam was able to incorporate additional clauses.

realise and the strategy they would use to realise this. The Port Authority of Rotterdam indicated the minimum desired modal split (see table 3.3) in its proposal request. The modal split ambitions of the candidates and their proposed strategies to achieve a high share of intermodal transport were evaluated as part of the decision-making process by PoR (see De Langen et al, 2012b).

Table 3.3: Desired modal split for container transport from the terminal by Port of Rotterdam (Source: unpublished Request for Proposal Maasvlakte 2, 2005)

Transport mode	*2015*	*2020*	*2025*	*2030*	*2035*
Road	45%	42%	40%	37%	35%
Rail	16%	17%	18%	19%	20%
Inland shipping	39%	41%	42%	44%	45%

The modal split proposed by the chosen candidate was at least the desired modal split by the Port Authority of Rotterdam and has been incorporated into the contract. 2015 is the first year in which the modal split will formally be a performance criterion according to the contract. If the targets are not met (financial) consequences can be enforced[21]. After including this obligation in the terminal concession to Rotterdam World Gateway (a consortium of DP World and the shipping lines APL, MOL, Hyundai and CMA CGM), modal split obligations have also been incorporated in the concession contracts of the two other major terminals (ECT and APMT) in the Maasvlakte area in Rotterdam[22].

3.4 Effects of concession conditions for terminal operating companies

In general, regulatory and market changes have been drivers for change in the choice of transportation mode (Meixell and Norbis, 2008). However, the modal split concession clause is a novelty in the port industry; no academic research on the effects has been done. The use of these concession clauses has been widely discussed. Figure 3.2 shows the results of a 2012 survey taken among shippers and forwarding companies in the Netherlands.

The results presented in figure 3.2 originate from a larger survey among shippers and forwarders in the Netherlands, executed through the Dutch industry associations EVO (shippers) and FENEX (forwarders). Details about the execution of the survey are presented in chapter 5. Other results from the survey are discussed in chapter 5 and 6, the full questionnaires (in Dutch) can be found in appendix 1 and 2. Non-response bias was tested per type of respondent (as forwarders and shippers were approach separately). The forwarders responded in three waves (N=97). The first wave of responses occurred after

21 The goal of including this clause is not to generate additional revenue, but to ensure that the modal shift will be realised.

22 Incorporating such a clause in an existing concession is complex and requires some sort of re-negotiation concerning the concession.

the initial invite, a second wave after an e-mail reminder and a last wave after a second reminder by phone. An ANOVA test indicated that there is no significant difference between the early and late respondents (with $\alpha = 0.05$). The shippers responded in two waves (N=48). The first wave of responses occurred after the initial invite while the second wave occurred after an e-mail reminder. The Independent Samples T-test indicated that there is also no significant difference between the early and late respondents (with $\alpha = 0.05$) amongst shippers. With a response rate of 12,6% the non respondents could have a significant impact on the outcome. However, based on Armstrong and Overton (1977), who argue that late respondents can be considered as a proxy for non-respondents, we conclude that, in this study, non-response bias is not an issue.

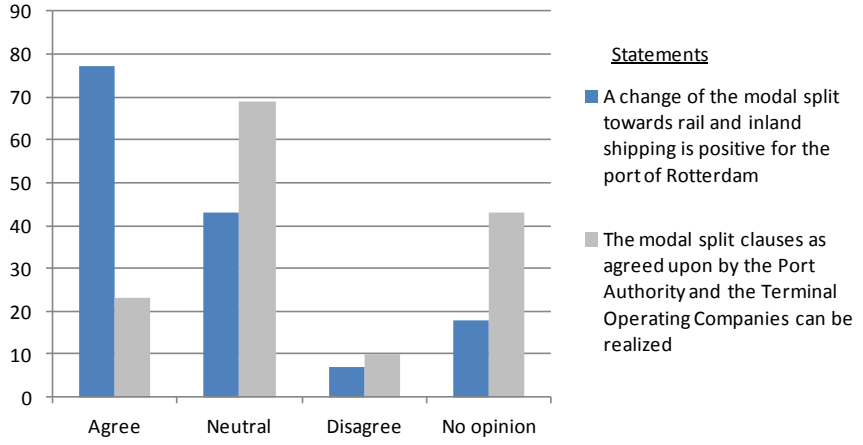

Figure 3.2: the position of shippers and forwarders towards a modal shift and the concession clause (N=145)

We have tested whether or not shippers and forwarders respond differently to the statements in figure 3.2. To test for significant differences, we changed the answers into an interval scale. We had to deal with the "no opinion" answers, which can't be positioned on an interval scale. To overcome this problem we performed an Independent Samples T-test in which we deleted the "no opinion" answers (in the case of the statement "A change in the modal split towards rail and inland shipping is positive for the port of Rotterdam" 8% of the shippers indicated "no opinion" and 13% of the forwarders indicated "no opinion", for the second statement 26% of the forwarders and 35% of the shippers indicated "no opinion"). Also, we performed an Independent Samples T-test in which we combined the answers "neutral" and "no opinion" into one response category since Lam et al. (2010) found that the "no opinion" or "don't know" option is often chosen to indicate that the respondent has a lack of knowledge. Lam et al. (2010) also found that in multiple other cases, the respondent used the "don't know" option even though the respondent was knowledgeable. Both

T-tests show that for the statement, "A change in the modal split towards rail and inland shipping is positive for the port of Rotterdam", there is a significant difference between shippers and forwarders, with shippers agreeing more often with the statement than forwarders ($\alpha = 0.05$). This could be explained by a difference in experiences with organizing transport. Forwarders have to deal with this in their daily business, which does not necessarily need to be the case for shippers. Thus, shippers may have a broader perspective and a longer-term vision, in which a modal shift is positively evaluated. This is supported by industry reports suggesting that shippers are more advanced and ambitious with regard to sustainable supply chains than their (transport) providers (Carbon Disclosure Project, 2012). Furthermore, previous research also shows that forwarders are more price-sensitive than shippers (De Langen, 2007). Of course, also between shippers difference exist in the importance they attribute to price and environmental efficiency (Lammgård and Andersson, 2014). As shippers ultimately drive supply chain design, this is an important finding for port authorities that develop modal split ambitions. For the statement, "The modal split clauses as agreed upon by the Port Authority and the Terminal Operating Companies can be realised", such a significant difference does not exist ($\alpha = 0.05$).

Differences aside, these results show that shippers and forwarders (the two main customers of ports) acknowledge the importance of a modal shift towards rail and inland shipping. This is a relevant finding, as it provides support for the statement that modal split clauses can improve port competitiveness. Shippers and forwarders are less convinced that modal split targets can be met. This is in line with the analysis presented above that shows that a disruption of past trends is required to meet modal split targets.

Building on this conclusion, this chapter presents results from three in-depth cases that analyse whether and how terminal operating companies (TOCs) are impacted by modal split obligations. Case study research was used since this methodology best fits the aim of exploring and understanding the effects of the new concession clauses, prior to the first year (2015) in which they will formally be implemented (see chapter 2 for a more detailed argumentation for case study research). We have selected three cases of terminal operators in Rotterdam that all have modal split clauses in their contracts. All three cases (terminal operating companies) are located at the Maasvlakte in Rotterdam. During the second half of 2011 we conducted semi-structured interviews with the management of all three companies (ECT, APMT and Rotterdam World Gateway). The interviews were recorded, transcribed and analysed by the authors. The cases cover the largest deep sea terminals in Rotterdam (ECT and APMT handled 56% of the

total throughput volume in 2011) and are comparable since they are operating in close vicinity and in the same competitive environment[23].

Central in the theoretical framework that was developed for analysing the cases is a distinction between two types of potential effects of modal split clauses:

1. The impact on terminal design and operations.
2. The impact on the business model TOC's apply in a port.

3.4.1 The effect on terminal design and operations

Terminal clauses can have an impact on the terminal operations as shown by a simulation performed by Veenstra et al. (2012). Also the design is relevant to take into consideration since the modal split has a direct impact on both a terminal's layout and equipment type (Steenken et al., 2004). There are a wide variety of container terminal operating systems. The choice for an operating system depends on space restrictions, labour costs, the share of sea-sea transhipment and the expected modal split for hinterland volumes (Steenken et al., 2004). Wiese et al. (2010) show that the choice of equipment types used for terminal operation (e.g. rail-mounted versus rubber-tired gantry cranes) affect a container terminal layout. In general, a terminal can be segmented into four parts: seaside operation, horizontal transport, storage yard operation and landside operation, as pictured in figure 3.3.

Various studies on container terminals specifically deal with optimising operations and planning on the seaside and container yards. Stahlblock and Voss (2008) conclude that only a few studies have an integrative approach to container terminal logistics, even though such an approach is increasingly relevant as a terminal's competitiveness depends on waterside operations, internal logistics and landside operations.

For the green-field site in Rotterdam, the TOCs had to make a bid that included a modal split target and a terminal design that would be able to realise the intended modal split. Thus, to strengthen their bids, the candidates had to aim for a high intermodal share in the modal split. Since terminal design has a clear effect on terminal operations, they were included in the bids. This was relevant for the port authority, as it provided a 'check' on whether the modal split ambitions were reflected in the terminal design. Keeping in mind a modal split of 65%

23 The cases are also different. Both ECT and APMT are located in the existing port area and are already in operation while Rotterdam World Gateway will begin its operations by 2014 and the modal split clause will become effective as of 2015. The concession contract of APMT for the existing terminal does not include a modal split clause, but the concession contract for the new terminal does. The ECT's contract was recently renegotiated and the modal split clause has been incorporated in the new concession contract.

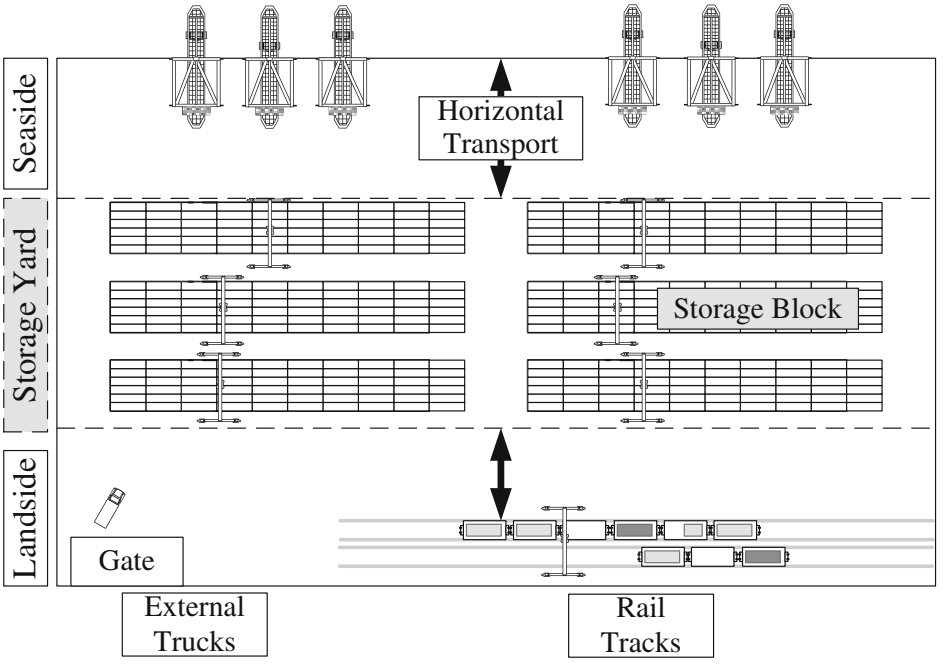

Figure 3.3: schematic overview of a container terminal layout (source: Wiese et al., 2010)

for rail and barge, this impacts investments in capacity for intermodal services, such as:

- extra rail infrastructure, often at the terminal (on-dock);
- extra quay capacity for inland shipping, which can be realized through additional dedicated quay length for barges than was previously the standard;
- planning tools for handling barges and trains.

A second potential impact of clauses concerns the pricing of inland modes. TOCs charge shipping lines for container handling. This charge covers the loading/unloading of the ship, the storage of the container in the stack and the loading/unloading of the container onto/off a truck, train or barge. Some TOCs differentiate tariffs based on the inland mode used. In some terminal designs, loading a container onto a truck is less costly for the TOC than loading the container onto a train or barge. This is because the truck essentially 'picks up' the container. Meanwhile, for barge and rail, the terminal needs to bring the container from the stack to the rail/barge quay. The modal split clause may lead to equal pricing for all modes as a stimulus for using intermodal transport.

3.4.2 The effect on the business model TOC's apply in a port

Some companies always operate with the same business model. However, others operate with distinct business models in different markets. As an example, many

airlines offer services with a network carrier as well as with a low-cost carrier (see Casadesus-Masanell and Tarzijan, 2012). These are different business models. Scholars have detailed the concept of a business model (IBM Institute for Business Value, 2012; Johnson et al., 2008; Margratta, 2002; Ostenwalder et al., 2005; Shafer et al., 2005; Zott and Amit, 2010) and proposed very similar definitions. We use the definition by Shafer et al. (2005): 'a firm's underlying core logic for creating and capturing value within a value network'. For TOCs, we make a distinction between two business models: a *terminal value proposition* and an *inland network value proposition*.

TOCs offer a terminal value proposition when they offer loading, stacking and unloading for a specific terminal to shipping lines. This is the most 'basic' product of a TOC. TOCs offer an inland network value proposition when they offer onward transport to an inland terminal and loading/unloading at this inland terminal as well. In this case, they do not provide 'just' terminal handling. We term this an inland network value proposition, as key to offering this value proposition is a network of inland terminals[24]. Large TOCs, such as Hutchison Port Holdings, DP World, APMT and PSA offer both business models. In some ports, they 'just' provide the terminal product, while in other ports they also provide the inland network value proposition. DP World, for instance, has developed an inland network value proposition in Antwerp, but not in Southampton. Likewise, Hutchinson offers, through its subsidiary ECT, an inland network value proposition in Rotterdam, but a terminal-only value proposition in Taranto (Italy). Other TOCs, like Eurogate and SIPG, offer a strong network value proposition in their home ports (Bremen and Shanghai, respectively), but only a terminal value proposition in other ports where they are active. The concession clauses can influence the value proposition TOCs develop, as they may drive or accelerate the development of an inland network value proposition. However, the clauses may also have no effect at all.

The cases, which will be discussed next, have been analysed based on the two types of effects the concession clauses can have: the terminal design and operations, and the development of an inland network value proposition (in addition to the already existing terminal value proposition). This results in a theoretical framework with on the horizontal axis the effect of the concession clause on the inland network value proposition and on the vertical axis the effect on terminal design and operations. The vertical axis could have also included transportation network design (instead of terminal design) as the involvement of a TOC in the design of the transportation network is related to the inland network value proposition. However, this would lead to a view solely on the

24 Similarly, TOCs could offer a maritime network value proposition, offering to handle ships in different ports. Even though many TOCs have various terminals around the world, these are sold and operated in isolation.

effect of the concession clause in the external environment of the terminal and neglects the impact it might have on the terminal itself.

Rotterdam World Gateway (RWG)
The first TOC that was confronted with modal split obligations was RWG. RWG senior managers indicated that the focus, two years prior to the expected opening, is on constructing the terminal. The modal split obligations in the concession contract have had an impact on the design of the terminal: RWG constructs a terminal that has the necessary infrastructure to handle the different modes of transport in the demanded shares. RWG argued that the shipping lines that are shareholders in the terminal (CMA-CGM, APL, MOL and HMM, the latter being partners in the New World Alliance) already have a modal split which is in line with the demanded modal split in the concession contract. Therefore, RWG does not expect problems in fulfilling this clause in the contract.

DP World, the terminal operating company in the consortium, stresses that, two years prior to the opening of the terminal, the strategy of how to cope with the obligation has not yet been determined. The most likely strategy to be used will be a re-active strategy, in which RWG will only take additional action if and when penalties for not achieving modal split targets are about to be given[25]. In this strategy, RWG will assess the best options based on costs and benefits of an improvement of the modal split towards the demanded levels. This strategy is a serious option given the fact that the shipping lines foresee the successful realisation of the modal split targets.

However, different, more pro-active strategies are also considered. One of these is to develop an inland hub, together with the partners of RWG, in order to increase the percentage of rail and/or barge transport. In case this strategy is followed, the question of who will organize the transport to the inland hub is still open. RWG could organise this, as this company has the contract with the port authority. However, it can also be organised by DP World or one of the ocean carriers. DP World indicated that it has no control over the use of the transport modality between the terminal and the hinterland in the current situation. According to DP World inland transport would be much more efficient if terminal haulage[26] was an established concept. This concept is difficult to implement given the different interests of the different firms in the supply chain (shippers, forwarders and inland transport operators).

25 Extra complexity for RWG is that its participating companies do not have an agreement on how to deal with possible penalties for not meeting the demanded modal split. This is especially relevant in a situation in which some of the carriers do meet the required modal split and others do not.

26 The terminal haulage concept is an addition to merchant and carrier haulage. Under terminal haulage, the terminal is responsible for the transport of the container between the deep-sea terminal and the final customer or inland terminal.

The hinterland strategy of DP World in Rotterdam is aimed at improving the link between the deep sea terminals and the inland terminals through higher visibility, frequency of the connections and reliability. Synchronisation of the connections between the inland terminals and the deep sea terminal reduces container dwell times at the deep sea terminal and results in cost savings. The development of intermodal services is done by a daughter company, DP World Intermodal. DP World Intermodal was founded in 2011, is currently focussed on North West Europe (especially from its existing terminals in Antwerp) and connects deep-sea terminals with inland hubs. DP World Intermodal is involved in the development of multi-user inland terminals (Beverdonk and TriLogiPort in Liege) and operates in partnership inland hubs in Duisburg, Germersheim and Strasbourg. The added value of DP World Intermodal is that it creates more visibility through the exchange of information between transport operators and the terminals and more bundling of containers[27]. DP World Intermodal creates value for the deep-sea terminal by giving them more control over the collection and arrival of containers. This reduces the peaks in arrivals that the terminal cannot influence or forecast well, with planning problems as a result. DP World Intermodal can provide the deep-sea terminal more insight in and control over these activities.

To conclude, in the case of RWG, the concession clauses have had a clear impact on its terminal design. The impact on the development of an inland network value proposition is still unclear, but the clauses most likely have an effect in accelerating the inland services developed by DP World, through DP World Intermodal.

APMT

A new terminal on Maasvlakte 2 will be operated by APMT. This will be APMT's second terminal in Rotterdam, as APMT already has a terminal in the port. In line with RWG, the new APMT terminal has modal split targets in its concession contract. Senior management is focussed on the construction of the terminal. The attention given to the modal split obligations is limited as the terminal is not yet in operation. APMT stated that the existing APMT terminal already performs better than the demanded modal split in the concession contract for the new terminal. APMT argues that the modal split clauses are relevant to APMT since they influence the logistics processes on the terminal. More intermodal volumes, especially by barge, require more barge-handling capacity. Investing in such capacity is complex given the fact that barge operators do not pay for (un) loading services. The handling of a container between the stack and a hinterland mode is paid by the shipping line. Pricing is not the same for all inland modes in all cases. In general, the costs of a truck move are lower than a barge move,

27 Although DP World Intermodal is focussed on services with DP World terminals, other deep-sea terminals will not be excluded from the intermodal services between the inland terminal and the port.

some TOCs also charge more for an intermodal move than for a truck move. However, shipping lines do not work with separate tariffs. Instead, shippers pay a standard terminal handling charge (THC) to the shipping line, regardless of the inland mode used. In the case that road transport is priced cheaper than barge and rail, shipping lines will prefer truck transport, unless they organise door-to-door transport themselves (carrier haulage). If the deep-sea terminal promotes intermodal transport, but continues offering lower tariffs for road transport, the shift to intermodal transport will have a negative effect on the profit margins of the shipping line. This is one of the reasons for APMT to decide to apply equal prices for truck and barge moves. This allows it to actively promote intermodal hinterland transport.

The hinterland strategy of APMT is aimed at realising larger container flows between the deep-sea terminal and inland locations through improving the intermodal service between them. AMPT does this through agreements with inland terminals and barge operators. Central in such agreements are *fixed windows* for barges. Until recently, APMT was not directly involved in the operation of inland services or inland terminals and did not sell hinterland connections. However, since the business unit responsible for the inland terminal in Neuss, Germany and intermodal services has been transferred from Maersk Line to APMT, APMT is more actively developing an *inland network value proposition*.

ECT

Before the discussion between PoR and ECT on including modal split obligations in the concession contract started, ECT had already developed an inland network value proposition, leading to a change in the modal split (more rail and inland shipping) at their terminals. The modal split obligations have been incorporated in the concession, but this has not had consequences for the terminal design, nor for the development of the inland network value proposition. An important driver for the development of this proposition is the new competition from RWG in the port of Rotterdam. ECT aims to create a competitive advantage with its inland network value proposition. ECT realized that if nothing would change, the landside container flows would become the bottleneck of the terminal. Therefore, it aims to increase its control over the containers going through the terminal, as this can lead to operational advantages such as shorter dwell times, better utilisation of handling capacity and higher utilisation rates on inland services.

To develop its inland network value proposition, ECT focussed on developing hinterland services by offering connections between its deep-sea terminals and

a number of large inland terminals (termed *extended gates*[28]), characterised by reliability and frequency. Reliability requires control over services, while frequency requires large volumes. Figure 3.4 shows the extended gateway services offered by ECT. ECT fully or partly owns the majority of inland terminals in its hinterland network. At these terminals additional services, such as customs clearance, are offered.

Figure 3.4: ECT's inland network value proposition of extended gates (source: website European Gateway Services)

ECT's hinterland services are aligned with the terminal operations in Rotterdam, for instance through fixed windows. Furthermore, the frequency of these services is so high (in some cases various services *per day*) that ECT can decide to send containers with the next service if they cannot be handled on time. In the most optimal situation, ECT offers a so-called synchromodal transport solution, where ECT decides what the best transport mode (e.g. rail, road or inland waterways) is to the inland terminal based on the demand of the customer and the circumstances. The ultimate aim of ECT is to change the logistics systems from pull (the receiver decides when to pick up the container at the terminal) to push (the terminal operator sends the container to an inland terminal in proximity to the receiver). This push system allows for optimising the terminal operations, inland service and inland terminal operations simultaneously. An important additional spin-off of this inland network value proposition is the possibility to improve the repositioning of empty containers, as these can be stored at extended gates instead of returned to the seaport.

28 Multiple academic papers have used the extended gate concept developed by ECT as a case. See for example Veenstra et al. (2012) for a broader discussion on the extended gate concept.

The extended gates are selected based on the potential to handle large volumes and the possibility to offer multimodal solutions; this results in a number of hubs along important corridors. ECT guarantees fixed windows for services to the extended gates, but not for intermodal operators with small container volumes. This approach is aimed to induce smaller inland terminals to connect with these inland hubs instead of shipping containers all the way to the deep-sea terminal.

The extended gateway services are open services; they are offered to shipping lines as well as shippers and forwarders. Shipping lines can sell the service under their own names. This allows shipping lines to offer an ILT-centred value proposition (which will be discussed in the next chapter). The connections in the network are open to all interested parties, including competitors or customers of competitors. Unlike APMT, ECT has not changed the difference in pricing between barge and truck moves.

ECT continues to invest in this inland network value proposition, for instance through co-developing IT-systems designed for flexible choices in inland transport modes and through addressing the liability arrangements that are a burden for delivering containers at an extended gate of ECT. The modal shift obligations in the concession contracts have had a minor influence on ECT's efforts in developing the inland network value proposition. But they are aligned and re-emphasise the importance of these efforts.

ECT truly has developed a new business model, which is offered in addition to its traditional business model. In the traditional business model, ECT only had a contract with a shipping line to load and unload the deep-sea vessel, stack the container and (un)load the hinterland transport mode. In the new business model ECT signs a contract with a shipping line, shipper or logistics service provider to deliver the container at an inland terminal. This changes the value proposition from a terminal value proposition to a port network value proposition which can be regarded as a widening of the scope of the TOC as mentioned by Franc and Van der Horst (2010).

Conclusions from the cases

Figure 3.5 shows the effect of modal split clauses on the three terminals in Rotterdam discussed above. The impact on the design and operation of the terminals is high, especially for the two newly developed terminals. The effect on the inland network value proposition is limited. ECT had initiated this development prior to the clauses in the concession. APMT has not truly developed an inland network value proposition, while DP World's inland network is mainly developed for existing terminals in Antwerp. For this case, the concession clauses may lead to an acceleration of DP World's efforts to develop this inland network value proposition for Rotterdam.

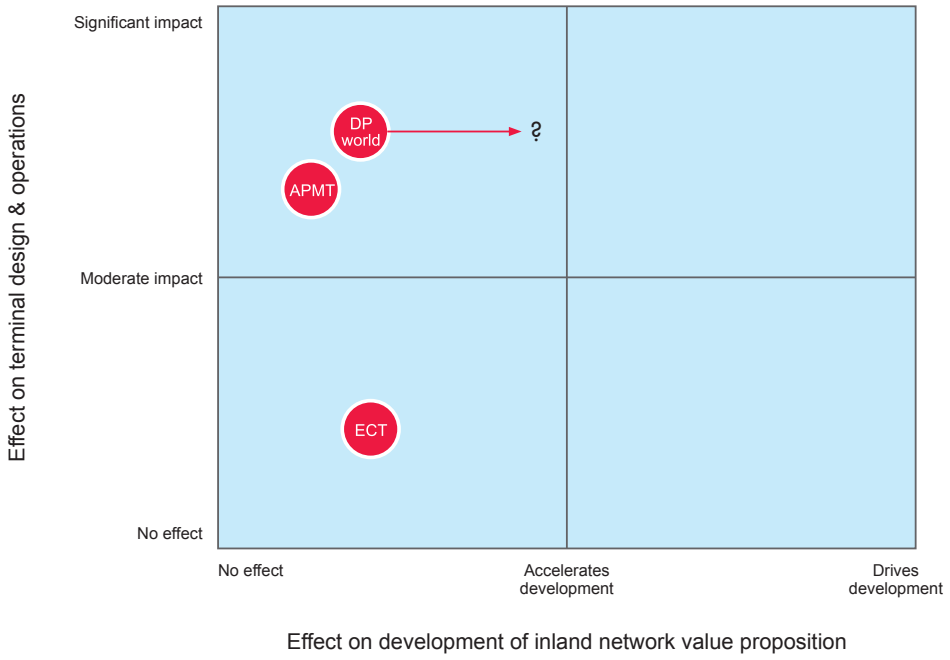

Figure 3.5: the effect of modal split clauses on terminals, three cases in Rotterdam

3.5 Discussion and conclusion

Intermodal transport is increasingly important for port competitiveness. The survey results also show that shippers and forwarders acknowledge that an increase of intermodal transport would be positive. However, shifting containers from road to rail or inland shipping does not happen overnight. Modal split obligations in the contracts of terminal operating companies are one of the instruments of port authorities to achieve a significant modal shift. Although shippers and forwarders wonder whether or not the set modal split targets can be met, the interviews indicate that the modal split obligations have a direct impact on the layout of a new terminal. Furthermore, terminal operators develop an inland network value proposition in some ports. The concession clauses may be instrumental in accelerating the development of such a proposition.

In case the concession clauses do effect in a increased focus on the hinterland by TOCs, this will improve the competitive position of the port as it improves the intermodal connectivity (e.g. more efficient processes, increased frequency or larger hinterland network). Since TOCs in other ports start to, or even further increase, focus on the hinterland, the concession clause contributes to, at least, the maintenance of the market share. Most probably, it will improve the market share as the TOCs are not only triggered by the larger competitive environment. They also have specific targets which stimulate TOCs to continuously improve their connectivity with the hinterland. The exact influence of the concession

clauses in the maintenance or growth of the market share will be difficult to measure. Numerous factors play a role. For example, the new terminals will, most probably, increase the total throughput volume, because multiple shipping lines have participated in or are committed to a terminal. Shipping lines will want to utilize these assets and shift volumes from other ports. As a result, hinterland traffic will also increase. The contribution of the concession clause in this increase is limited. However, the increased focus by TOCs on the hinterland, as a spin-off of the concession clause, will make the shift for shipping lines towards intermodal transport easier as hinterland connections are already in place or will be developed faster.

Concession clauses are relatively easy to duplicate by others. However, they can´t be incorporated in concessions at any moment in time. Only with new concession contracts or through renegotiations it is possible to include such clauses. Therefore, a competitive advantage arising from the increased focus on the hinterland driven by the concession clauses might be sustainable over a longer period of time.

3.5.1 Managerial contributions

Modal split clauses will have the largest impact if the port authorities incorporate these clauses in new concession contracts, since the terminal design can still be altered. When the modal split clause is incorporated in the contract during a renegotiation, the terminal design is generally fixed and difficult to change from a cost perspective as well as from an operational perspective.

When in operation, TOCs cannot force the carriers or the merchants, who decide on the mode of transport, to use intermodal transport to or from the hinterland. Therefore, it can be questioned whether demanding a modal split from a TOC is most suited to realize a modal shift. Although carriers and merchants have a larger influence on the mode of transport, deep sea terminals are the only locations where containers in such large volumes are transhipped which make them ideal locations to bundle containers to inland destinations. Not only is it easier for port authorities to organise this through TOCs with which they have a contract, it is also more efficient since port authorities need to deal with less companies. Furthermore, merchant and carriers are often not tied to a specific port. Imposing modal splits directly on these companies could drive them away to other ports. TOCs can co-develop an attractive inland network. In Rotterdam, all three TOCs recognise that by becoming more active in the hinterland, either by organizing the transport themselves or through partnerships with inland terminals, they can increase competitiveness and throughput and realise additional revenue streams. We have argued that TOCs can operate two business models simultaneously: the traditional terminal value proposition and a larger inland network value proposition. ECT is the most advanced in this respect.

Casadesus-Masanell and Ricart (2010) argue that a business model is the reflection of a realised strategy. With its extended gateway services, ECT has clearly initiated a new strategy, driven by operational improvements and the competitive environment in and outside the port, and is subsequently realising a truly new business model. The effects of the choice of the TOC whether or not to develop an inland network value proposition may be highly relevant for the competitive position of a port. The exploratory analysis in this chapter suggests that modal split clauses in concession contracts can accelerate the development of such an inland network value proposition, especially in the case of new terminals.

Instead of incorporating modal split obligations in concession contracts, port authorities could also consider to include an obligation to realize dedicated infrastructure for barges and/or trains. This is based on the observation that TOCs main action in their approach was to develop dedicated infrastructure for barges and trains. As a result TOCs will probably stimulate the utilization of the infrastructure as they will want to make a return on this investment. However, it should not be the port authority indicating what kind of infrastructure a TOC should develop for handling barges and trains. The advantage of a modal split target is that the TOC can decide for itself how it realizes the target, and to what extent it needs dedicated infrastructure. Without such a target, TOCs have only a small incentive to realize (and maintain) a large share of barge and/or rail transport.

3.5.2 Theoretical contributions

This exploratory chapter deals with a topic of increasing relevance in the port industry. Concession contracts are one of the key instruments in aligning the goals of terminal operators with overall port development goals. The three most important theoretical contributions of this chapter are:

1) A theoretical framework to assess the impact of modal split concession clauses on the existing business model (terminal value proposition) and a potential new business model (inland network value proposition). The cases broadly validate the usefulness of this framework. Since both modal split clauses as well as the inland network value proposition are relatively new to the port industry, the theoretical framework needs further validation. Afterwards, the framework might also be useful to assess other types of clauses or policies on the (potential) behaviour of TOCs.
2) The components for port competitiveness determined by e.g. Yeo et al. (2008) include the performance of inland transport. When a modal shift is considered as an improvement (as indicated by shippers and forwarders in the Netherlands) it consequently improves port competitiveness. It is therefore a relevant component of a framework for assessing port competitiveness and thus a relevant goal for port authorities as well as policy makers.

3) During the last decade, throughput volumes have substantially grown and intermodal transport has grown as well. Although significant subsidies have been given to stimulate a modal shift in favour of intermodal transport, limited change has been realized, at least in ports connected to inland waterways. Modal split clauses in concession contracts may be a more cost-effective method of changing the current modal split than subsidies. This is a contribution to the emerging literature on terminal concessions as well as the literature on modal shift policies (Blauwens et al., 2006).

Chapter 4

An intermodal value proposition for shipping lines[29]

29 This chapter is based on the content of Van den Berg and De Langen (2014b).

4.1 Introduction

Academics (Notteboom and Rodrigue, 2005; Van der Horst and De Langen, 2008) and practitioners are increasingly paying attention to the inland leg of intercontinental container transport. Mainly because the inland leg is often more costly than the maritime leg and port costs combined, and it can still be improved substantially (Van der Horst and De Langen, 2008). As container volumes increase, the share of intermodal transport as a percentage of the total inland transport is widely expected to increase. For these reasons various actors in the supply chain aim to create a competitive advantage through superior intermodal services (Frémont, 2009; Monios, 2011; Veenstra et al., 2012).

Since the introduction of the container in 1956 shipping lines have offered container transport on a port-to-port basis. Two decades later, several shipping lines started to offer door-to-door services. In most cases, shipping lines offered these door-to-door services to shippers, and outsourced the inland transport operations. Only in a few cases shipping lines have heavily invested in providing inland transport through their own terminals and transport companies (Heaver, 2002; Notteboom, 2004; Franc and Van der Horst, 2010). Despite the potential of creating competitive advantage through intermodal transport, in North West Europe[30] shipping lines haven't widely introduced a value proposition which features intermodal transport. The liner conferences which reduced competition and resulted in sufficient prices on the different maritime routes, might have limited the necessity to compete inland. Furthermore, the substantial fines shipping lines received for price and contract fixing, even though the conferences still existed (Benacchio et al., 2007), have made them cautious to start similar business practices inland. As a result, intermodal transport developed by shipping lines has received limited attention. Therefore, this chapter focuses on a third value proposition, in addition to the port-to-port and door-to-door value proposition, within the business model of shipping lines. The research question that will be answered is: What is the added value of an intermodal value proposition to shipping lines?

This chapter explores the development of the inland terminal (ILT) centred value proposition. The ILT-centred value proposition consists of the maritime leg and the leg to/from ILTs – but not the 'last mile' to the distribution centre or factory gate. The chapter starts with a review of the literature on the existing business model of a shipping line. Next, the three different value propositions are discussed in detail, followed by a section with relevant empirical observations

30 An ILT-centred value proposition is offered in other parts of the world. For instance, shipping lines provide door-to-door services in North America, but also offer services to/from container yards. In contrast to Europe, carriers have a larger role inland in North America. Heaver (2002) found that all major lines offer intermodal services for shippers in North America where conditions have been favourable to the development of long-term contracts for effective rail service.

related to the ILT-centred value proposition. The chapter ends with a discussion and conclusions.

4.2 Literature review

Firms involved in international door-to-door chains have grown substantially. Apart from market growth, the concentration in all relevant parts of this chain increased. In addition to shipping lines, terminal operators (Soppé et al, 2009), also forwarders increased in size: the largest forwarding companies handle the same volumes as medium sized shipping lines (Frémont, 2009). Even though the container industry has developed rapidly and is now an indispensable part of global trade (Fransoo and Lee, 2013), the industry is still relatively young. Companies continue to re-consider and modify their business model and position in the total supply chain. This applies to forwarders, some of which have transformed into 3PL and 4PL service providers (Lai and Cheng, 2004), to terminal operating companies, some of which have expanded their geographical scope and started offering additional services (De Langen and Chouly, 2009; Rodrigue and Notteboom, 2009; Veenstra et al., 2012) and this also applies to shipping lines.

4.2.1 The business model of shipping lines and inland transport

The core business of shipping lines is maritime container transport. Shipping lines operate a fleet of vessels, partly owned and partly chartered, in combination with a fleet of containers, also partly owned and partly chartered. The vessel and container fleet represent a large amount of capital. Shipping lines are therefore 'asset heavy' (in contrast to forwarders which are 'asset light'). As all asset heavy companies, shipping lines focus to a large extent on operational efficiency. The core business of shipping lines mainly consists of two operations: vessel logistics and container logistics (Frémont, 2009). Vessel logistics is aimed at optimizing the revenue generated by the vessel by minimizing slot costs (Notteboom, 2006b), maximising capacity utilisation and yield per slot. The introduction of (super) slow steaming and larger vessels shows the importance of low operating costs[31]. Container logistics is relevant for shipping lines as they provide a transport service including the use of a container.

When the container logistics is controlled by the shipping lines this is termed carrier haulage, when it is controlled by the forwarders (or shippers) is termed merchant haulage. In North America, all major shipping lines provide door-to-door services, but also offer intermodal services to/from container yards as conditions have been favorable to the development of long-term contracts for

31 One could argue that slow steaming, with a negative impact on the transit times, shows that both shipping lines and their customers are more cost oriented than value oriented.

effective rail service (Heaver, 2002)[32]. The percentage of carrier haulage differs substantially per country, mainly due to historical reasons (Frémont, 2009). In most ports, >50% of land transport flows are organized under 'merchant haulage'. Carrier haulage in Europe's largest ports (i.e. Rotterdam and Antwerp) is estimated to be somewhere between 25% and 40% (Notteboom, 2009b). The percentage of (door-to-door) carrier haulage also differs significantly between shipping lines. Some shipping lines focus on port-to-port (for instance, the world's second largest carrier MSC) while others have a stronger door-to-door orientation, including Maersk and APL (the largest and 7th largest carrier respectively). The door-to-door service (i.e. carrier haulage) was partially developed in response to the call from shippers for integrated supply chain services (Slack et al., 1996). Both industry analysts and academics have studied the benefits (or lack thereof) of carriers' door-to-door service strategies. The realization of cost reductions and the need to differentiate their services from competitors (Notteboom, 2004; Franc and Van der Horst, 2010), have driven shipping lines to broaden the scope to their door-to-door services. The cost reduction motive is discussed amongst others by Notteboom (2004), Frémont (2009) and Franc and Van der Horst (2010). The latter two papers also point out the small margins in shipping and suggest that a door-to-door services may be a means of differentiation. This argument, however, is questionable given the fact that the majority of shipping lines offers door-to-door services. The involvement of shipping lines may be better explained by operational considerations: the need for effective repositioning of the container fleet[33].

Repositioning is relevant at a local, regional and international scale (Theofanis and Boile, 2009). It has been estimated that repositioning costs amount to as much as $20 billion per year worldwide (Veenstra, 2005). The container fleet can be managed more effectively if carriers can make matches between drop off locations and nearby origins of new container journeys. This is termed *triangulation.* Such triangulation saves the transport of the empty container back to the port as well as two handlings –to take the container to a yard and later put it on a truck again. Opportunities for triangulation by shipping lines increase with larger percentages of carrier haulage containers, because for these containers, the shipping lines know in advance when and where the container

32 The context in which the development of intermodal services by shipping lines developed in North America is significantly differed compared to the situation Europe. The deregulation of the martime shipping industry in the United States in the ´80s resulted in greater commercial freedom and interest in the responsibiliy to serve shippers by shipping lines. This spurred the development of intermodal services by shipping lines. The arrangement of intermodal international movements, as a part of through pricing, was (and still is) the responsibility of the shipping lines. Due to the fact that shipping lines also purchased the inland transport, they were better positioned than freight forwarders to commit volumes for dedicated rail service to inland locations (Heaver, 2002). In Europe, shipping lines never realized such a dominant role in inland transport. Furthermore, the distances that need to be covered between ports in the US and inland locations are substantially larger compared to the distances in Europe which also favours the use of intermodal transport.

33 The operational rationale for inland activities of shipping lines is less strong in regions with large 'transloading volumes' where the cargoes of maritime containers are loaded in continental trucks that can carry larger volumes.

will be available for re-use respectively where and when an 'export container' is required. For merchant haulage, shipping lines do not know where and when containers will be returned, nor where and when export containers are required. Thus, containers are often returned empty to the port, to return to a nearby export location in the hinterland a few days later (Lopez, 2003; Theofanis and Boile, 2009).

In addition to the operational perspective, the commercial perspective is relevant for understanding the involvement of shipping lines in hinterland transport. As forwarders are non asset based providers of door-to-door services to shippers, that purchase shipping and inland transport, shipping lines that offer door-to-door services compete with forwarders. Thus, the business model of a shipping line with a door-to-door offering is not aligned with the business model of their largest customer group: forwarders (Haralambides and Acciaro, 2010). The demand of freight forwarders is especially price sensitive (De Langen, 2007). The competition between shipping lines and forwarders for the provision of door-to-door services has been an 'uphill battle' for the shipping lines. Over the last decade, the container volumes managed by large forwarders have grown considerably faster than those of the large shipping lines (Parola and Musso, 2007). The strong position of the forwarders can be explained by their position as a third party logistics service provider, with a deep involvement in managing supply chains for shippers e.g. in terms of integrated information systems (Yew Wong and Karia, 2010) and by the fact that forwarders are 'neutral' when selecting transport companies, whereas shipping lines (are perceived to) focus on their own services[34].

The academic literature has not been conclusive regarding the strategic logic of door-to-door offerings by shipping lines. Heaver (2002) observed increasing logistics offerings among large shipping lines. This is a form of vertical integration. He argues that shipping lines increasingly aim to provide shippers with a choice of door-to-door services and port-to-port service. Notteboom (2004) concludes that shipping lines gradually shift from pure shipping operations to integrated logistics solutions. In a latter article, Notteboom (2006a) concludes that shipping lines can also aim for differentiation within the port-to-port value proposition through superior schedule reliability and transit time reliability. Frémont (2009) takes a similar view and argues that competition between shipping lines continues to be based on their maritime networks, which remain a key factor in providing a shipping line with a durable competitive advantage over its competitors. Franc and Van der Horst (2010) only see a rationale for door-to-door offerings by shipping lines when existing logistics service providers

34 As an illustration, the organization of shipping lines, with commercial country offices responsible for their market is not focused on optimizing services for shippers with supply chains in the whole of Europe.

offer is poor and the shipping line can improve the supply of such services. This chapter aims to provide additional insights in this important theme.

The limited success in Europe of the door-to-door services of shipping lines is surprising. Given the fact that scale is such a key driver in lowering inland transport costs, and the fact that shipping lines manage very large volumes of maritime containers, compared to forwarders, shipping lines presumably could translate these scale advantages in attractive door-to-door propositions. To give one numerical example, for the port of Antwerp: the largest shipping line in Antwerp, MSC, handles roughly 2.5 million TEU import-export cargo (excluding transhipment cargo). One of the largest forwarders in Europe, Kuehne & Nagel, manages around 500.000 TEU in Europe, so probably no more than 100.000 TEU in Antwerp. This shows that the shipping lines handle substantially larger volumes of containers. However, they have not (or hardly) been able to translate this scale in attractive door-to-door propositions.

4.2.2 Positioning door-to-door services in the organisation of the shipping line

Shipping lines provide door-to-door services within the same organization as the port-to-port services. This has the advantage of internal synergies, e.g. through the shared use of information (Frémont, 2009). However, according to Haralambides and Acciaro (2010), mastering the capabilities to manage both the land side and maritime operations is complex because of the strategic and operational differences between both services. Ocean transportation is characterised by large assets, tight cost control and a focus on asset utilisation. In contrast, provision of door-to-door services is characterized by a focus on responsiveness. In addition, shippers demand transparency and cost breakdowns[35] (Haralambides and Acciaro, 2010), that reduce the ability to charge attractive prices and are cautious of becoming dependent on a specific shipping line (Frémont, 2009). On top of door-to-door services, some shipping lines (Maersk, APL, NYK) have developed a logistics service provider subsidiary that also provides warehousing services and acts as a freight forwarder or 3PL. These activities are positioned independently from the shipping line. Nevertheless, the issue of the independence of subsidiaries of the parent shipping lines remains an issue for customers: neutrality is crucial to customers as they expect the best offer based on an evaluation of all possible options without a preference of the service provider.

35 In addition Frémont (2009) also present another difference between shipping lines and forwarders. Compared to forwarders, shipping lines have limited network of logistics subsidiaries. If shipping lines want to compete with freight forwarders on the same level they either have to grow through acquisitions or find other possibilities to provide their services to the large customer base. This means that shipping lines have to make a choice between reinforcing their core business activity and developing other activities along the transport chain to offer value-added services to their clients.

4.3 Understanding the different value propositions of shipping lines

Figure 4.1 shows the two widely distinguished value propositions (port-to-port and door-to-door), and adds the 'port-to-ILT' (inland terminal) value proposition. In this value proposition at least one 'landside leg' to an *inland terminal*, but without the 'last mile' to the final destination, is provided.

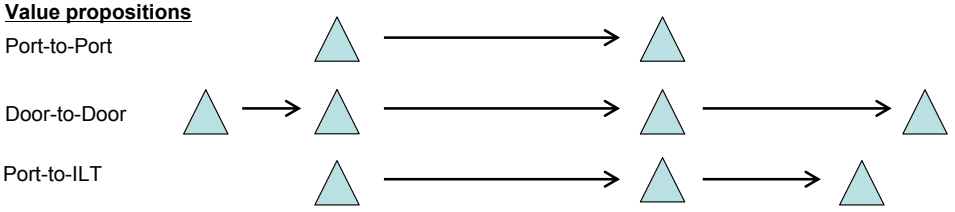

Figure 4.1: three value propositions in intercontinental container freight transport

Each different value proposition corresponds with a different 'scope' of the shipping line. A framework which distinguishes nine layers of activities in international container freight transport (see De Langen and Douma, 2010, for a detailed description) is used. The layers broadly represent a hierarchy, i.e. the higher layer activities influence operations and decisions at lower layers. The layers range from the design of supply chains (layer 1) to the development of infrastructure and industrial sites to enable freight transport (layer 9). Figures 4.2, 4.3 and 4.4 show the scope of a shipping line in relation to the three above mentioned value propositions.

The scope of a port-to-port value proposition is narrow (see figure 4.2). The focus is on designing a shipping network and effective operation of this network. No inland activities are provided. Commercial policies in which customers need to return the empty container to the port fit very well in this value proposition. The most important potential sources of competitive advantage in this model are the structure of the maritime network (Frémont, 2009) for instance with direct connections between ports that competitors cannot offer, lower slot costs (Cullinane and Khanna, 2000) for instance through larger vessels, or superior service quality (Notteboom, 2006a). Service quality is mainly determined by the 'on time performance' and the provision of information about the location and status of the container. Service quality creates value by enabling more efficient subsequent stages of the supply chains (e.g. lower safety stocks).

The scope of a door-to-door value proposition is much larger (see figure 4.3). The shipping line needs to offer three landside transport modes, rail, barge (where available) and road. This does not mean that shipping lines have to *operate* such services. However, unless shipping lines *design* scheduled barge and rail services, shipping lines cannot develop a competitive advantage over

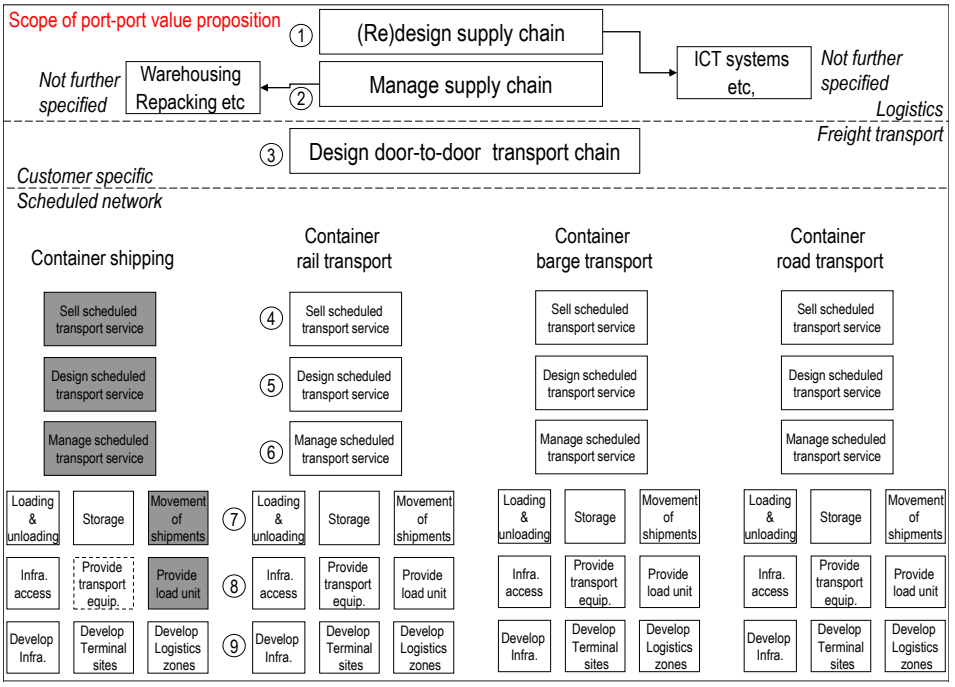

Figure 4.2: the scope of a port-to-port value proposition

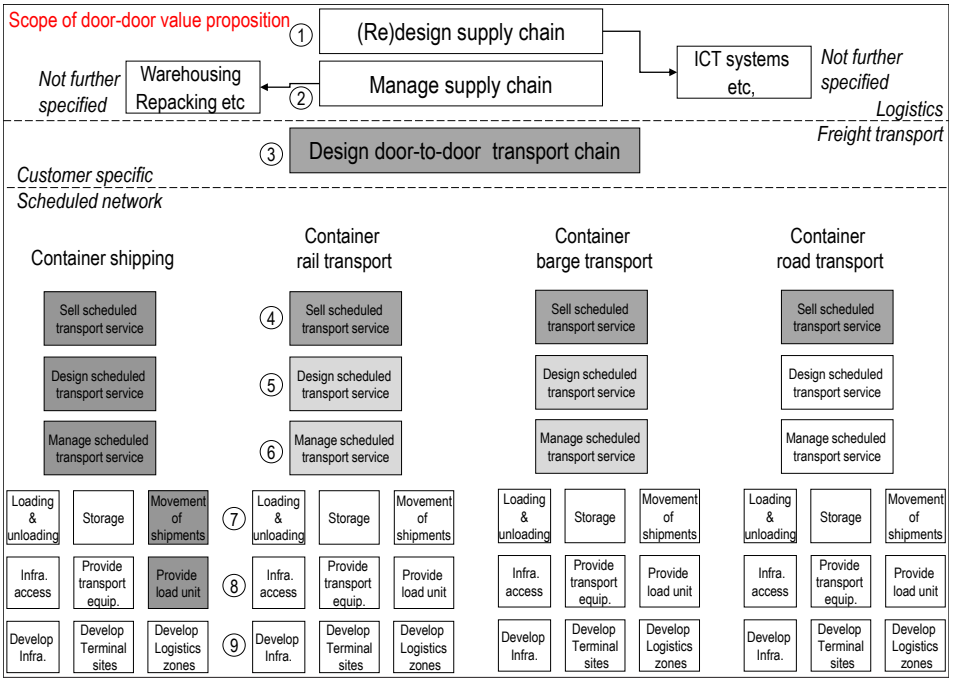

Figure 4.3: the scope of a door-to-door value proposition

a forwarder (forwarders can also make bookings for rail and barge services and have the advantage of impartiality). Furthermore, shipping lines that offer a door-to-door value proposition need to start *designing customer specific door-to-door chains* that are attractive for shippers. This is a key difference with the two other value propositions. Many shippers outsource the design and management of supply chains, including warehouse management as well as distribution. Furthermore, increasing visibility in supply chains demands *responsive* service providers, e.g. through flexible routing and mode choices for door-to-door chains. For instance, when sales are low, barge transport (cheap but slow) may be used. If sales are high and there is a risk of out-of-stock, road (expensive but fast) may be used. Shipping lines can only offer good door-to-door services when they develop the capabilities and systems to make these choices. This makes a door-to-door transport without warehousing and other logistics services unattractive to shippers (see Shang, 2009). For these reasons, some shipping lines have developed true logistics service providers. Maersk first developed Maersk Logistics, and later rebranded this as Damco Logistics, to further stress its independence from Maersk line. Damco purchases around 600.000 TEU of sea freight, and uses all major shipping lines. NYK Logistics, developed out of the container shipping line business, is now placed at arm's length and recently started to operate the freight forwarding activities under the name Yusen Logistics. These logistics service providers focus on large shippers and supply chain activities (level 1 and 2 in the figure), and are also designing door-to-door chains (level 3). In terms of the 'layer framework': it may be problematic to be active in level 3, without also being active in level 2 (and even level 1). Only offering the design of door-to-door chains (level 3) may not be enough to achieve an intimate relation with shippers.

The basic idea of an ILT-centred value proposition is that shipping lines continue to focus on 'scheduled services': designing (and operating) barge and/or rail services, without moving into the last mile, that requires the tight integration with shippers. In this proposition, shipping lines do translate the scale of their operations in attractive intermodal offerings. In an ILT-centred proposition, shipping lines do not design door-to-door services. They do provide a scheduled transport service from an inland terminal (ILT) to another ILT (or port) (see figure 4.4). In such a value proposition, shipping lines create value through designing rail and/or barge services (in partnership). Their added value in this design is derived from the volume of containers that they control, as well as from the operational coordination between shipping line, terminal operator and barge/rail operator. These sources of value added also explain why involvement in road transport is less likely: scale economies are limited, just as the need for coordination and planning[36]. Therefore, road transport is not included in this value proposition although it will always be a fall back option if transport can´t

36 Trucking is generally not planned long in advance, so trucking companies with many local truck movements are best positioned to plan and operate trucks.

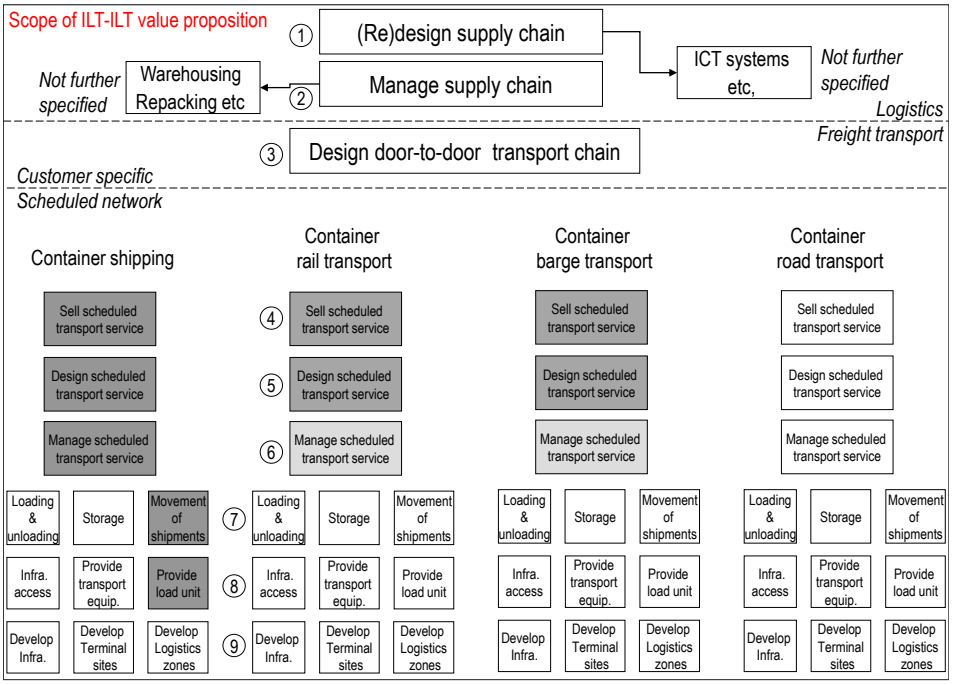

Figure 4.4: the scope of an ILT-to-ILT value proposition

be arranged via a barge or rail service. The development of ILT-centred value propositions may impact the liner service networks of the shipping line. The ILT-centred value proposition may increase the returns to scale and thus lead to less port calls. Furthermore, the value proposition increases the concentration of the container flows into and out of the hinterland. This results in less origins and destinations for the shipping line compared to the door-to-door value proposition. A good example which incorporates less port call and concentration of flows might be the extension of the Daily Maersk concept to inland terminals.

The ILT-centred value proposition also has operational and administrative implications which need to be taken into account. Shipping lines need to arrange bills of lading for (a selected number of) inland terminals (as is the case not for the inland port of Duisburg) or at least arrange for the commercial release of the container in the inland port instead of the seaport. Furthermore, shipping lines (or inland terminals) may need to arrange a customs status for the inland terminal, so that containers no longer need to be cleared at the seaport but can also be cleared at the inland terminal (see also Veenstra et al. (2012) who have identified these issues from a deep sea terminal perspective).

4.3.1 Comparing the three value propositions

Table 4.1 compares the three different value propositions, both regarding strategic positioning and operational efficiency in transport chains.

Table 4.1: a comparison of the three value propositions

	Door-to-door	*Port-to-port*	*ILT-centred*
	Issues related to strategic positioning		
Attractive value proposition for forwarders?	Limited, too close to the role of forwarders.	Yes	Yes, especially for forwarders aiming at strengthening intimacy with shippers (level 1 and 2).
Combination of distinct capabilities?	Yes, the door-to-door product requires customer specific capabilities.	No	No, the value proposition is still 'scheduled'.
Attractive value proposition for shipper?	Yes, with issues of transparency and neutrality.	Yes, for segment of shippers organising inland transport themselves.	Yes, for shippers that uses intermodal services.
Enables leveraging scale in intermodal services?	Yes	No	Yes
	Issues related to operational efficiency		
Repositioning of empty containers	Policy to return to inland terminals, enabling 'triangulation'.	Policy of return to seaport, leading to additional empty flows.	Policy of return to inland terminals, enabling 'triangulation'.
Impact on deep sea terminal operations	Enables higher efficiency, due to availability of data on hinterland modes & destinations.	No effect.	Enables higher efficiency, due to availability of data on hinterland modes & destinations.
Impact on liner service network	Focus on serving the main customers.	Focus on differentiation through maritime network.	Focus on a few large ports that connect to the major ILTs.
Number of origins and destinations	Extremely large.	Limited, depends on the number of calling ports.	Limited, depends on the number of ILTs served.

Contrary to port-to-port services, the ILT-centred value proposition allows for value creating for shippers: it covers a larger part of the transport, and uses the most efficient mode of transport due to scale economies. Compared to door-to-door, the ILT-centred value proposition has the advantages of being better aligned with the business model of forwarders in supply chains: it leaves customer specific design activities to these firms. Consequently, the 'capability set' of shipping lines is also more coherent: focussed on providing transport connections based on scale economies. With regard to operational efficiency, the ILT-centred value proposition enables triangulation of empty containers and leveraging of scale economies in intermodal transport. This may be increasingly relevant given the widely pursued strategies to shift cargo from road to intermodal services[37]. Furthermore, the ILT-centred value proposition also contributes to terminal efficiency, through better availability of information on inland destinations of the containers that are handled on the terminal[38].

4.3.2 Scale and intermodal as drivers of an ILT-centred value proposition

The growth of container volumes as well as the growth of vessel sizes, which have resulted in larger call sizes (the amount of unloaded and/or loaded containers per vessel), as well as the increased attention for 'on time performance' of the shipping lines, may increase the value of an ILT-centred value proposition. Intermodal services with barges and rail result in scale economies (Woodburn, 2009). The larger the volumes (per vessel), the larger becomes the potential role of the shipping line in designing intermodal services. As a fictitious example, if a shipping line can guarantee that every Monday afternoon (with a reliable on time performance), it has around 30 TEU for a certain inland destination, it becomes a valuable partner of intermodal operators. These operators may be willing to co-design an inland service tailored to the needs of the shipping line.

The value of the shipping line as a partner in the design of intermodal services (deciding the frequency, network and routes) is central to the success of an ILT-centred value proposition. Unless a shipping line can secure that it gets the lowest rates on such a service, forwarders will not purchase such ILT-centred services from shipping lines but directly from barge and/or train operators. The value of a shipping line derives from:

- Base volume. The shipping line may be able to provide >50% of the required cargo for launching an intermodal service.

37 For instance, port authorities are also pushing for more intermodal transport, the so called modal shift, to decrease congestion and increase their hinterland reach. The port authorities of Antwerp, Marseille and Rotterdam have all announced modal split targets for their hinterland container transport, which all aim for a reduction of road transport and an increase of rail and barge transport.

38 One of the major hurdles for efficient terminal operations is the fact that the terminal does not know the inland transport mode and the pick-up day of the container. Consequently, stacking of containers is inefficient.

- Empty repositioning moves as flexible cargo. The empty container movements are generally not very time sensitive and can thus be allocated to services in the last minutes, allowing the operator to increase utilisation.
- Flexibility of carrier haulage cargo. Shipping lines often have some flexibility in their delivery dates, which allows them to send containers with the next service if a service is fully booked. This also creates flexibility and allows an operator to improve utilisation.
- Fixed windows at dedicated terminals. Shipping lines often have dedicated terminals and thus can promise an operator a fixed window. This contributes to the reliability of the service.

4.3.3 The changing role of inland terminals

Inland terminals play an important role in ILT services. Three different functions of inland terminals has been introduced in chapter 2 (Rodrigue et al., 2010), being a satellite terminal, a load centre and transmodal centre. As addition to these functions Veenstra et al. (2012) introduces the extended gate concept, as part of the services provided by the deep sea terminal, in which the delivery point from the perspective of the shipper/receiver is extended from the seaport terminal along a corridor to an inland terminal. This fits very well with the dry port concept discussed by Roso et al. (2009).

The load centre function is most relevant to shipping lines. The storage area of such an ILT often functions as an 'extended storage area' of the shipper. Since the ILT is located relatively close to the shipper, an order to receive the container at the distribution centre can be met within hours. Thus, many warehousing operations use an ILT as a buffer for stock which is not immediately required. Rodrigue and Notteboom (2009) labelled this practice as warehousing-derived terminalization of the supply chain. This practice leads to a close integration between ILT and shipper. This changing role of the ILT increases the value of a proposition that sends a container to an ILT, without engaging in the 'last mile' from the ILT to the end destination.

The above analysis of the potential of an ILT-centred value proposition calls for more empirical research. The next part of this chapter provides an empirical exploration of the ILT-centred value proposition.

4.4 Empirical observations on an ILT-centred value proposition

It has been argued that an ILT-centred value proposition can become an increasingly relevant value proposition in liner shipping. However, existing literature on this value proposition is lacking. For this chapter, conversations with over 20 executives of shipping lines, inland transport operators, forwarders, shippers and terminal operating companies in Europe, all located or related to

Rotterdam, Europe's largest seaport, have been held. Next, relevant articles in business periodicals and specialised press have been analysed. The insights from these interviews are reflected in the preceding analysis. Furthermore, these interviews and industry analysis provide the basis for six relevant empirical observations.

Shippers as drivers of an ILT-centred value proposition

IKEA, the Swedish multinational offering low cost furniture to consumers, is one of the largest importers of containers in Europe. In Dortmund (Germany) IKEA operates its European distribution centre for its slow moving articles. The facility receives more than 17,000 FEU from suppliers all over the world. IKEA organizes the pre- and end-haulage of the container but tenders the transport of the container from the port of origin to the inland terminal in Dortmund, which is only a few kilometres from IKEA's distribution centre (DC). IKEA expects the shipping lines that provide maritime transport to deliver the container with intermodal transport to the inland terminal. The end-haulage is done by one train shuttle during the night between the inland terminal in Dortmund and the DC. This case shows that IKEA more or less forces the shipping lines to offer an ILT-centred value proposition and uses the ILT as an extended storage facility. The IKEA case is not exemplary for all shippers. Few shippers have sufficient volumes and buying power to force shipping lines to deliver at an intermodal terminal. And even fewer have direct rail access to their distribution facilities. Nevertheless, other large shippers such as Heineken en Philips have similar contracts with shipping lines. An important driver for shippers to incorporate intermodal transport in their supply chain, in addition to improved processes, reliability and/or cost reductions, is the focus on sustainability. Increasing the use of intermodal transport is an important measure for the reduction of a shipper's carbon footprint. Therefore, shippers are becoming more interested in such value propositions.

Increasing ILT offerings by carriers

Port-to-port and door-to-door are the two main value propositions of shipping lines, but they do offer ILT-centred value propositions as well. Recently, Maersk Line launched a carrier haulage service in the Netherlands which includes the pick-up or delivery of a container at a number of selected inland terminals throughout the Netherlands. This is an extension of the Daily Maersk concept inland. Maersk has divided the Netherlands into four regions where the container can be collected two days after the unloading of the container in Rotterdam, against a fixed price per region. Another example is MSC which coordinates their equipment, depots and inland transport for 21 countries in Europe through one organisation called Medlog. Through this organisation MSC has already developed dedicated trains from the port of Antwerp to multiple destinations in Europe. CMA CGM and NYK Line jointly participating in an inland terminal. For the first time in Europe, shipping lines started the operation of the

inland terminal in Duisburg-Rheinhausen in the beginning of 2008, through a joint venture (40% CMA CGM, 40% NYK Line and 20% Duisport). A rail shuttle operated by NYK Line and a barge shuttle of CMA CGM connect the terminal in Duisburg with the port of Rotterdam. The terminal is classified as a container yard which means that Bills of Lading can show Duisburg as a place of origin or destination.

The example of MSC is clearly driven by internal considerations. Coordinating the equipment via one organization results in lower transport costs as volumes can be bundled and less repositioning is needed. For Maersk, CMA-CGM and NYK Line it can be questioned whether the new service offerings are driven by customer demands or internal considerations as the same advantages might apply. Still, the service is marketed. From a business model perspective this includes a value proposition which needs to fulfil a customer demand (Osterwalder and Pigneur, 2004). Based on the examples above, the offer of the shipping lines consist of a scheduled and reliable service which combines maritime and inland transport to an inland terminal close by, against, presumably, highly competitive prices. For the customer, this can result in lower transport costs, increased reliability (due to the scheduled service) and flexibility (the pick-up and drop-off of the container in the vicinity of the customer) and an improvement of the ease of doing business (close to an one-stop shop).

Competition from deepsea terminals that develop ILT-centred value propositions
Terminal operating companies have started to develop inland services. An interesting example is the 'European Gateway Services' (also discussed in the previous chapter) developed by ECT, a terminal operating company (TOC) in Rotterdam owned by Hutchinson Port Holding. This service consists of providing hinterland transport to a number of inland terminals in Europe (Veenstra et al., 2012). Currently ECT has 10 extended gates, three in the Netherlands, three in Belgium and four in Germany. These ILTs can also be used for storage of empties and reefer containers. Bookings on these extended gate services can be made electronically and goods can be customs cleared at the extended gate. In that case, no documents are required to send goods to the extended gate (for instance Rotterdam to Duisburg). ECT regards the extended gateway network as an open network. All interested parties can use it, be it shippers, forwarders, shipping lines or other terminal operators. Other terminal operating companies, such as DP World in Antwerp, also invest in inland terminals. Even though there are different approaches by different TOCs they all develop extended gates to bundle large flows of containers from the deep sea terminal to the extended gate. This enables shuttles services between deep sea terminal and extended gate, with a large scale and frequency of barge and or rail services, leading to low costs per TEU. Thus, in the extended gate concept, TOCs offer transport between the deep sea terminal and the extended gate, which may be called *terminal haulage* (see De Langen and Chouly, 2009). The TOC also is well positioned in the battle

for managing intermodal inland services, as they have even a larger scale than the shipping lines to develop competitive intermodal services. However, the TOC does not have contractual relations with shippers. The shipping lines use the extended gateway services (e.g. in the case of ECT, various shipping lines use the service, some actively promote it to their customers), but at the same time develop their own inland services (for example both ECT and NYK Line have their own shuttle service to different terminals in Duisburg). This suggests competition between shipping lines and terminal operators[39].

Scale of the shipping line vs inland operator influences value of ILT services

One of the key drivers of the development of ILT-centred services is scale economies. If shipping lines (or terminal operators) have scale advantages on specific inland destinations, there is a clear logic for developing an ILT-centred service. However, in some cases, the inland operators have developed such a large scale, that the volumes of individual shipping lines are not sufficient to influence the design of inland networks. In such cases, shipping lines develop contracts with such inland operators to outsource their inland transport and are not involved in *service design*. An example is the deal of Maersk line in the UK, with rail freight operator Freightliner. The agreement provides Maersk with committed space for the transportation of boxes from the UK's largest container port, Felixstowe. Freightliner provides the most comprehensive service from Felixstowe offering services to 15 destinations across the UK. The agreement is said to cover up to 190,000 containers each year. Freightliner is the leading container rail operator in the UK, handling over 80% of UK container rail volumes to/from ports. Freightliner handles about 1 million TEU per year, and has 9 inland rail terminals, that handle the majority of inland container volumes in the UK. In this case, Maersk is an important customer (with around 15-20% of total container volumes of Freightliner), but Freightliner is better positioned to create scale economies in inland rail transport. In such cases, it is unlikely that shipping lines develop their own services, but instead use the services of incumbent inland operators. This may also apply to the US, where the large Class A rail operators control huge volumes as well as access to rail infrastructure. In such a case, the distinction between an ILT-centred product or a door-to-door product becomes less relevant, as most inland transport operators provide the 'last mile' as well. However, in this example it still may be the case that active marketing of Maersk of services to the 15 ILTs in the UK would lead to a shift from the port-to-port volumes to services to the ILTs, with advantages related to empty repositioning and terminal efficiency.

39 In conceptual terms, there is an opportunity space for ILT services, that may be filled by both shipping lines and terminals (and rail/barge operators). Early initiatives may yield competitive advantage.

Transaction costs influence the selection of inland propositions

One of the main drivers in supply chains is the increased outsourcing of logistics activities by shippers. These activities are outsourced to a limited number of service providers, that are well integrated with the shipper (e.g. information sharing on forecasts, stock levels and so on). Thus, many shippers carefully select transport operators and oblige shipping lines to use these carriers for their door-to-door services. This is termed *merchant inspired carrier haulage*. Such an arrangement obliges shipping lines to negotiate with an inland transport operator selected by the shipper. In such an arrangement, the shipper contracts a door-to-door product from the shipping line and thus has only one contractual relationship, while securing specific transport companies are used. In such an arrangement the distinction between a door-to-door product and an ILT-centred product becomes blurred, as the shipping line sells a door-to-door product, but provides either a port-to-port product or a ILT-product. Shipping lines benefit from shifting port-to-port volumes to port-to-ILT services, not from shifting volumes from the door-to-door product to the ILT product.

Barriers to the development of ILT-services

Various barriers may prevent shipping lines from developing an ILT-centred value proposition:

- For shipping lines, 'boardroom attention' is on the port-to-port business; this is where losses and profits are made, an ILT-centred value proposition will not change that. Thus shipping lines may find it difficult to commit resources to the development of ILT-centred offerings.
- The local branches of shipping lines do not possess the capabilities to develop ILT-centred value propositions. These offices have an operational focus. Thus, while on the one hand the 'business development' of ILT-centred services needs to be done locally (given the need to adapt to local market characteristics), the local branches currently are too focused on operations to do so.
- Forwarders may only be interested in an ILT-centred value proposition when various shipping lines offer it, to prevent dependence on the network of one shipping line. This implies it will be hard for shipping lines to develop a competitive edge with an ILT-centred value proposition.

4.5 Conclusions: the potential of the ILT value proposition

The shipping industry has developed rapidly, with growing volumes, larger ships, industry concentration and more involvement in terminal operations. Nevertheless, the two main value propositions offered by shipping lines have not changed. A port-to-port value proposition, consisting of a network of overseas destinations, and door-to-door container transport, which includes the full design of the transport chain based on customer demands. This chapter suggests an evolution towards an additional ILT-centred value proposition. A

value proposition which combines the maritime leg with an intermodal leg to provide added value through intermodal transport by an improved operational coordination and bundling of container volumes. Such an ILT value proposition is already established in North America but uncommon in Europe. Developments, like the further growth of vessel sizes, the modal shift targets imposed by port authorities, and more sustainable solutions demanded by customers, may provide a conducive environment for this value proposition. Either driven by internal consideration or customer demand, the examples we have provided do indicate that terminal operators, shipping lines as well as shippers are (further) developing such a value proposition.

The ILT-centred value proposition of shipping lines, as presented in this chapter, may have two advantages over a full 'door-to-door' service. First, shipping lines maintain an orientation on 'scheduled transport' with a limited number of origins and destinations. This leads to a more coherent 'capability set' than also managing the last mile trucking moves that are required in door-to-door services. Second, the ILT value proposition is better aligned with the position of forwarders in supply chains as it does not provide a substitute to the services offered by forwarders. In addition, an ILT-centred service may have three advantages over a port-to-port product. First, it enables better repositioning of empty containers[40] and leveraging of scale economies in intermodal transport. Intermodal services can be synchronised with deep sea services by aligning the fixed windows of shipping services with fixed windows for intermodal services. This contributes to the reliability and transit time of such services. Second, it contributes to terminal efficiency, through better information on inland destinations of containers. Thirdly, it provides a relationship with the inland terminals which becomes increasingly important to the shipper as an 'extended storage area'. This changing role (see Roso et al., 2009 and Rodrigue et al., 2010) increases the value of a proposition to/from the inland terminals.

While it seems unlikely that shipping lines will fully move into developing an ILT-centred value proposition in the short run, next steps of shipping lines may be expected. The additional competition on hinterland transport with TOCs may accelerate active involvement by the shipping lines. A likely key issue for shipping lines is the potential of an ILT-centred value proposition to shift customers from port-to-port to the ILT service. This potential is directly related to volumes and scale economies generated by the shipping lines. A strategy of shipping lines to start offering ILT services to a limited but comprehensive network of ILTs, thereby creating incentives to inland operators to become part of this network, may be an effective approach. Whether or not shipping lines fully develop an ILT-

40 Empty movements are generally not time sensitive and can be allocated last minute to services, allowing the operator to increase utilisation. The same applies, but to a lesser extent to carrier haulage containers since shipping lines often have some slack regarding the final delivery time and thus some flexibility in allocating containers to intermodal services.

centred value proposition, offering this additional value proposition can create a competitive advantage. Since most shipping line offer a door-to-door this is no longer a differentiator. The operational advantages of the ILT-centred value proposition, like scale economies, are an interesting driver but may not provide an enduring source of competitive advantage. However, the relationships which need to be developed with inland transport operators are crucial for a succesful service. The better these relations are developed, the harder it becomes to dublicate these resources by competitors and the longer the advantage sustain.

4.5.1 Managerial implications

Implementing the ILT-centred value proposition requires substantial efforts or to put it differently: it touches all elements of a shipping lines' business model. To name a few. First, a shipping line needs to analyse the hinterland container flows and make a network analysis to decide which inland terminals to call with intermodal connections from the sea port. Second, arrangements need to be made with the inland terminals to develop the services to make an ILT-centred value proposition attractive. For example, the terminal should have container depot facilities. This needs to be accompanied by changes in internal (IT) systems to add multiple inland locations as container yard so that bills of lading to these inland destinations can be made and enable re-use of containers at the inland depot. Third, intermodal connections need to be developed between the sea port and the inland terminal either in partnership with intermodal operators (the asset light and low risk option) or with own barge or train operations and inland terminals. And finally, it needs to be sold.

Chapter 5

The perspective of shippers and forwarders on the value propositions of shipping lines[41]

41 The content of this chapter is based on Van den Berg and De Langen (2014c)

5.1 Introduction

Despite the rapid development of the shipping industry, with growing volumes, larger ships, industry concentration (Panayidis and Wiedmer, 2011; Ducruet and Notteboom, 2012) and more involvement in terminal operations (Midoro et al., 2005), the two main value propositions offered by shipping lines have not changed. The previous chapter introduced a third value proposition for shipping lines, centred around the inland terminal. The theoretical review indicated that the ILT-centred value proposition can be of added value to shipping lines. Furthermore, the empirical findings indicate that there is a demand and supply of such a value proposition. However, more empirical research from the demand side is necessary to better understand the potential of the value proposition. Therefore, the research question that will be answered in this chapter is: What is the interest of shippers and forwarders in an intermodal value proposition of shipping lines?

This chapter not only focus on the interest in the ILT-centred value proposition but also takes in consideration the carrier selection stage in which the value proposition might play a role. Furthermore, the potential differences between the customer groups (i.e. shippers and forwarders) are analysed. Therefore, the research in this chapter is partly exploratory, in the sense that the surveyed forwarders and shippers are asked rather general questions, with the aim to enhance our understanding of their selection processes and partly involves tests of hypotheses derived from the literature review. This chapter is structured as follows. In the next paragraph the hypotheses are developed, starting with a literature review on shippers and forwarders in relation to maritime logistics. The third paragraph describes the used methodology. The results of the survey are presented in this fourth paragraph and the chapter ends with a discussion and conclusions.

5.2 Hypotheses

Shipping lines serve two customer types: shippers and forwarders[42]. Research on forwarders and shippers with regard to logistics have been mainly focused on port choice (De Langen, 2007; Tongzon, 2009, see Magala and Sammons, 2008 for a new framework for understanding and analysing port choice), shipping line selection criteria (Brooks, 1990; Kannan et al., 2011), forwarder capability assessment (Daugherty et al., 1996, Lai and Cheng, 2004; Lai, 2004) and the

42 Even though we treat 'forwarders' as a homogeneous group, they are not. For instance, Lai et al. (2004) distinguish four different types of freight forwarders: traditional freight forwarders, transformers, full service providers and nichers, Similar typologies of forwarders have been also discussed by Juga, Pekkarinen and Kilpala (2008). Likewise, shippers are far from a homogeneous group. Tongzon (2009) distinguishes three types of shippers: shippers which sign long-term contracts with shipping lines, shippers which are using freight forwarders and shippers which are independent (and frequently tender their container transport). Exploring carrier selection processes of these different types is interesting and relevant, but beyond the scope of this chapter.

relationship between shippers and forwarders (Knemeyer and Murphy, 2005; Selviaridis and Spring, 2007). Brooks (1990) concluded that in almost ten years the criteria of Canadian shippers for selecting shipping lines evolved marginally. The four most important selection criteria were costs, frequency of sailings, transit time and directness of sailing. All shipping lines improved their performance, no significant differences between the carriers were perceived. Kannan et al. (2011) identified 45 selection criteria and clustered them into 7 general factors. They found that clients still place great importance on costs when evaluating shipping lines.

Regarding differences between shippers and forwarders, De Langen (2007) concludes that the main difference is that forwarders are more price sensitive than shippers. Tongzon (2009) found that port efficiency is the most important factor in the port selection by forwarders. Another difference is the extend of concentration in both industries; while the container shipping industry is rather concentrated (Sys, 2009), the forwarding industry is fragmented (see e.g. Tongzon, 2009). The use of forwarders may be a tool for shippers to create leverage vis-à-vis sipping lines with a degree of market power. This issue deserves more attention but is beyond the scope of this chapter. Notwithstanding these findings, differences between these two groups deserve more attention, especially in relation to the business model differences. Shippers focus on the overall supply chain, while for the forwarder, organizing container transport is their core business. Therefore, it is expected that shippers and forwarders have a different opinion with regard to the importance of services provided by shipping lines. Furthermore, shippers and forwarders may have a different perception of differentiation between shipping lines. These propositions are included in the first two hypotheses.

Hypothesis 1: Shippers differ from forwarders in the importance attached to service attributes of shipping lines.

Hypothesis 2: Shippers differ from forwarders in their perception of differences between shipping lines.

Attitudes towards the three value propositions

As discussed in the previous section, shipping lines face difficulties providing door-to-door services in addition to the port-to-port services due to the different requirements in capabilities and requested transparency (Haralambides and Acciaro, 2010)[43]. Differentiation can also be realized with port-to-port services

43 Some shipping lines (such as Maersk, APL and NYK) have developed an independently operating subsidiary that provides logistics services such as warehousing services. Some of these subsidiaries (such as APL Logistics) operate as a freight forwarder. However, such a set-up does not allow for synergies. This may explain why other shipping lines (e.g. Maersk Line) offer door-to-door services themselves, but have a subsidiary that provides warehousing and other supply chain services (Damco, also a part of AP Moller).

through superior schedule reliability and transit time reliability (Notteboom, 2006a), especially since it has been argued by Frémont (2009) that maritime networks remain a key differentiator. In addition, providing door-to-door services brings shipping lines in direct competition with their largest customer group: forwarders (Haralambides and Acciaro, 2010). For these reasons, the ILT value proposition may be attractive: it allows shipping lines to significantly improve operations while aligning well with the business model of the forwarder. Therefore, our hypothesis is that there is a significant interest in an ILT-centred value proposition. We further argue that the interest in an ILT-centred value proposition is dependent on the current value proposition (door-to-door or port-to-port) that shippers and forwarders use. Customers with port-to-port bookings probably have established inland operations and are less likely to switch to an ILT-centred value proposition than customers who currently purchase door-to-door services. This results in the following two hypotheses.

Hypothesis 3: Shippers and forwarder have an interest in an ILT-centred value proposition.

Hypothesis 4: Interest in the ILT-centred value proposition is influenced by the ratio of door-to-door to port-to-port bookings.

Furthermore, we expect that the difference in the business model of the shipper (which sources container transport as a necessary part of its supply chain) and forwarder (for which the organization of container transport is a core capability) has an impact on the share of port-to-port versus door-to-door bookings. Shippers generally focus on their core business and outsource the organisation of transport through door-to-door bookings or through a forwarder. In contrast, forwarders realize margins through purchasing the different parts of the transport chain separately. This results in the last hypothesis.

Hupothesis 5: Forwarders have a lower share of door-to-door bookings than shippers.

5.3 Methodology

The goal of this chapter is to understand the differences between shippers and forwarders with regard to the carrier selection criteria. We have analysed both the importance of the selection criteria as well as the differences between the selection criteria experienced by the shippers and forwarders. Furthermore, the research also specifically addresses the potential of the ILT-centred value proposition. A survey among Dutch shippers and forwarders is used for this analysis. We acknowledge that having only Dutch companies in our sample might make it difficult to generate general conclusions that can be applied more

broadly. Both shippers and forwarders surveyed in this study, however, are operating internationaly and many of them are multinationals (which includes, amongst others, different historical and cultural backgrounds). The results of this survey are therefore relevant.

Forwarders and shippers were invited by e-mail by their Dutch industry associations (FENEX for forwarders and EVO for shippers), to participate in a survey. FENEX and EVO were responsible for conducting this survey. The questionnaire was co-developed with FENEX and EVO. (the questionnaires, in Dutch, can be found in appendix 1 and 2). First, all FENEX members (N=385) received the web-based questionnaire in the beginning of May 2012. The questions discussed in this dissertation where included in a larger questionnaire of FENEX which is send to their members on a yearly basis. As many as 116 responses were received (a very satisfactory response rate of 30%) over a period of 6 weeks. Sixty-two respondents were relevant as the other 54 respondents did not purchase maritime container transport. In November 2012, the web-based questionnaire was sent to EVO members registered as international shippers (N=764). After one week the response period was closed[44] and in total 48 respondents completed the questionnaire. This low response rate (6%) was partially explained by the fact that a substantial share of international shippers do not use maritime container transport because, for instance, they export by road (35% of all international transport to/from the Netherlands goes by road; CBS, 2010) to continental European markets (note that the two largest trading partners of the Netherlands are Germany - 21% of total import and export value - and Belgium 10% of the total import and export value; CBS, 2013). The combined responses resulted in a response rate of 12.6%. All respondents held a management position.

The study of Kannan et al. (2011) was used to identify potential sources of differentiation (i.e. shipping line services). Based on existing literature and through the use of focus groups they identified 45 selection criteria for ocean container carriers and clustered them in 7 different factors (i.e. Rate, Customer service, Operations, Reputation, Infrastructure, Scheduling and IT orientation and communication). Out of the 7 factors identified by Kannan et al. (2011), we retrieved potential sources from 5 factors. For 'Operations' we introduced a new item 'Sustainable operations' as carbon emissions are increasingly regarded as relevant service attributes (see Song and Xu (2012) and Cariou (2011) for papers that address the environmental footprint of shipping operations). We have not included a 'Reputation' factor as we regard this as a 'derived' effect (for instance due to a better reliability or better information provision -both included as potential differentiators), not a primary potential source of differentiation. In the study by Kannan et al. (2011) more than 80% of the importance was attributed

44 As the survey was conducted by EVO and had to meet EVO protocol we couldn't extent the response period to be in line with the survey conducted by FENEX.

to the remaining 5 factors. From 4 factors we could directly apply 6 potential sources of differentiation, from 1 factor we retrieved 2 potential sources which we adjusted to the goal of our study (see table 5.1).

Table 5.1: Deduced potential sources of differentiation

Factors Kannan et al. (2011)	*Potential sources of differentiation*
Rate	1. Price of maritime transport
Customer service	2. Customer service
IT orientation and communication	3. Up-to-date information on location and status of the container
Scheduling	4. Frequency of sailings
	5. Flexibility
	6. Transit time
	7. Arrival reliability of ships and containers
Infrastructure	8. Intermodal transport from/to an inland terminal (*adjusted to the goal of our study*)
	9. Delivery of empty containers at inland terminals (*adjusted to the goal of our study*)
	10. Sustainable operations like reducing the carbon footprint (*new*)

The survey questions were discussed with FENEX and small adjustments were made[45]. Subsequently, the questionnaire was tested with a forwarder using the method developed by Jansen and Hak (2005). Some questions were slightly adjusted, overall the questions were valid and not ambiguous. The questionnaire for shippers consisted of the same questions, where necessary adjusted to the different type of respondents. All questions were checked by EVO on clarity. Both questionnaires were in Dutch.

Non-response bias was tested per type of respondent (forwarders and shippers). The forwarders responded in three waves. Responses were obtained after the initial invite, after a reminder by e-mail and after a second reminder by phone. We used the One-way ANOVA test to identify significant differences between the three different response waves for variables measured on an interval scale. We found a significant difference for one item: 'delivery of empty containers at inland terminals', both for the importance attached to this item, $F(2,29) = 4.596$, $p = 0.014$, as well as the experienced differences between the shipping lines on this item, $F(2,59) = 4.878$, $p = 0.011$. For variables measured on an ordinal scale we used the independent samples Kruskall-Wallis test. No significant differences

45 We excluded a potential source of differentiation (i.e. providing door-to-door transport) as this conflicted too much with the interest of the forwarders. We also made the introduction for the question regarding the transport service which combines a sea leg and intermodal land leg more neutral (i.e. we deleted the term shipping line and only mentioned that container transport mainly provided on a port-to-port or door-to-door service).

where found for these variables. The shippers responded in two waves: after the initial invite and after a reminder by e-mail. Here, we used the independent samples *t*-test to identify significant differences between the early and late respondents for varaiables measures on an interval scale. We found a significant difference between the first wave (M = 4.58, SD = 2.36) and second wave (M = 3.00, SD = 2.17) for importance attributed to item 'transit time'; t (46) = 2.05, p = 0.046. Furthermore, a significant difference existed between the first wave (M = 7.56, SD = 1.92) and second wave (M = 8.67, SD = 0.78) for importance attributed to item 'intermodal transport from/to and inland terminal'; t (43.98) = -2.842, p = 0.007. For varaiables measured on an ordinal scale, we use the independent samples Mann-Whithney test. No significant differences where found for these varaiables. Since we observed a limited number of significant differences between the early and late respondets, we do not consider non-response bias to be an issue based on the notion that late respondents can be considered as a proxy for non-respondents (Armstrong and Overton, 1977).

5.4 Results

Respondents (both shippers and forwarders) were asked to rank ten potential sources of differentiation based on their importance to the respondent. We used ranking as response category to force respondents to directly compare and differentiate between items. The most important item was ranked first (resulting in a score of 1) and the least important on the tenth place (resulting in a score of 10). The price of maritime transport has been ranked as most important by 47% of the respondents. Overall, price was also ranked as most important (μ = 2.27), followed by frequency of sailings (μ= 3.40), reliability (μ = 3.46) and transit time (μ = 3.69). Sustainable operations is ranked as the least important by 43% of the respondents (μ = 8.94) just after intermodal transport from/to an inland terminal (μ =8.29). These results indicate that shipping lines' customers are mainly cost driven. Furthermore, despite growing awareness of the environmental impact of supply chain operations the importance attributed to sustainable operations is low.

To test whether or not shippers and forwarders have a different stance towards the potential sources of differentiation, we used the independent samples *t*-test to find significant differences between the two groups . The *t*-test revealed significantly different rankings between forwarders and shippers; only two items showed no significant difference (see table 5.2). The most prominent difference between the ranking by shippers and forwarders is related to frequency of sailings and reliability. Whereas shippers rank reliability, on average, on a second place, forwarders find reliability less important with a ranking on the fourth place. In contrast, forwarders rank frequency of sailings as second and shippers rank this on a fourth place. This may be explained by differences in business models: forwarders benefit from more options (frequency), while shippers

focus on the entire supply chain, and are negatively impacted by unreliability through a negative impact on the productivity of people, assets or, in the worst case, lost sales. That may also explain why shippers value reliability more than forwarders. Another difference is the importance attributed to the delivery of an empty container at an inland terminal. Forwarders indicate that this is important, probably because this enables them to create single trips. Finally, forwarders rank sustainable operations significantly lower than shippers. With 8 out of 10 potential sources of differentiation for which a significantly different importance is given; hypothesis 1 is accepted.

Table 5.2: importance attributed to potential sources of differentiation

	Number of respondents		*Mean ranking [1,10] (Std. Dev)*		*Significance*	*MD*
Potential source of differentiation	Forwarder	Shipper	Forwarder	Shipper	p-value (two-tailed)	
Price of maritime transport	62	48	2.03 (1.629)	2.58 (1.724)	0.092	-0.551
Frequency of sailings	62	48	2.60 (1.311)	4.44 (2.584)	0.000	-1.841
Transit time	62	48	3.31 (1.275)	4.19 (2.394)	0.024	-0.881
Arrival reliability of ships and containers	62	48	4.08 (2.256)	2.67 (1.667)	0.000	1.414
Customer service	62	48	4.82 (1.510)	5.58 (1.900)	0.021	-0.761
Up-to-date information on location and status of the container	62	48	6.37 (1.632)	5.83 (2.309)	0.175	0.538
Flexibility	62	48	6.50 (1.844)	5.35 (2.037)	0.003	0.371
Delivery of empty containers at inland terminals	62	48	7.18 (1.584)	8.27 (2.283)	0.003	-1.093
Intermodal transport from/to an inland terminal	62	48	8.65 (1.641)	7.83 (1.787)	0.014	0.821
Sustainable operations like reducing the carbon footprint	62	48	9.47 (0.564)	8.25 (1.952)	0.000	1.218

Respondents were also asked to indicate to what extent they experience difference between shipping lines, for the same potential sources of differentiation as in the previous question. The respondents had three possible options “much difference”, “some difference” and “no difference”. We translated this into a

score on an interval scale starting from 1 for "no difference" up to 3 for "much difference[46]. Table 5.3 provides an overview of the descriptive statistics for all respondents.

Table 5.3: extent of experienced differences by respondents (N=110)

Potential source of differentiation	*Mean*	*Std. Dev.*
Price of maritime transport	2.50	0.538
Customer service	2.36	0.646
Frequency of sailings	2.31	0.571
Flexibility	2.30	0.685
Transit time	2.29	0.611
Arrival reliability of ships and containers	2.29	0.708
Up-to-date information on location and status of the container	2.16	0.671
Intermodal transport from/to an inland terminal	2.03	0.670
Delivery of empty containers at inland terminals	1.98	0.754
Sustainable operations like reducing the carbon footprint	1.72	0.679

The indicated perceived differences by the respondents (table 5.3) suggests that the respondents experience differences for those attributes that they consider important (see table 5.2). For example, price is indicated as most important and most strongly perceived as different, while sustainable operations are the least important and respondents also perceive the least difference between shipping lines. This suggests that the higher the importance given to a specific item, the more difference is experienced. Therefore, we calculated if these two correlate with each other. For this, we used the Pearson Correlation Coefficient. The results show a significant correlation between importance and experienced differences for five items, as presented in table 5.4. The correlation is negative, which is logical since a higher importance (i.e. the higher the ranking the lower the score), will result in a higher experienced difference. As it might be expected that all relevant information is available to make a decision, the previous finding suggests that shippers and forwarders are biased and make decisions based on their preferences; they only perceive differences for items they consider relevant. This behavioural conclusion has a managerial implication: shipping lines need to carefully communicate relevant service characteristics to relevant market segments.

We also tested whether the importance and perceived difference are also related for the two individual groups , again by using the Pearson correlation coefficient. For shippers (N=48) this is the case for transit time (r = -0.441, significance

46 Although we acknowledge that a 5 or 7 point scale would have given the respondents the possibility to better nuance their responses, we are confident that the 3 point scale provided us with reliable and valid results (see for example, Jacoby and Matell, 1971)

0.002, two-tailed with α = 0.01), delivery of empty containers (r = -0.481, significance 0.001, two-tailed with α = 0.01) and sustainable operations (r = -0.286, significance 0.049, two-tailed with α = 0.05). For forwarders (N=62), this is the case for price (r = -0.300, significance 0.018, two-tailed with α = 0.05), delivery of empty containers (r = -0.411, significance 0.001, two-tailed with α = 0.01) and intermodal transport (r = -0.532, significance 0.000, two-tailed with α = 0.01). This indicates that the importance given to these attributes influences the experienced differences between shipping lines. This suggests that segments of shippers/forwarders that value some service characteristics also perceive differences between shipping lines. This may, for example, be relevant for an ILT-centred value proposition.

Table 5.4: correlation between importance and experienced difference (N=110, two-tailed)

Potential source of differentiation	*r*	*Significance*	α
Transit time	-0.311	0.001	0.01
Price of maritime transport	-0.253	0.008	0.01
Delivery of empty containers at inland terminals	-0.481	0.000	0.01
Sustainable operations like reducing the carbon footprint	-0.265	0.005	0.01
Intermodal transport from/to an inland terminal	-0.330	0.000	0.01

For two items, shippers and forwarders experienced differences between shipping lines differently. Forwarders experience more difference than shippers for the delivery of empty containers at inland terminals (μ forwarders = 2.15, μ shippers = 1.77, p = 0.009, two-tailed with α = 0.05). This can be explained because the business model of forwarders is aimed at making combinations and reducing costs which can be done through using empty depots in the hinterland of a port, therefore forwarders are more focused than shippers on this issue and experience more difference. Second, shippers experience more differences for sustainable operations than forwarders (μ shippers = 1.94, μ forwarders = 1.55, p = 0.003, two-tailed with α = 0.05). This shows again that shippers have more attention for sustainability. With only 2 out of 10 service attributes for which experiences are significantly different, hypothesis 2 is rejected. In addition to the previous question, respondents were asked to indicate on a 5 point Likert scale to what extent they agree with the statement 'Shipping lines only differentiate themselves based on price'. The responses to this statement show that on average there is no strong opinion (μ = 2.97, where 3 stands for 'Neutral') and where 45% disagrees and 37% agrees with this statement (see table 5.5). To test for differences between shippers and forwarders on this statement, we used the Mann-Whitney test as we deal with an ordinal scale. The results indicate that there is no significant difference between shippers and forwarders. There is also no significant difference between the respondents who indicated that costs are the most important criteria and the respondents who did not. We did find a

significant correlation, by applying the Spearman's rank correlation coefficient, with the experienced differences on transit time (ρ = -0.210, significance 0.028, two tailed with α = 0.05). This suggests that those customers that perceive differences in transit time are less cost driven.

Table 5.5 Statement: Shipping lines only differentiate themselves based on price (N=110)

Possible answers	*Frequency*	*Valid Percent*	*Cumulative Percent*
Fully disagree	4	3.6	3.6
Disagree	45	40.9	44.5
Neutral	21	19.1	63.6
Agree	30	27.3	90.9
Fully agree	10	9.1	100.0
Total	110	100.0	

Value Propositions

The second part of this study addresses the potential of the ILT-centred value proposition. The respondents were asked to indicate the share of every booking type they make. On average, 69% of the bookings are port-to-port, 26% are door-to-door bookings, and 5% are done up to the inland terminal. Table 5.6 shows that forwarders and shippers differ in their ratio of bookings. Based on the independent samples *t*-test, we found significant differences between forwarders and shippers in the share of port-to-port (p = 0.005, two-tailed with α = 0.05) and door-to-door bookings (p = 0.002, two-tailed with α = 0.05). As forwarders have a lower share of door-to-door bookings compared to shippers and this difference is significant, hypothesis 5 is accepted.

Respondents also indicated whether they would be interested in a transport service which combines the maritime leg with an inland leg to or from an inland terminal, with a minimum score of 1 (not interesting) and the maximum score of 4 (very interesting). The average score of 2.55 suggests that shippers and forwarders are interested in this proposition, especially since almost 85 per cent indicates that the value proposition is 'somewhat interesting' or more (Table 5.7). Therefore, hypothesis 3 is accepted.

We also checked if shippers and forwarders differ in their responses on the previous question. The Mann-Whitney-test indicates that there is no significant difference between shippers and forwarders (p = 0.769 with α = 0.05). Furthermore, we asked the respondents to indicate if they agreed or not with the statement "My experiences with intermodal transport are positive" on a 5

point Likert scale[47]. We used Spearman's rank correlation coefficient to test if there is a correlation between the respondents who have a positive experience with intermodal transport and the interest in the value proposition[48]. This is a significant correlation ($\rho = 0.221$, significance 0.033, two-tailed with $\alpha = 0.05$, $N = 93$). Furthermore, based on the Spearman's rank correlation coefficient, we found that the interest in the ILT-centred value proposition is negatively correlated to the share of port-to-port bookings ($\rho = -0.302$, significance 0.001, two-tailed with $\alpha = 0.01$, $N = 110$), positively correlated to the share of door-to-door bookings ($\rho = 0.237$, significance 0.013, two-tailed with $\alpha = 0.05$, $N = 110$) and positively correlated with the share of port-to-ILT bookings ($\rho = 0.244$, significance 0.010, two-tailed with with $\alpha = 0.05$, $N = 110$). These results indicate that respondents with a large share of door-to-door bookings are more interested in the intermodal value proposition. This may be because the door-to-door offering is similar to the port-to-ILT offering (only the 'last mile' is not provided). Thus, the costs to switch from door-to-door to port-to-ILT may be relatively low. Based on the previous test results, we accept hypothesis 4.

Table 5.6: type of booking per type of respondent (N=110)

Type of booking		*N*	*Mean*	*Std. Dev.*	*Std. Error Mean*
Port-to-Port	Forwarder	62	77.84	25.155	3.195
	Shipper	48	57.98	42.049	6.069
Door-to-Door	Forwarder	62	16.55	23.239	2.951
	Shipper	48	38.50	41.231	5.951
Port-to-Inland Terminal	Forwarder	62	5.61	9.210	1.170
	Shipper	48	3.52	8.303	1.198

Table 5.7: Responses on the statement: I consider a transport service which combines maritime transport with inland transport to or from an inland terminal, (N=110)

Possible answers	*Frequency*	*Valid Percent*	*Cumulative Percent*
Not interesting	17	15.5	15.5
Somewhat interesting	34	30.9	46.4
Interesting	41	37.3	83.6
Very interesting	18	16.4	100.0
Total	110	100.0	

Finally, we tested if there is a significant relationship, by applying Spearman's rank correlation coefficient, between the share of port-to-port bookings (or

47 A 5 point scale for this statement is used to give respondents the posibility to be more specific on their position, which is relevant since the statements is positively framed.

48 In the questionnaire of the shippers, before we posed the statement on the experiences with intermodal transport we filtered out the shippers which did not made use of intermodal transport which were 17 out of 48.

door-to-door bookings) and the statement that shipping lines only differentiate themselves based on price. No significant relationship is found (ρ = -0.064, significance 0.505 for port-to-port and ρ = 0.051, significance 0.594 for door-to-door bookings). This suggests that door-to-door transport is *not* less price sensitive than port-to-port transport. This conclusion is supported by the absence of a correlation between the share of port-to-port and door-to-door bookings and the experienced differences between shipping lines. We conclude that this research suggests that providing door-to-door bookings is *not* a source of differentiation for shipping lines. This is contrary to the arguments of Frémont (2009) and Franc and Van der Horst (2010) that door-to-door bookings may be a source of differentiation for shipping lines and lead to a less price sensitive demand. Both studies did not empirically test these arguments; the test in this article suggests that the customers of shipping lines do not perceive a door-to-door service as something that differentiates one carrier from another carrier.

5.5 Discussion and Conclusions

We have analysed the perspective of shippers and forwarders on the value propositions of shipping lines in general and the ILT-centred value proposition in specific. Our main findings from a survey among shippers and forwarders in the Netherlands are:

1. Shippers and forwarders differ on what they find important in the offering of shipping lines. However, both are mainly cost driven which confirms the results from previous research by De Langen (2007) and Tongzon (2009). Furthermore, the ranking of the potential sources of differentiation in the offering of the shipping lines has a large overlap with the results from Kannan et al. (2011).
2. Both shippers and forwarders still have a rather limited interest in sustainability. Forwarders attribute the lowest importance to sustainable operations. Shippers experience more difference between shipping lines on sustainability than forwarders.
3. Shippers and forwarders have a different share in type of bookings. Forwarders mainly book on a port-to-port basis (78% of the bookings) and have a relatively small share of door-to-door bookings (17%). In contrast, shippers have a larger share of door-to-door bookings (39%).
4. The relationship between importance and experienced differences of service attributes indicates that forwarders and shippers only perceive differences for items they consider relevant.
5. Customers of shipping lines can derive value from an ILT-centred value proposition. Both forwarders and shippers are interested in such a value proposition, especially if they already have a positive experience with intermodal transport. Customers with a large share of door-to-door bookings are more interested in the ILT-centred value proposition.

Our main findings can be explained for the most part by the different business models of shippers and forwarders and their position in the supply chain. For example, forwarders attach more importance to frequency as providing choice is a key component in a forwarder's business model. Another key feature of their business model is increasing margins though optimizing transport by matching import and export flows. Therefore, forwarders rank the delivery of an empty container at an inland terminal as more important and experience more difference than shippers. Shippers focus more on reliability compared to forwarders as that has repercussions for their supply chain. These results also underline the findings of Notteboom (2006a) that shipping lines can differentiate themselves based on reliability, with the addition that reliability is more important to shippers.

5.5.1 Managerial implications

In contrast to the conclusions of Frémont (2009) and Franc and Van der Horst (2010), our findings suggests that providing door-to-door bookings is not (any longer) a source of differentiation for shipping lines. Furthermore, we conclude that door-to-door transport is not less price sensitive than port-to-port transport. The findings indicate that price is most important to customers, regardless of the type of booking (door-to-door or port-to-port). When customers evaluate shipping lines they only perceive differences for items they consider relevant. This means that shipping lines need to carefully communicate relevant service characteristics to relevant market segments. For example, customers which are more focused on transit times are less cost driven. In line with this, we propose that shipping lines can create value for a part of their customers by offering an ILT-centred value proposition. However, shipping lines have to keep in mind that more ILT bookings is likely to go at the expense of less door-to-door bookings. Perhaps shipping lines can also interest those that currently use a port-to-port service, for instance by offering the return of empties to inland terminals, on the condition that the ILT product is used.

Chapter 6

Environmental sustainability in freight transport: the attitudes of shippers and forwarders[49]

49 This chapter is co-authored by Peter W. de Langen.

6.1 Introduction

The previous chapters already touched upon the potential of intermodal transport to reduce the environmental impact of transport. The focus on this characteristic is not without a reason. Due to the globalization of trade container traffic increased from 28,7 million TEU in 1990 to more than 153 million TEU in 2010 (World Shipping Council, 2011) and thus impacts the environment. The total transport sector accounts for 22% of global CO2 emissions, road transport accounts for the majority of transport emissions with 74% of the transport emissions and shipping accounts for 9% (International Energy Agency, 2013). Contrary to most manufacturing industries where emissions decreased, CO2 emissions in transport increased in the last two decades (EEA, 2013). Without any political intervention Skinner et al. (2010) projects that transport related green house gas emissions in Europe in 2050 would be 74% higher than they were in 1990 and around 25% above 2010 levels. Piecyk and McKinnon (2010) conclude that trends in supply chains such as centralization, increased online sales, shorter lead times and more frequent deliveries may lead to even more emissions. With these trends in mind, shippers and forwarders, as the major purchasers of freight transport, have a strong influence on the emissions generated.

Transport companies have already taken various initiatives to improve the environmental performance of transport (for example, within the port and shipping industry BSR's Clean Cargo working group, GreenFreight Europe, the World Port Climate Initiative and EcoPorts are focusing on this topic[50]). However, most shippers and forwarders seem to limit their focus and primarily steer on costs (De Langen, 2007; Tongzon, 2009) and value sustainability as least important (Lammgård and Andersson, 2014; chapter 4). Despite these findings, consumers push for insight on and a reduction of the carbon footprint of the products they buy. In addition, academics have found significant positive relationships between environmental and firm performance (Molina-Azorín et al., 2009). This suggests that shippers and forwarders might need to bridge a gap in order to realize a potentially winning strategy. To bridge this gap we need a better understanding of the position of shippers and forwarders towards sustainability within freight transport. Therefore, the research question that

50 The Clean Cargo working group is a global business-to-business group of companies set up by BSR to improve the environmental performance in marine container transport through measurement, evaluation, and reporting. GreenFreight Europe is an independent voluntary program for improving environmental performance of road freight transport in Europe with multinational shippers, carriers, retailers and associations as members. The World Port Climate Initiative was initiated to reduce greenhouse gas emissions by taking measures as port authorities. Examples of initiatives are the environmental ship index and initiatives to promote the use of shore power and LNG as a shipping fuel. EcoPorts, an initiative of European ports and now incorporated in the European Sea Ports Organisation (ESPO), supplies tools to their members to review and take measures for greening the port.

will be answered in this chapter is: What are the attitudes of shippers and forwarders towards environmental sustainability in freight transport?

This study contributes to theory in two ways. First of all, it takes into account the perspective of both shippers and forwarders. To our knowledge, this is one of the first studies doing so in relation to sustainability. Therefore, it provides new insights on the relationship between shippers and forwarders on this topic. Second, it contributes to existing theory on the attitudes of shippers and forwarders as a different sample of the population of shippers and forwarders has been targeted in another moment in time. The research is also relevant to practice. Based on the existing attitudes, areas for improvement can be identified to increase the influence of shippers and forwarders on the environmental performance of freight transport.

This chapter is structured as follows. First, we provide an overview of the literature related to sustainability practices and the potential to improve the environmental performance of transport. Second, we develop six hypotheses on the attitude of shippers and forwarders towards environmental sustainability. Third, we outline the used methodology and thereafter we present the results from our empirical research. We finalize this chapter with a discussion and conclusions.

6.2 Literature review

A reduction of CO2 emissions is often center stage in efforts of companies to become more sustainable. However, this is only a part of sustainability measures within logistics. Logistics Social Responsibility (LSR) which is defined by Carter and Jennings (2002) as the socially responsible management of the supply chain under a cross-functional perspective, and can be seen as a part of Corporate Social Responsibility (CSR), includes a wider range of sustainability measures. Ciliberti et al., (2008) developed a taxonomy for LSR practices in five different areas: Purchasing Social Responsibility, Sustainable Transportation, Sustainable Packaging, Sustainable Warehousing, and Reverse Logistics. As this research focusses on freight transport, we will elaborate on sustainable transport. Within the liner shipping industry research has been performed on the impact of shipping route design on CO2 emissions (Song and Xu, 2012) and the effect of slow steaming on reducing CO2 emissions (Cariou, 2011). On the land side Lättilä et al., (2013) found that emissions can be reduced through using intermodal transport. The authors came to this conclusion based on a simulation model of the utilization of a dry port network in Finland compared to road transport. A reduction of up to 45% of CO2 emissions could be realized. In contrast, Kim and Van Wee (2014) found that the assumption that intermodal freight systems emits less CO2 than the truck-only freight system does not always hold; factors like distance of shipments, sources of electricity, vessel sizes and drayage distance are relevant. When analysing intercontinental container transport,

emissions in shipping are dominant (generally > 70% of the total door-to-door emissions), even though environmentally more friendly per ton kilometer. As an example with the data given in table 6.1, for a journey from 200 km inland in China to a destination 200 km inland in Europe, more than 90% of emissions is from shipping. For short sea shipping, hinterland transport is often the largest contributor to emissions.

Table 6.1: the emission range for different transport modes and port operations (Source: authors, based on Geerlings and Van Duin, 2011; CEFIC, McKinnon, TMS and company websites of terminal operators and shipping lines)

Component	*Emission range*	*Important determinants of emissions per shipment*
Transport mode (gram CO2 per ton/km)		
Road	60-140	Load rate, weight/volume ratio, quality of truck, traffic condiutions, truck speed
Rail	20-50	Load rate, train size, power system (electricty or diesel), speed of train
Deepsea shipping	7-10	Vessel size, utilization, speed
Shortsea shipping	15-30	Vessel size, utilization, speed
Small RoRo	50-60	Vessel size, utilization, speed
Barge	20-50	Vessel size, speed of water (on river), utilization rate, speed
Bulk shipping (large vessels)	5-7	Vessel speed and size
Air freigt (medium to long haul)	550-800	Size of aircraft, distance, utilization
Pipeline	4-6	Batch size
Transport node (kg per TEU or ton)		
Handling of a container in a seaport	12-20 (TEU)	Terminal size and equipment, number of intra-terminal moves
Handling of a container at an inland terminal	5-10 (TEU)	Terminal size and equipment, number of intra-terminal moves
Nautical services (vessel traffic management, towage, mooring)	< 1 kg per ton	Fuel and sustainability of pilotage and inspection vessels

Fries et al. (2009) found that that the willingness to pay a higher price for increased environmental performance of a shipment is low. As a result, Cariou (2011) and Lättilä et al., (2013) discuss measures that reduce CO2 emissions as well as overall transport costs. Aronsson and Huge Brodin (2006) identify four strategies within the logistics context that can reduce costs *and* emissions: standardization, consolidation, visibility support systems for better planning and flexible understanding of transportation and warehouses. Within operations research, Dekker et al., (2012) found that the focus is often on cost minimization, and emission reductions associated with cost reductions are often not quantified although this often applies and is relevant for the awareness. Only recently, studies on service network design problems within intermodal transport started

to consider greenhouse gas emissions as a primary objective (Bauer et al., 2010) and already provide promising models with emission- and cost-efficient solutions (Qu et al., 2014). From a procurement point of view, Eng-Larsson and Kohn (2012) studied several cases in which companies shifted to other modes of transport and found that shippers are not driven by reduced environmental impact but by reducing costs and increasing service levels. A similar conclusion can be drawn from the studies by Large et al. (2013) and Lammgård and Andersson (2014) who found that while procuring logistics services other modes of transport are often not considered even though a shift may reduce the environmental impact. In such cases, government interventions, like regulation, can drive an improved sustainability performance. Björklund (2011) concludes that purchasing green transport services is heavily influenced by government policies. Award schemes for sustainable transport are acknowledged to stimulate both shippers and logistics service providers to improve their environmental sustainability (Pieters et al., 2012). In addition, Bergqvist and Egels-Zandén (2012) argue that green port dues may be an interesting measure to stimulate shippers and logistics service providers to choose for more sustainable ways of transport.

Shippers often outsource the organization of transport to third party logistics service providers (3PLs), for many of which forwarding services is an important business activity. Thus, 3PLs/forwarders (we use the term forwarders in the remainder of this chapter) can contribute substantially to reducing the environmental impact of supply chain operations, specifically through reducing the carbon footprint associated with transport activities. Both shippers and forwarders can use 'environmental purchasing' (see Zsidisin and Siferd, 2001) to reduce emissions. This approach is widely regarded as an effective way of improving industries' environmental performance (Björklund, 2011). However, forwarders, that generally do not operate transport services, may not have the capabilities to provide accurate measures of environmental footprint.

6.3 Hypotheses

The preceding literature review provided a further introduction of environmental sustainability within transportation, including the position of shippers and forwarders. As these two companies have different roles in the supply chain, differences between both can be expected. This is depicted figure 6.1.

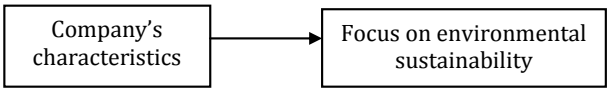

Figure 6.1: conceptual framework 1

The current theory regarding the focus on environmental sustainability is mainly based on the perspective of either shipper or forwarder. According to Evangalista et al. (2011) many forwarders do not focus on green supply chain performance. When forwarders are focused on environmental performance, this is mainly driven by pressure from customers (Lieb and Lieb, 2010; Colicchia et al., 2013). Evangelista et al. (2011) found that especially small forwarders evaluate investing in green initiatives with a short-term perspective, whereas a long term commitment is often required for investment decisions to improve environmental performance. Top management of the forwarders indicated that the reputation as an environmentally friendly company is of secondary importance (Wolf and Seuring, 2010). Kudla and Klaas-Wissing (2012) point out the agency problem in relation to environmental purchasing. They suggest that shippers may need to implement selection and evaluation criteria for the environmental performance of forwarders. Likewise, Large et al. (2013) conclude that "shippers' stimuli for providers' sustainable actions are still underdeveloped". Furthermore, both Pieters et al. (2012) and Lammgård and Andersson (2014) conclude that sustainability is relevant to the shipper, but costs and reliability are more important. As presented in chapter 5 both shippers and forwarders regard the sustainability of shipping lines' service offering as a relatively unimportant selection criterion. Although sustainability is not top priority, the above indicate that it is mainly incorporated by shippers. Therefore, we propose that forwarders are less concerned about sustainability than shippers[51].

Hypothesis 1: Forwarders are less concerned about sustainability than shippers.

Company size has been identified as a factor that influences the position of shippers towards sustainability. Lammgård (2012) indicates that surveys among shippers show that larger companies rate environmental considerations as more important than smaller companies. Furthermore, company size also influences the willingness to pay for environmental improvements. Especially small companies are more focused on costs. Therefore, we propose that small shippers are less occupied with sustainability than large shippers.

Hypothesis 2: Small shippers are less concerned about their environmental performance than large shippers.

Metrics for the environmental performance in freight transport are required to enable sustainable purchasing. The most common performance metrics used

51 Previous studies have identified relevant differences between shippers and forwarders; De Langen (2007) found that forwarders are more price sensitive than shippers. Tongzon (2009) also found a strong focus of forwarders on efficiency and costs.

by forwarders and shippers are CO2 emissions and energy use (Björklund and Forslund, 2013). However, a standard methodology for measuring environmental impact is still lacking (Colicchia et al., 2013). In addition, even shippers which have an environmental orientation in the procurement process do not translate this in clear and consistent demands from the forwarder (Wolf and Seuring, 2010) or do not specify how to measure the environmental performance and how to handle non-compliance (Björklund and Forslund, 2013). Therefore, we expect that forwarders perceive a lower demand for performance metrics than shippers indicate to transmit.

Hypothesis 3: Forwarders perceive a lower demand for metrics on environmental performance than shippers indicate to transmit.

In addition to the differences and relationship between shippers and forwarders, we address their attitude towards environmental sustainability in general. This is depicted in the second conceptual framework (figure 6.2) which addresses sustainability at different levels; sustainability as company target is a strategic level; sustainable purchasing is tactical; and measurement instruments are operational. The next hypotheses are related to this conceptual framework.

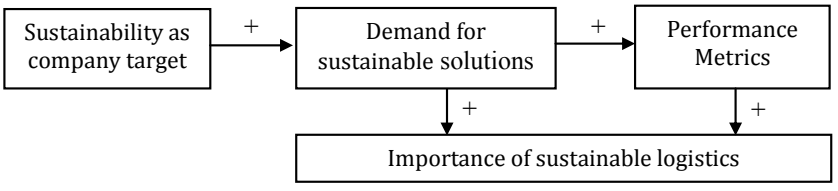

Figure 6.2: conceptual framework 2

In theory, business goals are translated into strategies and actions. However, Wolf and Seuring (2010) found that shippers and forwarders which do attach importance to reducing environmental impacts of transportation do not always translate this into strategies and actions. In general, regulations are seen as an important driver for environmental sustainability. However, Philipp and Militaru (2011) conclude that shippers' buying behaviour is mainly influenced by company specific characteristics and perceived quality levels of sustainable logistics services. In addition, Björklund and Forslund (2013) found that a higher level of managerial involvement is related to larger inclusion of environmental performance criteria in contracts. Based on this line of reasoning we propose that companies with a focus on sustainability will incorporate this more often in their demand or offering.

Hypothesis 4: Companies with sustainability as company target translate this more often into their procurement / service offering.

Furthermore, it might be expected that companies which demand sustainable solutions more often demand insights in the environmental impact of transport operations.

Hypothesis 5: There is a positive relation between demand for sustainable solutions and requirements for sustainability performance metrics.

The increasing focus on green logistics may result in more sustainable purchasing and more advanced supplier evaluation and selection processes (see Govindan et al., 2013). Perotti et al. (2013) conclude that companies start perceiving green supply chain management as a critical issue. Isaksson and Huge-Broding (2013) studied the green offerings of several forwarders and found that the extent of green logistics offerings strongly differs per forwarder. Despite the overall tentativeness concerning the future of green logistics found by Isaksson and Huge-Brodin (2013) and the limited, and over the years stable, priority of environmental aspects within the purchase of transport services by shippers (Lammgård and Andersson, 2014), we expect a positive relationship with the demand for sustainable logistics due to the increasing focus on sustainability.

Hypothesis 6: The importance of sustainable logistics will increase.

6.4 Methodology

To explore the attitudes of shippers and forwarders towards environmental sustainability, a survey has been carried out in the Netherlands among forwarders and shippers, especially those which are involved in container transport. The CO2 emissions in the Netherlands are, based on percentages, comparable with the global emissions with 21% of the total emissions related to transport of which 78% is related to road transport (Van der Meulen and Kindt, 2010). The data from the survey stems from the same survey as discussed in chapter 5 (the survey questions, in Dutch, can be found in appendix 1 and 2). Therefore, in this paragraph only relevant characteristics of the respondents and data used in this chapter will be discussed here. During 2012, forwarders and shippers were invited to participate in the survey through their Dutch industry associations (FENEX for forwarders and EVO for shippers). Out of the 116 responses of the FENEX members, 100 respondents answered the questions presented in this chapter. The remaining 16 respondents did not provide ocean forwarding services. The forwarders responded in three waves. A Pearson Chi-Square test was executed to test for significant differences between the answers of the early and late respondents. No significant differences were found (with $\alpha = 0{,}05$)[52].

52 For one question answer categories had to be combined to meet the test requirements. This resulted in the use of the Fischer's exact test. These results also indicated that there is no significant relationship between the early and late respondents.

The questionnaire sent by EVO resulted in 48 completed the questionnaire. The shippers responded in two waves. Again, the Pearson Chi-Square test was used, since we deal with nominal variables, to test if the answers of the early respondents significantly differ from the late respondents. However, for all questions the input and output requirements of the Pearson Chi-Square test were not met. After combining some response options we could use the Fischer's Exact test. The results indicate that there is no significant difference between the early and late respondents. Still, the non-respondents could have a significant impact on the outcome. However, based on Armstrong and Overton (1977) who propose that late respondents can be considered as a proxy for non-respondents we conclude that in this study non-response bias is not considered to be an issue.

6.5 Results

To test the hypotheses, we used the responses on four different questions. First of all, we asked the respondents to indicate if sustainable operations is one of their company's targets. We incorporated this question as sustainability as a company target signals a high importance of sustainability (see Lieb and Lieb, 2010). Second, to translate sustainability goals into improved environmental performance this requires sustainable purchasing. Therefore, we asked the respondents to what extent they demand sustainable solutions. Third, we wanted to know if metrics are used to measure the environmental performance. As emissions (especially CO2) are most commonly used metrics (Björklund and Forslund, 2013) we asked the respondent to indicate if insight on the environmental performance is demanded. The fourth and final question is related to the expectation for the future with regard to the importance of sustainability within logistics. With the responses to these questions in combination with the company's characteristics (business model: shipper or forwarder and company's size) we were able to test the hypotheses. The next section presents the responses to the questions and afterwards the test of the hypotheses

The first question addressed the incorporation of sustainability in company's targets. The results in table 6.3 indicate that almost 50% of the respondents have a company target focussed on sustainability and that more than one third of the respondents are developing a target. This indicates that most companies are at least considering sustainability as relevant topic.

Table 6.2: responses to the question if sustainable operations is one of the company's targets

Response option	*Shipper*	*Forwarder*	*Total*	*Percent*
Yes	25	46	71	48.0
Developing	19	35	54	36.5
No	4	19	23	15.5
Total	48	100	148	100.0

The second question deals with the demand for sustainable solutions. The results presented in table 6.3 show that, in more than 50% of the cases the respondents never demand sustainable solutions. Forwarders indicate that their customers often do not demand sustainable solutions.

Table 6.3: responses to the question to what extent sustainable solutions are demanded?

Response	*Shipper*	*Forwarder*	*Total*	*Percent*
Never	15	64	79	53.4
Sometimes / Most of the times	23	36	59	39.9
Always	10	0	10	6.8
Total	48	100	148	100.0

The third question involved the demand for insight on the environmental impact. Table 6.4 shows that less than 5% of shippers and forwarders always demand insight in the environmental impact. More than 50% indicated that insight is never demanded.

Table 6.4: responses to the question to what extent insight on the environmental impact is demanded.

Response	*Shipper*	*Forwarder*	*Total*	*Percent*
Never	27	56	83	56.1
Sometimes	14	44	58	39.2
Always	7	0	7	4.7
Total	48	100	148	100.0

The final question regarding sustainability deals with the expectations about the importance of sustainable logistics within the next five years. Table 6.5 shows that 84,5% of the respondents think that the importance of sustainable logistics will increase during the next five years.

Table 6.5: responses to the question how the importance of sustainable logistics will change in the next 5 years

Response	*Shipper*	*Forwarder*	*Total*	*Percent*
Importance will definitely not increase	1	2	3	2
Importance will probably not increase	2	12	14	9.5
Don't know	1	5	6	4
Importance will probably increase	22	49	71	48
Importance will definitely increase	22	32	54	36.5
Total	48	100	148	100

For all questions we tested for significant differences between shippers and forwarders. A Pearson Chi-Square test indicated that shippers and forwarders do not significantly differ in their responses with regard to sustainable operations as a company´s target. To test whether this also applies for the demand for sustainable solutions, we used the Mann-Whitney U test. The results shows a significant difference between shippers and forwarders (sign. = 0.000 and $\alpha = 0.05$). The difference can be partly explained by the fact that forwarders have multiple customers, some of which may demand sustainable solutions while others do not. A surprisingly high number of forwarders indicate that sustainable solutions are never demanded. This suggests a perception gap between forwarders that do not seem to experience a demand for sustainable solutions while shippers indicate that they do purchase sustainable transport solutions. This perception gap could be explained by a difference between actual and stated preference. However, it might be expected that this would apply to both shippers and forwarders. Another explanation of this perception gap is that shippers assume that sustainable solution not necessarily need to be more expensive. Forwarders might think otherwise. To summarize, although shippers and forwarders are equally concerned about sustainability on a strategic level (company target), shippers more often take sustainability into account in their procurement. Therefore, we conclude that hypothesis 1, which proposes that forwarders are less concerned about sustainability than shippers, is partly supported. Differences can also be found between responses from shippers and forwarders on the question regarding the demand for insight on the impact on the environment[53] (table 6.4). However, the differences are not significant. Therefore, hypothesis 3 is rejected.

The significant difference between shippers and forwarders in relation to the demand for sustainable solutions could be explained by the fact that many forwarders mainly serve smaller shippers. To test hypothesis 2, which proposes that smaller shippers are less likely to engage in sustainable purchasing than

53 Compared to the demand for sustainable (transport) solutions, a larger share of the respondents (56%) indicated that insight on environmental impact is never demanded. The increase is caused by the larger number of shippers which never demand insight on the environmental impact. This in line with our literature review indicating that shippers not always translate the strategy into performance metrics.

large shippers, we analysed the relationship between company size (based on number of employees and number of transported containers per year) and demand for sustainable solutions and insight on the environmental impact. We found a significant relationship between the number of transported containers per year and the demand for insight in the environmental impact (r = 0.354, sign. 0.014, two tailed with α = 0.05)[54], table 6.6 provides an overview of the average number of containers per year per response category. This result can be explained through the potentially higher reporting standards/demands at larger shippers compared to smaller shippers. Based on the significant relationship we accept hypothesis 2.

Table 6.6: average size of shippers combined with their demanded insight on the environmental impact

Demanded insight on the environmental impact	*Total number of containers per year*		
	N	*Mean*	*Std. Deviation*
Never	27	864	2.022
Sometimes	14	2.950	8.969
Always	7	7.952	10.627
Total	48	2.506	6.705

The questionnaire addresses sustainability issues at different levels; sustainability as company target is a strategic level; sustainable purchasing is tactical; and measurement instruments are operational. We analysed if responses at these different levels correlate with each other to test hypothesis 4 and 5. For the demand for sustainable solutions and measurement of the environmental impact we combined the answer categories "sometimes" / "most of the times" with "always" in order to meet the requirement of having less than 20 % of the cells with an expected count less than 5 (table 6.7 and 6.8). We found that sustainability as company target significantly correlates with both demand for sustainable solutions and demand for insight in the environmental impact. The Chi-Square test indicated that the relation between these variables is significant: X^2 (2, N = 148) = 37.69, p <.01. The relationship is strong (V = .505).

Table 6.7: responses for demand sustainable solutions and company targets combined

Demand for sustainable (transport) solutions?	*Is sustainable operations one of your company targets?*			
	Yes	*Developing*	*No*	*Total*
Never	20	38	21	79
Sometimes and always	51	16	2	69
Total	71	54	23	148

54 When two outliers (respondents with 30.000 and 34.000 containers per year) are deleted, the relationship remains significant (r = 0.341, sign. 0.021, two tailed with α = 0.05).

We also found that sustainability as company target is significantly related with demand for insight in the environmental impact, with X^2 (2, N = 148) = 21.22, p < .01. The relationship can be defined as moderate / strong (V = .379). The results from both Chi Square tests can be found in table 6.9 and 6.10.

Table 6.8.: responses for insight on environmental impact and company targets combined

Insight on environmental impact?	*Is sustainable operations one of your company targets?*			
	Yes	*Developing*	*No*	*Total*
Never	26	39	18	83
Sometimes and always	45	15	5	65
Total	71	54	23	148

Table 6.9: results from the Chi-Square test (Demand for sustainable transport solutions)

	Value	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	37.690[a]	2	0.000
Likelihood Ratio	40.849	2	0.000
Linear-by-Linear Association	36.064	1	0.000
N of Valid Cases	148		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 10,72.

The significant relationships indicate that companies with explicit sustainability targets translate this in a demand for sustainable solutions and transparency. Hypothesis 4, which proposes that companies with sustainability as company target translate this more often into their procurement or service offering, is accepted.

We have also analysed the relationship between the demand for sustainable solutions and the demand for insight on the environmental impact. Again, we found a significant relationship (ρ = 0.530, sign. 0.000, two tailed with α = 0.01), therefore hypothesis 5 is accepted.

Finally, we found a significant relationships between demand for insight in environmental impact and the expected change of importance of sustainable logistics within the next 5 years (ρ = 0.336 with α = 0.01) and between demand for sustainable solutions and expected change of importance of sustainable logistics within the next 5 years[55] (ρ = 0.358 with α = 0.01). Combined with the large share of respondents which indicate that the importance of sustainable logistics will increase, we accept hypothesis 6.

55 These results are based on 142 responses, we deleted six responses ("don't know").

Table 6.10: results from the Chi-Square test (Insight on environmental impact)

	Value	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	21.224[a]	2	0.000
Likelihood Ratio	21.801	2	0.000
Linear-by-Linear Association	18.403	1	0.000
N of Valid Cases	148		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 10,10.

The relation with purchasing services from shipping lines

The conducted survey also addressed shippers´ and forwarders´ perception of the services of shipping lines (see chapter 4 for an in-depth analysis of the results of this part of the survey). Two questions regarding shipping lines are also relevant for the analysis presented in this chapter: the importance shippers and forwarders attribute to sustainable operations of shipping lines and the extent to which sustainable operations are perceived as a source of differentiation between shipping lines. The respondents (both shippers and forwarders) indicated that sustainability is one of the least important service attributes and the experienced difference is limited (see chapter 4). Despite these outcomes, there are relevant differences between forwarders and shippers. The demand for sustainable solutions strongly correlates with the importance attributed by shippers and forwarders to sustainable operations (r_S = -0.405[56], sign. 0.000, two tailed, N = 110) as well as with the experienced difference between shipping lines (r_S = 0.431, sign. 0.000, two tailed, N = 110). These outcomes indicate that companies which focus more on sustainability do take this into account when reviewing transport service providers.

6.6 Discussion and conclusions

The results from the survey suggest an ongoing transition towards more sustainable purchasing of international container transport, which huge differences between companies. Shippers and forwarders have made sustainability as a company target and expect that the importance of sustainable logistics will increase during the next few years. These results are in line with the results from Kudla and Klaas-Wissing (2012) which indicated that forwarders think that sustainability will become a relevant decision criterion within the next five years. However, the results also indicate that there is still a large group of both shippers and forwarders that have not incorporate sustainability in their operations. Apparently, such shippers and forwarders do not attach value to an improved environmental performance and do not think a focus on a better environmental performance can lead to overall cost savings, which still seem to be the primary decision criterion (Eng-Larsson and Kohn, 2012; Large et al., 2013; Lammgård and Andersson, 2014). This approach is unlikely to achieve

56 The negative correlations can be explained by the score given to the importance (i.e. the higher the importance the lower the score the respondents had to give).

competitive advantage through a truly sustainable performance. BSR (2010) identified several trends that will impact the container shipping industry and result in more attention for reducing environmental impacts. These trends may ultimately lead to changes in business models. Shippers and forwarders may need to change their mental frames to change their business models. We further discuss this issue in the section on managerial implications.

6.6.1 Theoretical contributions

The analysis presented in this chapter explores the extent to which sustainability is incorporated in decisions on freight transport. Based on our empirical findings we can conclude that those companies which have a focus on sustainability on a strategic level also translate this into tactical and operational measures. However, the environmental performance is only to a limited degree incorporated in purchasing contracts (see also Wolf and Seuring, 2010; Björklund and Forslund, 2013). The main conclusions from our survey are that:

1. Shippers are not more focused on sustainability than forwarders in terms of company goals and demanding performance metrics, but do demand more often sustainable solutions. This difference can be explained by the fact that a forwarder purchases transport on behalf of multiple customers and, as most shippers seem to have a limited focus on sustainability, may lose customers when engaging in sustainable purchasing. Especially, because forwarders might think, in contrast to shippers, that sustainable solutions are more expensive.
2. The size of shipper (based on import or export volume) has a positive influence on the demand for transparency of the environmental performance (i.e. large shippers more often demand insight of the environmental performance compared to small shippers).
3. If companies have sustainability targets this has a positive influence on the demand for sustainable solutions. Furthermore, demand for sustainable solutions positively influences the extent to which environmental performance metrics are demanded. This is in line with the findings of Björklund and Forslund (2013) who found that those LSPs which indicate to have included environmental performance in contracts also seem to be more aware and have it "at the top of their agenda". We can therefore conclude that companies which do focus on sustainability also translate this into the different levels of the organization.
4. Expectations about the increasing importance play an important role in the demand for sustainable transport and the demand for insight on the environmental performance.

6.6.2 Managerial contributions

Shippers, as drivers of global supply chains, are best positioned to lead the transition towards a more sustainable way of transporting goods. Shippers are, in general, driven by consumers who increasingly demand insight on the carbon footprint of the product they are interested in. Although the carbon footprint of the transport is in general relatively small, it needs to be included to obtain the whole picture. This leads to additional pressure on transparency of the environmental performance of transport. A key mechanism to realize improved environmental performance as well as monitoring, as discussed in this chapter, is sustainable purchasing. When the vast majority of shippers would apply sustainable purchasing, the whole transport industry would be affected. From road hauliers (forced to use clean engines) to port authorities (for example through green port dues, Bergqvist and Egels-Zandén, 2012 or concession contracts, see chapter 3). Although shippers and forwarders indicate that sustainability will become more important, they still regard sustainability as relatively unimportant when, for example, comparing shipping lines.

Perhaps shippers and forwarders don't know how to deal with environmental sustainability. Another possibility could be that existing mental maps (which focus on reductions of transport costs) are relevant in the explanation for the existing attitudes. Such mental maps are known to influence strategic decision making. For example, Wiersema and Bantel (1992) and Finkelstien and Hambrick (1990) studied the effect of demographics of top management and managerial team tenure on mental maps of companies. According to Gary and Wood (2011) accurate mental models about the key principles of the business environment lead to superior decision rules and performance outcomes. Multiple studies demonstrated the positive relationship between corporate social responsibility (which also includes environmental concerns) and financial performance (Orlitsky et al., 2003; Molina-Azorín et al., 2009; Moneva and Ortas, 2010; Perotti et al., 2013). This relationship might be explained by the mental models which include, by nature, social responsibility. Even though shippers and forwarders may not be driven by social responsibility, they could still benefit from adjusting their managerial mental models. Moving away from the mindset that improved environmental performance is only of added value when costs remain on the same level or, preferably, decrease. The value creation through sustainable transport operations (especially in the eyes of the end consumers) may be high enough to give companies which change their mental models a (first mover) advantage over the ones sticking to the established mental frames. There are technological options with a superior sustainability performance (as two examples: zero emission container terminals, ships on solar energy, but these are not (yet) embraced by the main players in the industry). The finding of Finkelstien and Hambrick (1990) that long-tenure management teams (with established mental frames) tend to pursue imitative strategies in line with industry-percentions, whereas short-tenure teams tend to pursue novel strategies that deviate widely from industry patterns may be relevant in this respect.

Chapter 7

New insights for port pricing[57]

57 This chapter is co-authored by Peter W. de Langen and Paul J.C. van Zuijlen.

7.1 Introduction

The previous chapters have dealt with the different key players within the transport chain. Port authorities have started to focus on the hinterland as well. Chapter 2 introduced the idea of treating ports as platforms within two-sided markets to utilize pricing strategies to influence the different players. Until now, the increasing focus on the hinterland have not yet resulted in a different view on port pricing. Academics have mainly discussed to what extent the costs of ports and port related infrastructure should be passed on to port users and to what extent public funding is appropriate (see for instance Haralambides et al., 2001). In this discussion, cost recovery as pricing objective has become more important. Various academics including Button (1979) Haralambides et al. (2001) and Haralambides (2002) have also argued for the application of the user pays principle to port infrastructure. The review of port pricing literature by Acciaro (2013) demonstrates that their exist a large body of literature on infrastructure cost recovery and external costs (i.e. congestion). However, it also demonstrates the limited attention to revenue management, pricing strategies and pricing structures in ports. This is in strong contrast with, for example, the airport industry, where these issues have already received significant attention (see for example Zhang and Zhang, 1997; Graham, 2009; Bel and Fageda, 2010). Therefore, this chapter focuses on port pricing, which include linkages to all players discussed in the previous chapters. The research question that will be answered is: what pricing principles can port authorities apply to attract both transport service providers on the sea-side as well as the land-side?

To answer the research question, we will apply the two-sided market theory to gain new insights on port pricing. To our knowledge, the two-sided market theory haven't been applied to seaports before. A few treat ports as platforms that consist of multiple distinctive but interrelated markets or networks (Carbone and De Martino, 2003; Lam and Song, 2013). One relevant characteristic of this platform is the complex interrelations between the market for ship calls and the market for cargo flows. Shipping lines will only call ports if there is enough cargo to make a stop economically interesting, while shippers will only consider using a port if shipping lines offer sufficient connections to/from that port. For newly developing ports that still need to attract cargo as well as services from shipping lines, the challenge to overcome this 'chicken and egg problem' is far from trivial. One example of port development that failed to meet this challenge is the container terminal in Amsterdam. Due to fierce competition from nearby ports, as well as some disadvantages of Amsterdam (the need to pass a lock and draft limitations), shipping lines did not call the port with sufficient services to make it an attractive alternative for port users of established ports in the area (Rotterdam and Antwerp). As a result, the foreseen container flows never materialized. The situation described above is related to the theory of two-sided markets. A relatively new concept that has already been applied to airports (Appold and Kasarda, 2011; Gillen, 2011; Ivaldi et al., 2011). This

concept is relevant for pricing, as optimal pricing for two-sided markets has special characteristics (see Rochet and Tirole, 2006, for a general discussion of two-sided markets and Kaiser and Wright, 2006 for an empirical analysis of pricing in the magazine industry). In short, two- sided markets may perform better when one side of the platform is be used for free while the other side pays relatively high charges (as examples, take dating sites that are free for women and newspapers that are free for users).

This chapter assess the applicability of the theory of two-sided markets to ports and subsequently distracts relevant pricing principles for port authorities. We focus on the role of port authorities, as they are the developers of the port and generally set the pricing. Furthermore, this chapter deals with what pricing structures port authorities (should) use to charge their users, not how much port authorities (should) charge. The chapter is structured as follows. First a general overview of port pricing is provided, supported by overview of six existing pricing structures of port authorities. Second, an introduction is provided into the theory of two-sided markets, followed by the a literature review on the application of this theory to airports. Based on these findings, the theory is also applied to seaports. This chapter concludes with proposing six general port pricing principles, based on the relevant insights from the preceding analysis.

7.2 Port pricing

Regardless of contractual arrangements, importers and exporters are the final users of the port. Generally speaking, they pass on their generalized port costs to their customers (often consumers). Various potential structures of charges from port authorities, which are virtually all government-owned, and increasingly operate as a landlord (Peters, 2001; Verhoeven, 2010), to port users are shown in figure 7.1.

Importers and exporters receive a charge from shipping lines that generally includes (part of the) port costs. Furthermore, port users may directly pay handling fees to terminal operating companies. This is generally the case in bulk transport and in the transport of cars, but not in the container industry, where the shipping line pays the terminal operator and charges so-called 'terminal handling charges' to port users (see Fung et al., 2003 on THCs). Finally, port users may be directly charged by port authorities. Such direct charges are often termed 'cargo wharfage'. In a large number of ports, such cargo wharfage charges do not exist. In these cases, shipping lines and port service providers charge importers and exporters, and exporters do not pay directly to port authorities.

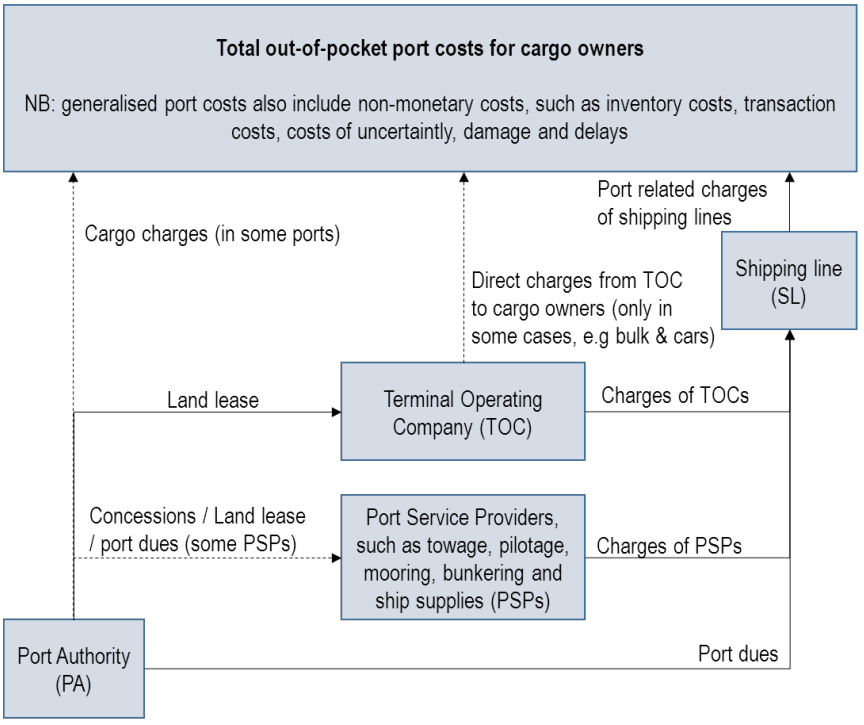

Figure 7.1: The structure of charges in ports (source: developed by the authors)

7.2.1 Pricing of port authorities; some cases

The diversity of port pricing mechanisms is huge (see Haralambides et al., 2001 for port pricing in Europe, with a focus on the extent to which costs of port infrastructure are recovered). Here, we present the pricing structures of six port authorities in various parts of the world. The collected data, in particular the revenues, is retrieved from the financial statements of six landlord port authorities. The revenues are allocated to the different 'customers'. The cases are used to compare the distribution of revenues (i.e. charges) to different port users. We acknowledge that there are underlying differences of activities, assets and accounting principles. For example, the financial statements of port authorities use different wording for the revenues received from similar customers (see table 7.1). However, the comparison serves to demonstrate the huge diversity of pricing structures.

In all cases we have ignored 'other (operating) income' as, in most cases, it could not be allocated to a specific port user as this item was not further specified and it represented only a relatively small amount of income[58]. The cases are selected

58 In the case of Melbourne 'other income' consisted of a fairly large amount of money as this emerged from a transfer of a hinterland rail connection from the government to the port authority. Since this result is incidental, this revenue is ignored in our analysis (Port of Melbourne, 2012; Port of Melbourne, 2013).

based on data availability, data was extracted from the financial statements of the year 2012[59].

Table 7.1: customer types and used wording in financial statements (source: developed by the authors based on annual reports of port authorities)

Customer type	*Used wording*
Shipping lines	Port dues, Seaport dues, Channel fees, Harbour dues, Cruise, Berthage, Marine services and Shipping services.
Tenants	Lease revenues, Rent and ground leases, Rents, Leases, Quayage, Property rentals, Fixed rent, Variable rent and Rental income
Shippers	Cargo dues, Wharfage charges, Gateway improvement fee
Barge operators	Inland port dues, Inland port charges

South Africa

In South Africa there is one port authority for all South African ports, called Transnet National Ports Authority (TNPA), an independently operating division of the Transnet Group that also includes the operator of railroads and ports. TNPA provides port infrastructure as well as specific port services. TNPA does not receive government funding, the costs of the entire port infrastructure (investment costs, maintenance costs and operational costs) have to be recovered from port users. Recently, TNPA proposed a new tariff structure as the current pricing structure is considered to lack a sound economic rationale[60]. The new tariff structure is aimed at full cost recovery. The required revenue to cover all costs is calculated on an aggregate level. The general principle is that users of specific port services or facilities should pay these. However, there are exceptions to this principle, partly because it is problematic to radically change the inherited pricing structure (in which shippers pay substantial wharfage fees) at once. TNPA proposed to reduce but not abolish the direct charges to shippers. The new proposal suggests that terminal operating companies should contribute 33% (lease revenues), shippers 46% (cargo dues) and shipping lines the remaining 21% (port dues) of the required revenue.

Rotterdam and Amsterdam

In contrast to the tariff structure in South Africa, the port authority in Rotterdam does not levy charges to shippers. The revenue in Rotterdam is generated by charges to three types of port users. The first user group consist of tenants that are charged by means of land lease and quay fees. The second group is composed

59 The financial statement of TNPA of 2012 did not provide sufficient details to determine the division of the revenues by different type of port users. Therefore, we used figures of the current division as outlined in the proposal for a new tariff structure TNPA (2012).

60 Preceding this proposal extensive research and stakeholder consultation has been conducted. Stakeholders that were involved are shippers, shipping lines, terminal operating companies, governments and the ports regulatory body.

of shipping lines that pay the port dues. The last group comprises barge operators that are charged inland port dues. The revenue generated from the latter group is limited. The port authority of Amsterdam has a comparable split of income streams from port users. The port authority of Amsterdam generates revenue from the same three port users. The shipping lines pay, besides the regular seaport dues, also environmental dues that fund ship waste collection[61].

Melbourne

Compared to the other cases, the Australian port of Melbourne generates the largest share of its revenue by means of wharfage fees to shippers. Wharfage fees are comparable to the cargo dues of South Africa. These wharfage fees are paid by shippers (Port management Act 1995, 2010). The second way in which the port authority of Melbourne generates revenue is by means of channel fees. Shipping lines have to pay these fees in order to reach the port of Melbourne. Finally, lease agreements with tenants generate revenues.

Vancouver

The port authority of Vancouver, called Port Metro Vancouver, generates part of its revenue by means of leases that are paid by tenants. Furthermore, shipping lines pay the port authority harbour dues, cruise dues and berth dues. Besides these charges, container shipping lines contribute for wharfage and gateway improvement dues that are charged on containerized cargo. Moreover, shippers that transport non-containerized cargo are levied for by means of wharfage and a gateway improvement fee. Thus, wharfage and the gateway improvement fee are levied to different users on the basis of the type of cargo involved[62].

Singapore

The port authority of Singapore, called the Maritime and Port authority of Singapore (MPA), has five items on its operating revenue account, namely port dues and marine services, shipping services, rental income, training and miscellaneous revenue[63]. The vast majority of all revenues are generated by the port dues charged to shipping lines. This group pays the port dues and marine services and shipping services. Rental incomes are generated by charging tenants.

61 In the income statement it is stated that public funds are made available for maintenance and repair of public roads within the port area. Since this income is not generated by one of the port users, this item is ignored. (Port of Amsterdam, 2013; van Oosten, 2012)

62 In order to assign the right proportion of costs to the right users, the share of containerized cargo in 2012 is calculated on the basis of its contribution in total tonnage, which is 19%. (Port Metro Vancouver, 2012; Port Metro Vancouver, 2013).

63 The item training is revenue arising from the maritime master programs that are offered by the port authority. However, due to the limited amount this item is ignored in the analysis. (MPA, 2013; Worldbank, 2007)

Table 7.2 summarizes the revenue structures of port authorities. The huge differences between pricing structures of port authorities are surprising. In most industries, pricing structures are fairly uniform in the sense that prices may differ, but there is uniformity in terms of what types of customers are charged (see Reid & Plank, 2000 for an overview of industrial marketing). In seaports various users are charged and in varying proportions. Shipping lines and tenants are charged in all cases, but their relative contributions differ significantly. For example, in Singapore shipping lines generate more than 98% of the total revenue, compared to 18% in Vancouver. The contributions of tenants in the total port revenue also strongly differs per port. In Vancouver this group of port users accounts for 66% of the total revenue generated, compared to 1.4% in Singapore. Moreover, in the ports where shippers contribute in port revenues they generate a rather large share of total revenues. Illustratively, in Melbourne 70% of the revenues is generated by shippers. Finally, the Dutch ports generate revenue from charges to inland transport operators.

Table 7.2: the division of revenues over different types of ports users (sources: financial statements port authorities, 2012)

Customers Ports	*Shipping lines*	*Tenants*	*Shippers*	*Barge operators*
South-Africa	20.0%	19.0%	61.0%	-
Rotterdam	49.0%	48.7%	-	2.3%
Amsterdam	54.9%	40.6%	-	4.5%
Melbourne	12.6%	17.3%	70.1%	-
Vancouver	17.8%	65.6%	16.6%	-
Singapore	98.6%	1.4%	-	-

The presented diversity suggests that an analysis of pricing structures is highly relevant in the port industry. In the airport industry[64], best comparable with seaports, managing bodies have a much more uniform pricing structure with a distinction between aeronautical and non-aeronautical revenues (Graham, 2009)[65]. The shares of revenue types differ between airports, for instance in relation to the size of the airport (in larger airports the share of non-aeronautical revenues is higher), but there are widely applied principles regarding who is charged for what. In the next section, a detailed analysis of ports as two-sided markets is provided, benefitting from relevant findings on airports.

64 Airports and seaports provide a location where cargo or passengers arrive, depart or transfer to another destination.

65 Another comparable industry is the provision of road infrastructure. The 'owner' of a road can provide the road as a collective good (users are charged indirectly by means of taxes) or as a private good, where users pay directly. In the latter case, value-based pricing and congestion charging is possible. Contrary to ports, the road 'owner' can only charge one user of the infrastructure, namely the vehicle driver (see Johansson and Mattsson, 1995; Button, 2010).

7.3 Ports, two-sided markets?

The theory of two-sided markets has its roots in two distinct research fields. The first research field is that of network industries (see early works such as Katz and Shapiro, 1985, 1986 and Farrell and Saloner, 1985, 1986). The basic idea of this theory is that when the number of users of a certain product increase, the utility to all of its users will increase, so-called network externalities. This is for instance the case for communication networks. As a general rule, firms operating in markets with network externalities set prices that match the expectations of potential buyers with respect to the expected future size of the market. Studies on network industries do not take into consideration the potential multi-sidedness of markets. The second research field is that of multiproduct pricing, as introduced by Baumol (1982). Multiproduct pricing theory deals with firms that produce a number of interrelated products (as one example, razor blades and shaving foam). A change of the quantity of sales of one product impacts the sales of (an)other product(s). As a result of combining both research fields, the theory of two-sided markets emerged as a recent contribution to economics and strategic management literature. Rochet and Tirole (2003, 2006), Evans and Schmalensee (2007) and Armstrong (2006) defined the logic, characteristics and assumptions of two-sided markets. Firms that develop a two-sided platform[66] often create a critical mass of users on one side of the platform (in some cases by providing services for free). Due to network effects, this increases the value of the platform for users on the other side. Examples of two-sided markets include newspapers and magazines (with readers on the one hand and advertisers on the other side) or social media networks like LinkedIn and Facebook. Pricing in two-sided markets often does not relate to costs; in some cases users on one side of the platform receive services for free –or even are paid to use the platform, while users on the other side of the platform are priced. In theoretical terms, cross-group externalities have to be taken into consideration. By considering cross-group externalities a price setter incorporates the benefits of a larger network of users on the other side of the platform; the lowest prices must be offered to the platform side with the largest positive externalities on members of the opposite side (Rochet and Tirole, 2003, 2006). When players in one market are linked to more than one platform, they are considered to be multi-homing. In contrast, when players in a linked market are only using one platform they are single-homing. Obviously, users that multi-home show higher price elasticity's (Rochet and Tirole, 2003, 2006; Evans and Schmalensee, 2007).

Evans and Schmalensee (2007) identified four distinctive types of two-sided markets: advertising supported media, transaction systems (for example credit card companies which charge merchants, while users can make use of the credit

66 In the literature (two-sided) markets and (two-sided) platforms are both used. In the remainder of this chapter two-sided market is used for the theory, a platform is the infrastructure, product or service through which the interaction takes place. The customers linked to the platform are defined as the markets.

card almost for free), software platforms (program developers and software users, which can only benefit from the applications if they have access to the software platform) and exchanges (i.e. platforms where buyers and sellers can do business and negotiate prices). Three criteria need to be met for qualifying as a two-sided market:

1. The main benefits of the two distinct markets arise from interacting via a common platform (Rochet and Tirole, 2003). A common feature of platforms is that they are able to minimize transaction costs and provide a platform that offers interaction as service. As a result, the existence of a platform is justified by transaction cost minimization as its value offering. (Evans and Schmalensee, 2007)
2. The interaction of the two markets linked to the platform leads to complementarities; both markets gain from each other's presence. Yet, the positive externalities arising from the interaction are not internalized by users. So, when deciding whether or not to use the platform, the positive externalities that are caused on the other users of the platform are not taken into account (Rochet and Tirole, 2003, 2006).
3. The attractiveness of the platform, expressed in total number of interactions, depends not only on the overall price charged by the platform, but also on distribution between both sides. (Rochet and Tirole, 2003, 2006) A key condition for this to work is that users of the platform are unable to bypass the pricing structure (Evans and Schmalensee, 2007).

The two-sided market concept has been applied to airports. However, the following literature review shows that there is no consensus on the question whether airports can be classified as a two-sided market.

7.3.1 Airports as two-sided markets?

Gillen (2011), Appold and Kasarda (2011) and Ivaldi et al. (2011) have argued that airports are two-sided markets. Besides the traditional revenue streams from airlines, airports increasingly generate revenues from passengers. Appold and Kasarda (2011) use the example of Amsterdam Schiphol airport where 70% of the operating income consists of non-aviation revenues. It is argued that as a result of revenue generation from two markets – the airliners and the shopping passengers – airports are basically a platform operating as a two-sided market. In this argument, airports bring together passengers and airlines and internalize the network effects of both markets: airlines benefit from a large group of passengers, whereas passengers benefit from a large network of destinations and frequent flights.

In line with this approach Gillen (2011) argues that airports should adopt a two-sided market view and reconsider the pricing structures, moving away from

cost-based pricing and towards including cross group network externalities and the price elasticity of demand in pricing decisions. For some users prices below marginal costs may be appropriate, because this type of user provides larger benefits for other users of the platform (Ivaldi et al., 2011; Gillen, 2011; Appold and Kasarda, 2011). In practice, most airports set landing fees at a low level, to attract more carriers, leading to a larger network of destinations and more frequent flights, which, in turn, attracts more passengers. The losses on the airline side are recovered, for example by additional parking and shopping revenues (Ivaldi et al., 2011; Gillen, 2011; Appold and Kasarda, 2011). Ivaldi et al. (2011) argue that there is empirical evidence that airports are two-sided markets. First, the quality of airport facilities and the aeronautical product do matter to customers, so by changing fees charged to airlines, airliner demand as well as passenger demand for the platform changes. Likewise, changing concession fees for shops would influence passenger demand as well as airline demand for the airport. Second,the fact that most airports cross-subsidize one side of the platform (the aeronautical side) with revenues from the other side (the passenger / non aeronautical side demonstrates that airports are platforms. Figure 7.2 summarizes the view of an airport as a two-sided market.

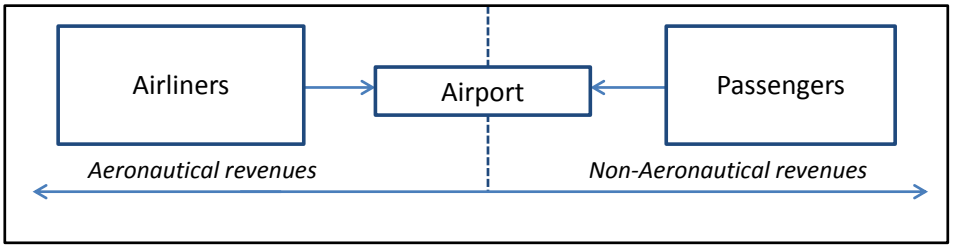

Figure 7.2. Airport as two-sided market

In contrast to the above, Fröhlich (2010) argues, based on the three criteria of two-sided markets, airports can't be qualified as such. First of all, airports do not provide a platform where passengers and airlines interact. Virtually all tickets (the transaction between airline and passenger) are sold before a passenger arrives at the airport. As a result, airports are circumvented when passengers are deciding to buy a ticket. Second, airports are an input factor for airlines and the relationship between airlines, airports and (shopping) passengers is purely vertical. The externalities involved are not cross-group externalities but vertical externalities. Vertical externalities can be best described by the effects of product decisions 'upstream' on 'downstream' activities. As an example, if airlines decide to increase the number and frequencies of destinations to be served from a certain airport, that airport would benefit through higher retail revenues. Thus, airport operating companies are multiproduct companies, selling complementary products (both the passenger transfer function as well as shopping space) to different groups of airport users. And third, lowering

airline charges will not affect passenger spending at the airport[67]. Thus Fröhlich (2011) concludes that the criteria for two sided markets are not satisfied. The empirical results of Ivaldi et al. (2011) may be valid, but can also be explained by regarding airports as multiproduct firms with vertical externalities. Figure 7.3 depicts airports as input factors for airlines.

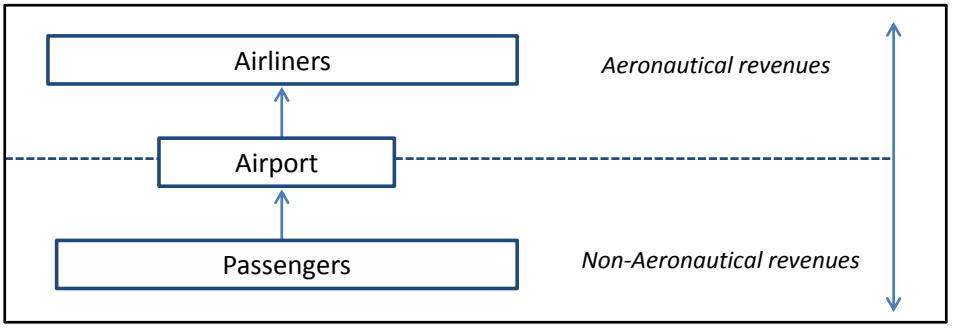

Figure 7.3. Airports as input factor in vertical markets

7.3.2 Seaports as two-sided markets?

In the literature on seaports, Carbone and De Martino (2003) treat a seaport as a platform. A decade later, we, as presented in chapter 2, and Lam and Song (2013) regard seaports as platforms with a sea-side and a land-side. The attractiveness of the platform can be improved by increasing the land-side network – this is by attracting a larger share of shippers in the contestable hinterland of a port – due to the network effects that emerge. A higher quality of the 'land-side product' is also beneficial for the shipping lines calling at the seaport. Conversely, the more shipping lines that call at a seaport, the more attractive it is for shippers in the hinterland to make use of that particular port. Chapter 2 suggest that by setting the appropriate prices in each market, seaports can take advantage of the existing cross-network externalities. This would imply that seaports are two-sided markets. In this analysis, the seaport as a market is defined as the node used by multiple supply chains, primarily, for loading and unloading of cargo between different modes of transport. Although seaports have characteristics that could indicate that they are a two-sided market (figure 7.4), we dismiss this claim, along the lines of the arguments provided by Fröhlich (2010) for airports.

The first criterion for two-sided markets states that the main benefits of the two markets arise from interaction with each other via the platform. The platform offers a place where participants of both markets can interact at low transaction costs. In the case of seaports this assumption does not hold. Shipping lines, shippers, forwarders and hinterland transport companies do not need the port

67 The only effect may be an 'income effect': passenger may have more to spend as their tickets are cheaper, and consequently spend marginally more at airports. This is mainly a theoretical argument.

to interact with each other. Moreover, as a result of the further integration of transport chains, the distinction between sea-based and land-based logistics markets, is increasingly blurred.

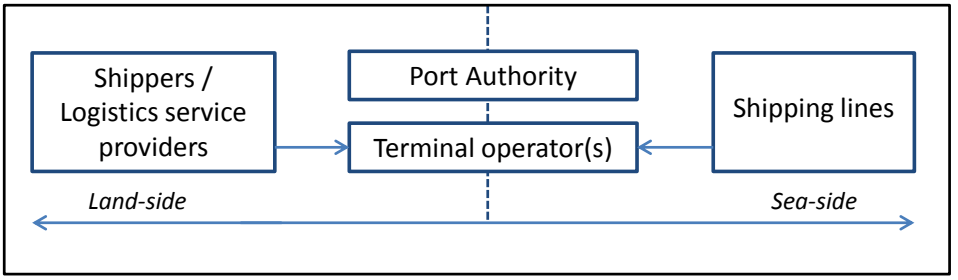

Figure 7.4: Seaport as a platform or multiproduct company with vertical markets

The second criterion states that markets connected by the platform benefit from each other's presence, due to network effects, but the decision to make use of the platform does not take into account the effects on the other side of the network. More technically, cross-group externalities arising from interaction are not internalized by users. Here, like in the case of airports, regardless of the type of supply chain organization, the relation between shipping lines, ports, forwarders, hinterland transport companies and shippers is vertical. In the airport, only airlines cause vertical externalities, whereas in seaports there are a number of user groups of seaports that cause vertical externalities. Besides shipping lines, also terminal operating companies, inland transport service providers as well as freight forwarders can create vertical externalities (see De Langen, 2007, Tongzon and Sawant, 2007 and Tongzon, 2009 for studies on port selection criteria that show such vertical externalities, e.g. for shipping lines, hinterland connections is a relevant port selection criterion). Hence, port authorities and, to a lesser extent, terminal operators can in broad terms be seen as multiproduct companies that sell complementary products to vertically related supply chain members that make use of the port. For these users the seaport is an input factor.

The third criterion for two-sidedness is the distribution of costs over the two markets linked to the platform influences the total number of interactions, even if the overall price remains unchanged. For seaports, regardless of the pricing structure, all charges influence the overall generalized transport costs that are passed on to importers or exporters. The relation between seaport users is vertical and cross group externalities are non-existent. Above, we have reviewed the situation in which the platform is provided by the port authority and terminal operator (similar to the airport case. In the situation in which the port authority is considered to be the only organization providing the platform

and the terminals operators and shipping lines represent both markets (figure 7.5), the outcome of the analysis remains the same.

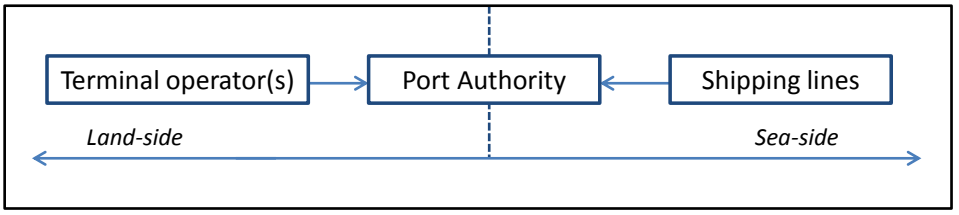

Figure 7.5: The port authority as a platform provider or multiproduct company with vertical markets

First of all, the actual interaction between both sides of the market is not provided by the port authority which should be the case for a two-sided market. Besides, the services provided by the terminal operator are the core of the port's value proposition. Therefore, the (basic) infrastructure provided by the port authority cannot be seen in isolation. Furthermore, attracting multiple terminal operating companies to a single port might increase competition within a port resulting in improved performance and/or lower prices. However, it also increases transaction costs for shipping lines as they need to review multiple options. Second, like in the previous case, a vertical relationship between terminal operators and shipping lines occurs. Vertical externalities come in to play since shipping lines benefit when other shipping lines use one or more terminals in the port. This results in higher utilization of the terminal(s) which increases terminal efficiency and reduces costs. And finally, to be a two-sided market, users of the platform should be unable to bypass the pricing structure and, the distribution of the prices charged should affect the attractiveness of the platform. Although this applies in the case as depicted in figure 7.5, the argument remains that in the end the prices influence the overall generalized transport costs that are passed on to importers or exporters. The price setter – the port authority – is therefore not a platform operator but a multiproduct company that sells its products and services to a number of vertically related seaport users. Changing costs allocations over different products might be beneficial, however the rationale behind this fact are not cross-group externalities. Hence, also the third assumption underlying the theory is not satisfied. Based on the previous arguments, we conclude that seaports can be best defined as multiproduct companies providing vertical related services. This view fits with a recently introduced concept by Talley et al. (2014). The concept, called port service chain, includes a chain or network of port service providers in order to realize the transport of the cargo through the port. In contrast with this study, Talley et al. (2014) focused on the evaluation of the port performance realized by this chain of service providers.

7.4 Conclusions: suggested pricing principles for port authorities

The growing importance of hinterland connectivity resulted in a changing focus of port authorities towards the hinterland. The rather traditional way of approaching port pricing, although in practice resulting in very different structures, has triggered us to assess the application of the two-sided markets theory. The theory entails that firms which develop a platform often create a critical mass of users on one side. The resulting network effects increase the value of the market for users on the other side. An important feature of two-sided markets is related to pricing which takes cross-group externalities into consideration. This means that the price setter should offer the lowest prices to the market with the largest positive externalities on members of the opposite side of the platform. Three criteria need to be met for qualifying as a two-sided market: the main benefits of the two distinct markets arise from interacting via a common platform, the positive externalities are not internalized by users and the attractiveness of the platform also depends on distribution of prices charged to both sides. Since the assessment of the applicability of the two-sided market theory is new, we have performed a literature review on the application of the theory in a comparable industry, i.e. airports. Based on the literature review, we conclude that airports can't be classified as a two-sided market. We have come to the same conclusion after an analysis of the market structure of seaports. This conclusion is driven by three observations. First, companies do not need the seaport to interact with each other. Second, port users do not create cross-group externalities but vertical externalities. And finally, overall generalized transport costs are passed on to the final customers which indicates a vertical relationship. Therefore, seaports can be best defined as multiproduct companies providing vertical related services. Although seaports cannot be regarded as a two-sided market, the preceding analysis provided a better understanding of the rationale of pricing structures and a basis for six pricing principles for port authorities to attract operators from the land-side and the sea-side. For each of the pricing principles, we provide examples of port authorities that apply them. Each specific port has its own unique characteristics. Applying the principles that best fit the characteristics contribute to the competitive position of the port. Therefore, these broad guidelines do not suggest that pricing structures of port authorities should or will converge to one standard. Instead, given the differences between ports, diversity of pricing structures is the expected outcome of the application of these principles.

Broadly follow a direct user pays approach

Based on our conclusion that ports are not two-sided markets, it is sensible to broadly follow the approach that the direct users pay for the services they receive.

This pricing principle implies that charges to shippers may not be effective for two reasons. First, port authorities do not really provide a service for shippers, whereas they do provide such a service for shipping lines (maritime access and vessel traffic management), terminal operators (port land) and inland transport operators (transport infrastructure). Thus, it is hard to find a legitimate commercial reason for charging shippers. Indeed, in countries where cargo wharfage is charged, it is regarded (and in some cases, like Italy also legally arranged) as a tax charged by a public agency, rather than as a price for a service. In most countries with cargo wharfage charges to shippers, pricing reform has reduced the level and share of such charges. Relevant cases include Melbourne (see Tongzon, 1993) and South Africa (see Transnet National Ports Authority, 2012; Gumede and Chasomeris, 2013). Second, charges to shippers have as disadvantage that shippers are not involved in transport operations. Therefore, incentive schemes for shippers to improve port operations are unlikely to be successful. In addition, shippers generally do not create vertical externalities. In the case a single shipper decides to choose for another port this would not influence the port choices of other shippers because of the relatively limited volumes that individual shippers transport[68]. Thus, incentive schemes aimed at maximizing vertical externalities are also unlikely to be effective.

This pricing principle also suggests that in case port authorities make investments in hinterland infrastructure, inland transport operators are to be charged directly. Generally, this will lead to relatively modest prices for inland operators, but such direct charges has the advantage that it provides port authorities with the ability to use price schemes to influence choices of inland transport operations, for instance by differentiating based on environmental performance or through congestion pricing. Although not put in practice, the Port Authority of Rotterdam could have, as shareholder in Keyrail (the infrastructure manager of the Betuweroute, the dedicated freight railway line between Rotterdam and the German border), influenced the infrastructure fee.

Capture value from 'non-core' tenants

We conclude that the port authority is a multi-product company, so it may be beneficial to deviate from cost based pricing to account for vertical externalities. Theories of multi-product firms have led to three main insights. First, differentiated pricing is unlikely to be effective in case a single customer buys different products. Due to market integration this is relevant in ports (take the AP Moller group consisting of terminals, shipping lines and logistics services, see also Soppé et al., 2009). However, ports mainly serve multiple customers which buy multiple products. Second, differentiated pricing is only beneficial for products or services that are non-perfect complements. In other words, it is only

68 In contrast, when a shipper has a large scale and a considerable influence on a single port than the situation would change. The results of this type of situation are comparable to the effects hinterland logistics companies cause. This situation is discussed in the next section.

beneficial for port authorities to use different price allocations when its products or services are considered to be non-perfect complements. The 'core users' of the seaport -terminal operators and shipping lines- are perfect complements: both are required for freight transport. Potential imperfect complements include warehousing, port related industries, and other port related service providers (such as maintenance, ship repair and office buildings in the port). Thus, it makes sense to charge relatively high prices to non-core tenants, as these do not create externalities but do benefit from externalities created by others (shipping lines that create maritime connectivity and hinterland operators that create hinterland connectivity). Although the prices can't be set too high as non-core tenants not necessarily have to be situated within the premises of the port. This differentiation is, to a limited extent, applied in the port of Barcelona. Concessionaires need to pay a so-called tax based on the land usage. Companies which provide port activities (e.g. terminals) or related to port activities (e.g. nautical activities) pay 6% of the value of the land and water surface and, if relevant, 4% of the value of the infrastructure. Companies which provide complementary activities to port activities like logistic activities and warehousing pay 7% of the value of the land and infrastructure and companies which use land for port-city related activities pay 8%. All companies pay 100% of the defined yearly depreciation of the infrastructure. Third, differentiated pricing may be relevant if competitive forces in specific product markets differ. In this respect it is relevant to note that shipping lines generally operate in very competitive markets, whereas the competition between terminal operators is imperfect –unless there is intra-port competition (De Langen and Pallis, 2006). Thus, in cases where intra-port competition is lacking, port authorities may benefit from charging higher prices to terminal operators and lower prices to shipping lines.

Use incentives to align interests with terminal operators and shipping lines

As a third principle, building in incentives in pricing can 'send the right signals'. Thus port authorities may develop incentives in pricing. The use of incentives to align interests of contracting parties is widespread in most industries. For ports, Tongzon (1993) already mentioned this effect of the revised pricing structure of the Melbourne Port Authority, which at the time shifted from per ship fees to per day fees for using terminals. Tongzon also shows the positive effects of this shift on port efficiency. Other options to realize ship efficiency through port pricing are priority pricing and slot action (Strandenes 2004). Table 7.3 presents some potential incentive schemes in port authority pricing structures for shipping lines and terminal operators.

Table 7.3: potential incentive schemes in port authority pricing structures.

Port user	*Tariff*	*Potential incentive schemes*	*Rationale*
Shipping lines	Port dues	Yearly volume discount[1]	Rewards large and performing shipping lines.
		Large call size	Contributes to efficient utilization of port assets.
		Call frequency	Rewards high connectivity
		On time performance	Reward reliability of service and contributes to efficient utilization of the terminal
Terminal operating company	Land rents	Fast turnaround time	Contributes to efficient utilization of port assets.

Differentiate pricing to promote maritime and intermodal connectivity
The fourth principle suggests to promote maritime and intermodal connectivity through differentiated pricing. This argument is based on the vertical externalities that both types of connectivity provide. For maritime connectivity, one option is to reduce port dues for feeder vessels or for mother vessels with a relatively high transshipment share. The logic of such a pricing policy is that transshipment volumes are the most volatile freight volumes and –as volumes translate into connectivity- attracting such volumes will improve maritime connectivity. Likewise, for small and medium sized ports, differentiated tariffs for deep sea services (cheaper than short sea services, or discounts for services with new destinations) may be an option.

Various port authorities have taken different measures to stimulate maritime connectivity. The port authority of Rotterdam gives a discount of € 2.48 per container which is transshipped in the port between a deep sea service and short sea or feeder service, or vice versa (Port of Rotterdam, 2014). The port authorities of Antwerp, Bremerhaven and Gdansk stimulate maritime connectivity by giving discounts on port dues for new deep sea services, additional volumes and/or more frequent port calls (Port of Antwerp, 2013; Bremenports, 2013; Port of Gdansk, 2011). More specifically, the Port of Antwerp gives a discount of maximum 20% on tonnage dues for new container trade with a minimum of 100.000 TEU per year and a frequency reduction up to 30% reduction per call on tonnage dues for deep sea lines (> 200 calls), up to 40% for feeder line (>104 calls) and up to 50% for short sea lines (>52 calls). Bremerports give discounts up to 50% on tonnage charge for additional traffic either through the deployment of larger vessels, the introduction of new services or an increase in the number of port calls. During the first year the Port of Gdanks gives a discount of 50% on tonnage due and warfage fee to container vessels larger than 60,000 GT calling at Gdanks.

With regard to intermodal connectivity, pricing to promote intermodal connectivity as opposed to road transport, options include a specific charge for truckers that enter the port, without a similar charge for rail and barge operators or (temporary) incentives for shipping lines that develop new intermodal services. In 2009, the port authority of Los Angeles introduced a discount program for additional intermodal containers, which provided ocean carriers the opportunity to reimburse twenty dollars for every TEU which originated from or destined to a location outside California, transported by rail and above the intermodal volume compared to the previous year (Port of Los Angeles, 2009). As a negative incentive, the port authority of Rotterdam introduced a penalty for tenants if they don't meet the modal split demanded by the port authority (see chapter 3).

Maximize revenue from long term lease agreements, price port dues competitively

As a fifth principle, we argue that there is an important difference between land lease agreements that are signed with a 30 year horizon, and port dues that are revised annually. Given the fact that land lease agreements are fixed in the long term, tenants regard these costs as sunk costs, i.e. costs that have already been incurred and cannot be recovered. In making investments and pricing decisions, companies do not (or not fully) take these sunk costs into account[69]. Thus a lease agreement does not affect the pricing decisions of the terminal operator. Consequently, a price below the market value for a lease agreement, will not lead to more competitive pricing by the terminal, but it does affect the profitability of the port authority – and thus the investment resources of the port authority. Therefore, maximizing revenues (while simultaneously securing environmental performance) is the only valid approach for granting a concession. Of course, revenues cannot be maximized indefinitely, when setting price levels port authorities need to take into account, amongst others, that terminal operators can also operate in other ports as well. Port dues are revised yearly, thus allowing for adapting these to market conditions and the competitive position of the port. Port authorities, especially publicly owned (corporatized) ones, may have valid reasons to set port dues below profit maximizing values, as lower port dues are passed on to port users and thus create real economic benefits. Table 7.4 provides an overview of the development of the average income on port dues and land rents for the Port Authority of Rotterdam which clearly shows a tendency towards maximizing revenues from concession contracts and using port dues for competitive pricing.

69 Experiments show that in some cases investors do take sunk costs into account, but we assume rational decision making applies to the decisions of terminal operators that influence the competitiveness of a port. For instance, if a terminal operator decides on investing in new terminal equipment, it would not make sense to include the level of land rents in the decision making.

Table 7.4: Average income port dues and land rents (sources: annual reports Port Authority of Rotterdam)

Year	Land rent per hectare	Port due per ton
2003	€ 30,183	€ 0.61
2004	€ 33,956	€ 0.62
2005	€ 36,057	€ 0.62
2006	€ 36,645	€ 0.65
2007	€ 38,416	€ 0.65
2008	unkown	€ 0.66
2009	unknow	€ 0.68
2010	€ 47,411	€ 0.64
2011	€ 45,300	€ 0.67
2012	€ 49,308	€ 0.67

Consider differentiation of charges based on environmental performance

The final principle suggests that port authorities may consider differentiation of charges based on environmental performance. Such price differentiation is feasible for port dues but may be more complicated for lease contracts. With respect to port dues, various port authorities give discounts based on the Environmental Ship Index program as part of the Worlds Port Climate Initiative[70]. Bergqvist and Egels-Zandén (2012) propose charging port dues to hinterland transport companies, with incentives for the use of green transport modes. Empirical examples of incentives for greening inland transport exist in Rotterdam and Los Angeles. The port authority of Rotterdam introduced in 2012 a discount on inland port dues to vessels with an environmental friendlier engines than the engines which will be obligatory by 2025 according to the port regulations (Port of Rotterdam, 2014). The port authority of Los Angeles introduced a so-called Clean Truck Fee. Shippers need to pay a fee when they transport a container by truck in or out of the port of Los Angeles, only when the truck does not meet the demanded specifications in relation to the environmental impact. To our knowledge price differentiation in lease contracts based on environmental performance does not exist. However, we could imagine that incentives or discounts could be given to tenants when they improve their environmental performance[71].

70 Information about the Environment Ship Index and participating ports can be found at http:// esi.wpci.nl

71 Van Duin and Geerlings (2011) developed a model to calculate the CO2 emissions of a container terminal. Incentives or discounts could be proposed when tenants are able to reduce their environmental impact compared to the base year. The model of Van Duin and Geerlings (2011) also aims at providing directions for improvement like using electric driven vehicles.

Chapter 8

Conclusions

This dissertation started with an introduction into the container shipping industry and the role of ports in supply chains. In the container transport chain the inland transport has received increasing attention throughout the last decade because substantial improvements can still be made (Notteboom, 2004; Roso et al., 2009; Van der Horst and De Langen, 2008). Shipping lines (Heaver 2002; Frémont, 2009), terminal operating companies (Heaver et al., 2000; Rodrigue and Notteboom, 2009; Veenstra et al., 2012) and port authorities (Van Klink and Van den Berg, 1998; Monios, 2011) have all identified this area as a possibility for improving their competitive position and increasingly give attention to this potential source of differentiation. This dissertation covered the perspectives of the key players in the port and final customers of intermodal transport and their subsequent strategies and business models.

The conceptual framework (figure 8.1) provides an overview of the existing relationships (blue lines) and the strategies and/or business models on intermodal transport and influential relationships which are studied (orange dotted lines). Chapter 2 and 3 dealt with the hinterland strategy of port authorities, the influence of the port authority on terminal operating companies and their subsequent strategies and business models. Chapter 4 dealt with the business model of shipping lines, primarily focusing on one element of the business model: the value proposition. Chapter 5 zoomed in on another business model element: the target customers. The potential of the intermodal value proposition of shipping lines is assessed by acquiring input from customers. Chapter 6 assessed the attitudes of shippers and forwarders towards sustainability and their subsequent behaviour, as this can influence the interest in intermodal transport as the better environmental performance of intermodal transport is an often mentioned characteristic. Chapter 7 discussed pricing strategies (or revenue model from a business model point of view) of port authorities and how these can be used to influence the players discussed in this dissertation.

This final chapter provides an overview of the main results from the research. The following section gives per chapter a short summary, including the research question, and the main conclusions provide the answer to the research question. After the conclusions per chapter the main research question will be answered. This chapter ends with suggestions for future research.

Hinterland strategies of port authorities

Ports can realize growth of container throughput by extending the port hinterland into new regions. Intermodal transport is key in connecting the port with more distant, contestable, hinterlands. To facilitate this, Van Klink and Van den Berg (1998) propose that port authorities should shift their focus from the sea-side to the land-side. Various academics have questioned if there is a role to play by port authorities in the logistics chain, including the hinterland (Heaver

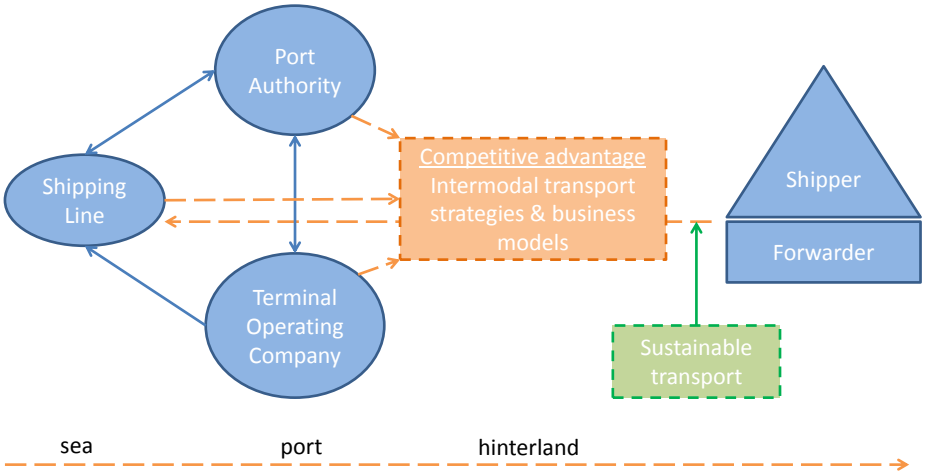

Figure 8.1: conceptual framework

et al., 2000; Slack and Frémont, 2005; Verhoeven, 2010). Still, Notteboom and Rodrigue (2005) propose a port networking strategy focused on inland terminals to tackle the problem of diseconomies of scale and create the necessary margin for further growth. Limited empirical research on such hinterland strategies of port authorities exists. Chapter 2 answers the call by Rodrigue and Notteboom (2009) for further research into this topic. The research question that takes centre stage in chapter 2 is:

What is included in a successful hinterland strategy of a port authority?

The research question is answered through a case study on the hinterland strategy implemented by the Port Authority of Barcelona. The hinterland strategy includes marketing (i.e. market research and promotion of the port and inland services through presentations and customer support) and development of intermodal transport services. Most efforts were spent on the development of the service, through investments in hinterland infrastructure (i.e. inland terminals) and the service itself (i.e. a rail connection). To fully understand the needs of the market, like a reliable service, the port authority became operationally involved. This provided the port authority with further understanding of what was necessary from an infrastructural and operational perspective to fulfil the needs of the market. The implemented strategy by the Port Authority of Barcelona proved to be successful because the extension of the intermodal rail network contributed to a significant modal shift from road to rail. Other benefits resulting from the strategy are direct returns, increased competitiveness and port dues (indirectly), and improved knowledge on rail bottlenecks that enable better port planning and strengthen the lobby for infrastructure improvements.

The case shows the changing focus of the port authority. The strategy followed by the Port of Barcelona has a strong overlap with the development of a port as described by Notteboom and Rodrigue (2005). The operational involvement even goes a step further than proposed by Van Klink and Van den Berg (1998) and Notteboom and Rodrigue (2005). Although operational involvement is not included in the business model of a landlord port authority, it does fit in with the aim of a port authority to develop a vital port. The port authority may be one of the few actors that is truly committed to a specific port and the intermodal connectivity of this port. The longer planning horizon and lower required return on investments of port authorities, compared to private companies, give the port authority the position to invest in an inland terminal or rail connection when private companies are reluctant to do so. This is especially relevant in situations where new infrastructure opens new markets for intermodal transport since it will not immediately result in a strong increase of market share in these areas (De Langen, 2007).

Another contribution of this case is that it proposes to see a port as a two-sided market as landlord port authorities provide a platform where cargo can be transferred between different modes. Ports are connected to maritime and hinterland networks. Both can create added value for port users due to network effects. In general, platforms have a two-sided network effect: the value of the platform to a user depends on the number of users on the other side of the network. An im portant element in these cases is pricing (Eisenmann et al., 2006). This perspective is also relevant for ports and is the main topic of chapter 7, namely, to analyse how a pricing strategy of a port authority may enhance the competitiveness of the platform. Chapter 3 analyses a new measure taken by the port authority of Rotterdam to influence the share of intermodal transport. Not so much by being active outside of the port area but within the port area through contractual agreements with terminal operators.

The effects of modal split obligations in terminal concession contracts
Intermodal transport is increasingly important for port competitiveness as it helps to reduce road congestion, makes more distant hinterlands reachable at competitive prices, reduces the difference between growing call sizes at ports and fragmented inland transport systems, and decreases the impact of the transportation sector on the environment as intermodal transport achieves better environmental performance. Due to the societal benefits which can be derived from intermodal transport (i.e. reduced congestion and lower environmental impact) public policies in Europe have been implemented to shift transport from road to rail and/or inland waterways. Although research on intermodal transport has increased substantially (see for example SteadieSeifi et al., 2014), little research on the effects of policies has been carried out (Bontekoning et al., 2004) and the effects of public policies (i.e. subsidies) are questioned (Macharis and Pekin, 2009). In addition, the modal splits in the

largest container ports in Europe, more specifically Antwerp and Rotterdam, show that a rather limited modal shift has taken place during the last decade. In combination with the high modal shift ambitions of both port authorities, insight into new measures to significantly change the modal split is of added value. Based on these observations, chapter 3 aims to enhance the understanding of more commercially driven initiatives by port authorities to realise a modal shift in ports. The Port Authority of Rotterdam introduced a new measure which is used as a case study to answer the next research question:

How will terminal operating companies cope with a concession clause aimed at a modal shift towards inland waterways and rail?

The measure introduced by the port authority of Rotterdam is a modal split obligation in the concession contracts of the terminal operating companies. Three different terminal operating companies (TOC) have agreed with this obligation and are used as cases to explore what the effect of these obligations are. The research is explorative as the clauses only become effective as of 2015.

The findings suggest that the impact of the modal split obligations have the largest impact when port authorities incorporate these clauses in new concession contracts, since the terminal design can still be altered at that stage. When a modal split clause is incorporated in a contract during a renegotiation, the terminal design is generally fixed and difficult to change. Although it is hardly impossible for TOCs to force carriers or merchants, who decide on the mode of transport, to use intermodal transport to or from their terminals, they can co-develop an attractive inland network. In all cases, the TOCs recognise that by becoming more active in the hinterland, either by organizing the transport themselves or through partnerships with inland terminals, they can increase competitiveness and throughput and realise additional revenue streams. The concession clauses have contributed to the development of the intermodal hinterland network or connectivity by TOCs. In some cases this can even result in operating a second business model by a TOC, namely a traditional terminal value proposition next to an inland network value proposition. A new strategy initiated by one of the existing TOCs, mainly driven by operational improvements and the competitive environment in and outside the port, is the most prominent evidence for the usage of the second business model.

Concession contracts are one of the key instruments in aligning the goals of terminal operators with overall port development goals. In addition to the impact of the concession clauses, three theoretical contributions can be derived from this chapter. First, the cases broadly validated the usefulness of the theoretical framework to assess the impact of modal split concession clauses on the existing business model (terminal value proposition) and a potential new

business model (inland network value proposition). After further validation of the framework, since both the modal split clauses as well as the inland network value proposition are relatively new to the port industry, the framework might also be useful to assess the impact of other types of clauses or policies. Second, a modal shift is considered as an improvement of the competitive position of a port. This is of added value to frameworks that assess port competitiveness (see for example the framework of Yeo et al., 2008). As a result, modal shift is also a relevant goal for port authorities and policy makers. Third, modal split clauses in concession contracts may be a more cost-effective method of changing the current modal split than subsidies. This contributes to the emerging literature on terminal concessions as well as the literature on modal shift policies (Blauwens et al., 2006).

The intermodal value proposition of shipping lines

The container shipping industry has developed rapidly, with growing volumes, larger ships, industry concentration and more involvement in terminal operations. Nevertheless, the two main value propositions offered by shipping lines have not changed. A port-to-port value proposition, consisting of a network of overseas destinations, and a door-to-door value proposition, which includes the full design of the transport chain based on customer demands. The door-to-door value proposition has been developed by shipping lines to differentiate from competitors (Notteboom, 2004; Franc and Van der Horst, 2010). Although in theory shipping lines might be able to offer a competitive door-to-door value proposition through utilizing internal synergies as port-to-port service is provided within the same organization (Frémont, 2009), mastering the capabilities to manage both land-side and maritime operations has proven to be rather difficult (Haralambides and Acciaro, 2010). Furthermore, a shipping line's' business model with a door-to-door value proposition is not aligned with the business model of its largest customer group: forwarders (Haralambides and Acciaro, 2010). However, the control over the inland logistics is also relevant for shipping lines as a significant amount of costs are involved in the repositioning of empty containers (Veenstra, 2005). Furthermore, the inland leg can still be improved substantially (Van der Horst and De Langen, 2008) as the efficiency of the maritime leg has already improved to a large extent due to the emergence of global carriers with comprehensive maritime networks and increases in vessel size (Notteboom and Winkelmans, 2001; Panayidis and Wiedmer, 2011). Finally, liner conferences, which have existed for more than a century but were abolished almost 10 years ago, reduced competition and resulted in sufficient prices on the different maritime routes. This limited the necessity to compete inland. As such, inland transport is relevant to shipping lines and still is a possible source of differentiation. Therefore, an evolution towards an additional value proposition that also covers the transport between the port and an inland terminal is suggested. As a result, two related research questions have to be answered:

What is the added value of an intermodal value proposition to shipping lines?

What is the interest of shippers and forwarders in an intermodal value proposition of shipping lines?

To answer the first research question, an assessment of the added value of the intermodal value proposition, which consist of the maritime leg and the leg to/from an inland terminal, excluding the 'last mile' to the distribution centre of the receiver, has been carried out in chapter 4. This is done through an extensive literature review, a comparison of the three different value propositions (i.e. port-to-port, door-to-door and the port-to-ILT) and empirical observations. The second research question is answered in chapter 5 through a survey among shippers and forwarders in the Netherlands.

In chapter 4 we have argued that the suggested value proposition can have advantages over the port-to-port value proposition as well as the door-to-door value proposition. Three advantages have been identified over the port-to-port value proposition. First, it enables better repositioning of empty containers and leverages the economies of scale of intermodal transport. Intermodal services can be synchronised with deep sea services by aligning the fixed windows of shipping services with fixed windows for intermodal services. This contributes to the reliability and transit time of such services. Second, it contributes to terminal efficiency, through better information on inland destinations of containers. Thirdly, it provides a relationship with the inland terminals which becomes increasingly important to the shipper as an 'extended storage area'. This changing role (as discussed by Roso et al., 2009 and Rodrigue et al., 2010) increases the value of a proposition to/from inland terminals. Compared to the door-to-door value proposition, two advantages have been identified. First, shipping lines maintain an orientation on 'scheduled transport' with a limited number of origins and destinations. This leads to a more coherent 'capability set' than also having to manage the last mile of trucking which is required in a door-to-door service. Second, the intermodal value proposition is better aligned with the position of forwarders in supply chains as it does not provide a substitute to the services offered by forwarders. In addition to these identified advantages, the empirical observations show that not only shipping lines but also terminal operators develop such a value proposition and that demand for this value proposition already exists among shippers. Furthermore, the modal split targets by port authorities, as discussed in chapter 3, and the increasing attention put on sustainable transport may provide an environment in which the demand for an intermodal value proposition will grow.

In chapter 5, the results from the survey indicate that, in contrast with previous conclusions of Frémont (2009) and Franc and Van der Horst (2010), providing

a door-to-door value proposition is not (any longer) a source of differentiation for shipping lines. The findings also indicate that price is most important to shippers and forwarders, regardless of the type of booking (door-to-door or port-to-port). When they evaluate shipping lines, differences are only perceived for items which they consider relevant. This means that shipping lines need to carefully communicate relevant service characteristics to relevant market segments. As a result, shipping lines can create value for a number of their customers by offering an intermodal value proposition. However, the survey results also show that the intermodal bookings are likely to go at the expense of door-to-door bookings. But first, shipping lines need to promote and actively sell the new value proposition to forwarders and shippers as this is currently not the case. Perhaps shipping lines can also interest customers that mainly book on a port-to-port basis by offering the return of empties to inland terminals, on the condition that the intermodal product is used. A 'recent' article in Lloyd's List provides additional evidence that the intermodal value proposition is of added value to shipping lines.

Lloyd's List, 15 April 2014
(…) Another trend noted by Mr Jan Overdevest (Managing director of Rotterdam's Waalhaven Group) is the increasing use of carrier controlled haulage to inland container yards as opposed to merchant haulage from the terminal to final destination. He explains that the shipping lines are transporting containers to inland terminals in the region of the final destination and the inland terminal organises the last mile delivery from there. He explains this is hassle-free for the carriers as it is easier for them to organise delivery to a single inland terminal rather than delivering directly to a variety of warehouse locations. He estimated that the use of carrier haulage had increased from a historical level of about 20% to 45% last year as a result of the continued development of this hybrid system. (…)

The results from the survey also have several theoretical contributions.

1. Despite differences between shippers and forwarders on what they find important in the offering of shipping lines, both are mainly cost driven. This confirms the conclusions from previous research by De Langen (2007) and Tongzon (2009).
2. Shippers focus more on reliability compared to forwarders as that has repercussions for their supply chain. These results also underline the findings of Notteboom (2006) that shipping lines can differentiate themselves based on reliability, with the addition that reliability is more important to shippers.
3. Shippers and forwarders have a different share in the type of bookings. Forwarders mainly book on a port-to-port basis (78% of the bookings) and have a relatively small share of door-to-door bookings (17%). In contrast, shippers have a larger share of door-to-door bookings (39%).

These findings can be explained for the most part by the different business models of shippers and forwarders and their position in the supply chain.

Environmental sustainability in freight transport

More than one-fourth of the global CO2 emissions are produced by the transport sector. Although in most other industries the total CO2 emissions decreased during the last two decades, this is not the case in the transportation sector. Sustainability within freight transport is therefore often related to emissions. Looking at intercontinental transport, emissions produced by shipping are dominant (generally > 70% of the total door-to-door emissions). Research on sustainable transport in liner shipping have therefore focused on the impact of shipping route design (Song and Xu, 2012) or the effect of slow steaming (Cariou, 2011) on reducing CO2 emissions. Moreover, the use of intermodal transport can reduce CO2 emissions (Lättilä, Henttu and Holmola, 2013). This advantage of intermodal transport over road transport is relevant but only of added value if there is a demand for more sustainable transport. Based on this observation the following research question is developed:

What are the attitudes of shippers and forwarders towards environmental sustainability in freight transport?

Chapter 6, and to a limited extent chapter 5, provide answers to this research question. The findings originate from a survey among shippers and forwarders in the Netherlands. Several conclusions can be drawn from the survey. First of all, shippers and forwarders still have a rather limited interest in sustainability. Other attributes are found to be more important (like costs, reliability and transit time) when evaluating the services of a shipping line. Compared to shippers, forwarders find sustainable operations least important. In addition, shippers more often demand sustainable solutions. Second, the size of a shipper influences the demand for transparency of the environmental performance (i.e. large shippers more often demand insight related to the environmental performance compared to small shippers). Third, companies which have a focus on sustainability on a strategic level also translate this into tactical and operational measures (i.e. sustainability targets, demand for sustainable solutions and environmental performance metrics). This corresponds with the findings of Björklund and Forslund (2013). And finally, the overall expectation is that the importance of sustainability will increase, which is in line with the findings by Kudla and Klaas-Wissing (2012). These expectations also play an important role in the demand for sustainable transport and insight on the environmental performance.

Although the results suggest an ongoing transition towards more sustainable purchasing of international container transport, there is still a large group of

companies which has not incorporated sustainability in their operations. From the literature review it can be concluded that improvements of the environmental performance are mainly driven by cost reductions. This approach is unlikely to achieve competitive advantage through a truly sustainable performance. Several trends that will impact the container shipping industry have been identified by BSR (2010) and it is expected that this will further stimulate shipping lines to reduce their environmental impact. It is suggested that this may ultimately lead to changes in business models. Shippers and forwarders indicate that sustainability will become more important, but still do not act upon this and regard sustainability as relatively unimportant. Perhaps the finding of Finkelstien and Hambrick (1990) that long-tenure management teams tend to pursue imitative strategies, whereas short-tenure teams tend to pursue novel strategies that deviate widely from industry patterns, may be relevant in this respect. This requires a transition of the existing mental frames (i.e. improved environmental performance is only of added value when costs remain on the same or lower level) towards a new mental frame (i.e. value is created through sustainable transport operations) to create a competitive advantage over the ones staying in their old mental frames.

New insights for port pricing

Chapter 2 introduced the idea of looking at ports as a platform in two-sided markets. In the existing literature only a limited number of papers treat ports as platforms. However, there is quite some literature on pricing, which is a key feature in two-sided markets (Eisenmann et al., 2006), or ports (Acciaro, 2013). Two pricing strategies are most prominent for pricing of port infrastructure: cost recovery and user pays principle (Button, 1979; Haralambides et al., 2001; Haralambides, 2002). Research on more commercial pricing strategies is rather limited (Acciaro, 2013). The two-sided market theory is relevant in this respect as it can provide new insights on port pricing, especially as it also includes the land-side, which is becoming increasingly relevant for port competitiveness as discussed in chapter 2 and 3. This brings us to the last research question:

What pricing principles can port authorities apply to attract both transport service providers on the sea-side as well as the land-side?

Chapter 7 first shows, based on several empirical cases, that large differences exist between the pricing strategies of port authorities (i.e. the inconsistency of the types of customers being charged). Second, the two-sided market theory is introduced and an analysis is carried out whether ports meet the criteria for two-sided markets. An analysis which has already been performed for the airport industry (Fröhlich, 2010; Gillen, 2011; Appold and Kasarda, 2011). The result of the analysis suggests that ports, just like airports, are not two-sided markets as the three criteria for two-sided markets are not met. This is mainly due to

two important differences: (1) the relation between seaport users is vertical and cross group externalities are non-existent, (2) the price setter – the port authority – is a not a platform operator but a multiproduct company that sells its products and services to a number of vertically related seaport users. Based on this result six pricing principles for port authorities have been derived. Because each specific port has its own unique characteristics, these pricing principles do not suggest that pricing strategies converge to one standard. The existing differences between ports will lead to a diversity of pricing strategies through the application of these principles. The six pricing principles to stimulate operations on the land-side as well as the sea-side, which have been supported by empirical examples, are:

1. Broadly follow a direct user pays approach. This principle is most functional, because cross-subsidizing one side of the platform with revenues from the other side of the platform is not effective, as ports are not two-sided markets. Pricing shippers would therefore not be effective for two reasons. First, port authorities do not really provide a service for shippers, which makes it hard to find a legitimate commercial reason for charging shippers. Second, charges to shippers have as disadvantage that shippers are not involved in transport operations. As a result, incentive schemes aimed at maximizing vertical externalities will not be effective. Furthermore, this pricing principle also suggests that in the case that port authorities make investments in hinterland infrastructure, inland transport operators are to be charged directly.
2. Capture value from 'non-core' tenants. The port authority is a multi-product company, so it may be beneficial to deviate from cost-based pricing to account for vertical externalities. Differentiated pricing is only beneficial for products or services that are non-perfect complements.
3. Use incentives to align interests of terminal operators and shipping lines.
4. Differentiate pricing to promote maritime and intermodal connectivity; this argument is based on the vertical externalities that both types of connectivity provide.
5. Maximize revenue from long term lease agreements and price port dues competitively.
6. Consider differentiation of charges based on environmental performance.

8.1 Competitive advantage through strategies and business models

The previous chapters dealt with strategies and business models in intermodal transport and hinterland networks. Suggestions by multiple academics have been made for port authorities (Notteboom and Winkelmans, 2001), terminal operators (Song and Panayides, 2008) and shipping lines (Notteboom, 2004) to develop such strategies and business models. However, empirical research on this topic from the perspective of all mentioned players was lacking. Therefore, the following main research question was developed:

Which kind of strategies and business models are, or can be, applied by port authorities, terminal operators and shipping lines to realise competitive advantage through intermodal transport?

All previously discussed research questions addressed a strategy and/or business model related to intermodal transport of a port authority, shipping lines or terminal operator. This paragraph gives an answer to the main research question, based on the main findings from the preceding analysis. As introduced in the first chapter, competitive advantage can be realized through rare and valuable organizational resources. This can also be described as a first-mover advantage grown through resource advantages. The competitive advantage becomes sustained when the resource cannot be duplicated by others, by being imperfectly imitable and not substitutable (Barney, 1991).

A first generic strategy (i.e. relevant for port authorities, shipping lines and terminal operators) which can provide competitive advantage is the provision of sustainable transport. Although this is not (yet) used as a key decision criteria, most shippers and forwarders do expect that the importance of sustainability will increase. Port authorities, shipping lines and terminal operators can create a competitive advantage by being a first mover by truly incorporating sustainability within their business model. This approach takes time and probably works best if it is driven by an intrinsic motivation. Providing (or facilitating/stimulating) intermodal transport as a strategy (or part of a strategy) could be a suitable substitute for the previous approach and can still result in an improved carbon footprint. Both approaches will contribute to an improved environmental performance, but will not result in a sustainable advantage once others have followed.

Port authorities can create competitive advantage in three different ways. First, a port authority can follow a strategy in which it becomes more involved in intermodal hinterland transport. This creates a competitive advantage as the involvement and subsequent knowledge increase is a rather rare resource of a landlord port authority. Since acquiring this resource takes time and effort, it will be hard to duplicate and therefore this strategy can result in a sustainable competitive advantage. Apart from this new resource, port authorities can also utilize characteristics of their existing business model (i.e. long-term planning and lower required returns on investment) which can be extremely helpful in the realization of an intermodal hinterland network. Second, port authorities can utilize pricing to stimulate intermodal transport. As current pricing strategies are diverse and the potential of pricing strategies are underutilized; introducing (novel) pricing strategies aimed at stimulating intermodal transport can become a competitive advantage as other port authorities are using ´old´ pricing principles which are primarily aimed at the sea-side. Duplicating these

pricing principles might not be difficult as port pricing is publicly available. However, actually adopting the pricing principles might be more difficult as port authorities can be confined to regulations or contracts which cannot be ignored or adjusted easily. Furthermore, not every pricing principle might work in every port. A port authority needs to apply pricing principles that best fit the circumstances. Therefore, a competitive advantage based on pricing might be more durable than at first sight. Third, port authorities can utilize concession contracts to stimulate a shift towards inland waterways and/or rail transport. As a modal shift is difficult to realize, for example due to the involvement of a large number of players with their own agenda (Van der Horst and De Langen, 2008), incorporating modal split clauses in concession contracts can be an important asset. As there are only limited occasions to sign concession contracts for new terminals or opportunities to incorporate clauses in existing contracts, this resource cannot easily be duplicated.

Terminal operating companies develop a strategy aimed at improving the connection between the deep sea terminal and inland terminals to increase the share of intermodal transport. They can even incorporate this in an additional business model, either stimulated by clauses in concession contracts or because of internal considerations to reduce bottlenecks and/or to attract and bind container traffic to their terminal. Causal ambiguity could be an important factor creating a sustainable competitive advantage from such strategies and business models. Causal ambiguity can be achieved through, for example, tacit in skills, complexity in skill and resource interaction and/or specificity of assets (Reed and DeFillippi, 1990) especially in relationship with other players in the transport chain. As a result, the competitive advantage resulting from these strategies and/or business models might never be fully understood by competitors.

Shipping lines can create a competitive advantage through offering an inland terminal centred value proposition. This would replace the door-to-door value proposition, which cannot be seen as a competitive advantage as it is offered by most shipping lines. Shipping lines with a well-established brand reputation are particularly well positioned to attract existing customers (e.g. customers currently buying the door-to-door service) due to lower information acquisition to customers (Bharadwaj et al., 1993). Furthermore, compared with the door-to-door value proposition the inland terminal value proposition has a better fit with the business model of the shipping line in which economies of scale play a major role. Although scale economies are not seen as an enduring source of competitive advantage as it is imitable and strategically equivalent substitutes are available (Bharadwaj et al., 1993), the necessary relationships with operators of the inland part make it harder for competitors to realize the same setup.

The previous chapters presented different intermodal strategies and business models, or part thereof, applied in practise by port authorities, shipping lines and terminal operators. In some cases, the actions taken may not reflect an intended strategy but instead are opportunities which have been grasped along the way. These companies might have kept it to that and tried to make the most of the opportunity. However, in most cases we have seen that the companies implemented a strategy or business model based on the added value it could bring to their operations, customers or the port community. Either driven by an opportunity or based on a thorough analysis, the strategies and business models which have been introduced are all characterized by substantial commitment over a longer period of time aimed at improving their competitive position and generating additional revenue streams. An important feature of these strategies and business models, which provides evidence of an intended strategy or business model, instead of only grasping an opportunity, is that in these cases multiple inland locations are included.

8.2 Future research, the journey continues

This last section provides an overview of the new research questions that have been raised in this dissertation and which can be used for future research. Furthermore, limitations of the research are mentioned along the way.

The nature of the performed research in this dissertation has been mainly explorative. Case studies have been carried out to analyse empirical examples of a hinterland strategy, a measure to stimulate intermodal transport, and identify pricing principles of port authorities. Although the findings are well founded, more in-depth case studies would contribute to the knowledge on port strategies related to intermodal transport and further improve the strategies that can be implemented. Furthermore, the potential of a 'new' intermodal value proposition of shipping lines and environmental sustainability has been explored through interviews and a survey. This study is the first to focus on differences between shippers and forwarders with regard to maritime and intermodal container transport by shipping lines. Although the research included only respondents from the Netherlands, we believe that the international activities of the respondents provide relevant results. However, replication of the study in other countries, within Europe, would be of added value due to cultural and historical differences which might play a role. The subsequent findings would suggest whether the results of this study can be generalized on a larger scale. Outside Europe, research into strategies of shipping lines in growth markets with currently limited shares of intermodal transport is a research opportunity. Further empirical analysis of the intermodal value proposition would also be of added value. Relevant issues include more detailed analysis of the current contractual relations between shipping lines and inland transport operators, the inland involvement of the shipping lines in relation to their market share

and quantitative models which incorporate scale economies in hinterland services. Future research on environmental sustainability by shippers and forwarders could include more specific survey questions, especially with regard to the different levels of the incorporation of environmental sustainability, as the used survey questions were rather exploratory. Furthermore, interviews with sustainability front runners (a shipper, a logistics service provider and a barge operator) in the Netherlands suggest that more research on mental maps and their impact on decisions regarding sustainability is a relevant avenue for further research.

Due to the timing of the research performed on the impact of the modal split obligations, research opportunities, especially for operations research, arise when the container terminals start their operations and the modal split obligations become effective. For example, do terminals with concession clauses have higher design capacities for rail and barge than terminals without such clauses? Or, what is the optimal design of a terminal with a substantially different modal split?

Port competitiveness

In this dissertation it is assumed, based on previous research, that port authorities, shipping lines and terminal operating companies can realize competitive advantage through intermodal transport. However, the expected improvements in competitiveness have not been analysed in a more quantified way. Research questions that are relevant in this respect, are: What is the impact of the modal split obligations in concession contracts on the competitiveness of the port? Will holding onto modal split targets that turn out to be overly ambitious have a negative effect on the competitive position of a port? What is the additional revenue stream of an inland network value proposition of a terminal operating company? To what extent does this additional business model improve the competitive position of the terminal operator? And has it improved the competitiveness of the port? How do shipping lines evaluate the added value of the intermodal value proposition and do they acknowledge that such a value proposition would improve their competitive position? Does the hinterland strategy of the Port of Barcelona substantially increase the competitiveness of the port? Based on the findings in this dissertation, most questions would logically be answered by saying that the followed strategies or applied business models indeed improved the competitive position. However, as mentioned before, this has not yet been supported by statistics.

Besides these questions, further research would be of added value to take other perspectives into account or to assess if the suggested strategies or business models are acknowledged as strategies or business models. For example, in chapter 2 the case study on the hinterland strategy of Barcelona only took

the perspective of the port authority into account. This is a limitation as other stakeholders play additional roles in developing hinterland networks and constrain the strategic choices of the port authority. Additional research on the influence of governments as well as players within the transport chain and their perspective on the role of the port authority is relevant. Chapter 3 identified two different business models which can be applied by TOCs. This topic also deserves further research on whether TOCs regard these as two different business models and, if so, when do TOCs decide to go for one or both business models.

Chapter 7 discussed in detail potential pricing strategies, but what is the effect of the pricing principles on port competitiveness? Chapter 3 showed that handling prices differ per transport mode. Many TOCs charge a higher fee to the shipping line for loading a container on a train or barge than on a truck. Intermodal transport becomes more attractive for shippers, forwarders and carriers when these tariffs are equal. Additional research on this pricing strategy is necessary to better understand the impact on the decision for a transport mode. Furthermore, a possible link can be made with the pricing strategy of port authorities and how this can stimulate equal pricing of transport modes. Vice versa a link can be made between the application of the two-sided market theory to the terminal operator; the effects of shifting the current contractual structure of the TOC from a 'one-sided model' (a contract only with a shipping line) to a 'two-sided model' (a contract with a shipping line and a contract with hinterland transport operators) is an interesting research opportunity. Finally, an assessment of the impact of the pricing principles from a total costs perspective, the corresponding price elasticity and the decision-making variables that play a role in port choice by tenants and shipping lines would contribute to our understanding of the usefulness of the pricing principles. In this same line, a more detailed analysis of the applicability of the suggested pricing principles and the effect of the applied principles used by port authorities is of added value. In-depth case studies, with attention for specific port characteristics and competing ports, would contribute to the body of knowledge on port pricing and could further improve the proposed pricing principles.

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Appendix A:

Regional and institutional context

This dissertation includes two detailed case studies. One focussing on the port of Barcelona (chapter 2) and the other on Rotterdam (chapter 3). Both ports are situated in Europe but in different countries, Spain and the Netherlands respectively. The regional and institutional context have an influence on the behaviour of the actors in the studied cases. Additional context of these two cases is presented in this appendix, to provide a better understanding from where the results in both cases originate.

Europe

The European container port system ranks among the busiest container port systems in the world. Europe counts many ports, there are about 130 seaports handling containers of which around 40 accommodate intercontinental container services. Growth in Europe has been particularly strong between 1995 and 2008. Container ports in the Hamburg–Le Havre range handle about half of the total European container throughput. The market share of the Mediterranean ports grew significantly between the late 1980s and the late 1990s at the expense of the ports in the Hamburg–Le Havre range. The significant improvement of the market share of the Mediterranean was mainly the result of the insertion of transhipment hubs in the region since the mid 1990s. Since 2000, the position of the northern range has gradually improved while Mediterranean ports and the UK port system lost market share (Notteboom, 2010).

During the last 20 years, several developments have shaped the European market. Notteboom (2010) identified several, of which the following are worthwhile mentioning. First of all, the number of Member States of the European Union almost doubled. Economic centres in East and Central Europe, the Nordic triangle and the Iberian Peninsula have taken up an important position in addition to the traditional economic heartland of Europe. The increased participation of these regions on the European economic scene opened possibilities for new load centres and inland transport corridors to emerge. Second, rail transportation has been liberalized in Europe. The process has been slow in many countries, but most European countries have seen the entrance of newcomers in the rail industry. And finally, major changes have taken place in port governance around Europe. Port authorities around Europe have gained a more autonomous status via commercialization, corporatization and privatization processes.

Barcelona

An important development for the port authority of Barcelona has been the drastic change of Spain's seaports' organization and management laws and regulations during the last two decades. Before 1992, Spanish ports were subject to tight regulations of the basic conditions under which port actors could act. By a law of 1992, Barcelona became a so-called General Interest Port and is owned by the national government of Spain with local government representation on

the board of the port authority. As such, the port authority is an autonomous legal body, under a landlord model responsible for the port's organization and management under the State's Ports Organization coordination and control. Since then, new laws have been introduced, aiming to enhance Spanish ports' efficiency and competitiveness. The most recent law of 2011 enacts that infrastructure investments as well as operating and capital expenditure costs must be funded entirely through internal resources. The investments made in ports need to have a net present value over zero and an equity level of at least 6%. Furthermore, Spanish port law requires a minimum return on assets of 2.5% yearly. Under the law, port authorities have full freedom to decide port dues and concession fees. The evolution of Spanish port law since 1992 has made the port authority of Barcelona an increasingly autonomous local body, as a landlord responsible for the port's management and development with an increased focus on financial performance (Van der Lugt et al. 2014). Castillo-Manzano et al. (2008) found that the legislative changes have contributed to around 35% of the total growth in the Spanish port traffic on average over the period 1993–2003.

Castillo-Manzano et al. (2013) describe the competitive environment in which Barcelona takes part. Ports on the Iberian Peninsula have a captive hinterland which is limited to the surrounding area, generally speaking an area the size of a province or smaller. As a result, there is fierce competition between ports because their hinterlands, or areas of economic influence, are generally non-exclusive. In short, there is little genuinely captive traffic, and the distances between the main markets, such as the capital city, Madrid, and its surrounding towns and dry port and the mainland ports are very similar.

Rotterdam

The competitiveness of the Port of Rotterdam has been a core part of national industrial politics since the second world war, due to the size of the port's cluster and the need to serve another core part of the economy, the logistics industry (Ng and Pallis, 2010). Up to corporatization in 2004, the port authority in Rotterdam had been an autonomous municipal body, controlled by the Municipal Board of Rotterdam. Due to external pressures, port users' changing requirements and globalisation of private port actors, the port authority already started attempting to gain more autonomy in the nineties. In 2004, the port authority became a public corporation with both municipal and national governments holding shares. Through this step, the port authority gained more autonomy. At the same time, its focus on its economic performance increased (Van der Lugt et al., 2014). For more details on the institutional framework of Port Authority of Rotterdam, also in comparision with other ports, see Ng and Pallis (2010).

As largest container port in Europe, the Port of Rotterdam has a leading position. All large shipping lines have included Rotterdam in their strings between Asia and Northwest Europe, one of the largest maritime trade routes. In 2005, several years before the economic crisis, when the container market showed double digit growth (Notteboom, 2010), the Port or Rotterdam authority started their tender procedure (De Langen et al., 2012b). During these years, ports were approaching a situation in which demand for container handling capacity was more than available. As a result the Port Authority of Rotterdam was well positioned to include additional requirements in the concession contract.

Appendix B:

Questionnaire send to FENEX members (forwarders)

Welkom bij de FENEX-Stemmingsbarometer 2012.

FENEX vindt het uitermate belangrijk om de brancheontwikkelingen binnen de expeditiesector voor u in beeld te brengen. Daarvoor vraagt FENEX u de Stemmingsbarometer 2012 in te vullen.

Na verwerking van de antwoorden van de leden ontvangt u via een e-mail een nieuwe link waarmee u toegang krijgt tot uw persoonlijke uitkomst van de Stemmingsbarometer 2012. Hiermee kunt u uw eigen antwoorden vergelijken met het sectorgemiddelde.

Indien u dat wenst, heeft u de mogelijkheid de deels beantwoorde vragenlijst tussentijds op te slaan en op een later moment weer op te roepen of door een collega verder te laten invullen. Hiertoe kunt u gebruik maken van de 'Stop' knop rechtsonder.

Wilt u de enquete door een ter zake kundige collega verder laten invullen, dan kunt u na te zijn gestopt, de link aan deze collega doorsturen.

Controle vraag

V01 De vragen in de vragenlijst hebben betrekking op specifieke bedrijfsactiviteiten binnen de expeditiesector. Om de juiste vragen aan u voor te leggen inventariseren we eerst welke activiteiten uw bedrijf verricht.

Verwacht u in de komende 5 jaar een groei of afname van de omzet van uw bedrijfsactiviteiten?

Indien u een of meer van deze activiteiten verricht, verzoeken wij u dit per activiteit kenbaar te maken door de vraag in te vullen. Verricht uw bedrijf een activiteit niet, noteer dan 'niet van toepassing'.
(Antwoordmogelijkheden: toename, gelijk blijvend, afname of n.v.t.)

1. Opslag en distributieactiviteiten
2. Zeehavengerelateerde activiteiten
3. Douaneactiviteiten
4. Luchtvrachtexpeditie activiteiten

De volgende vragen gaan over duurzaamheid.

V02 Is duurzame bedrijfsvoering één van uw bedrijfsdoelstellingen?

Ja.....❑

Nee .....❑

In ontwikkeling.....❑

V03 In hoeverre vragen opdrachtgevers om duurzame (transport) oplossingen?

Altijd…… ❑

Meestal…… ❑

Nooit……❑

V04 In hoeverre vragen opdrachtgevers om inzicht in de impact van de geleverde diensten op het milieu?

Altijd .....❑

Soms .....❑

Nooit.....❑

V05 In hoeverre verwacht u dat het belang van duurzame logistiek in de komende 5 jaar zal wijzigen?

Belang zal zeker toenemen.....❑

Belang zal waarschijnlijk toenemen.....❑

Belang zal waarschijnlijk niet toenemen .....❑

Belang zal zeker niet toenemen.....❑

Weet niet .....❑

V14 Welke verwachtingen heeft u ten aanzien van het wegvervoer?

A. De positie van het wegvervoer zal:

Verbeteren .....❑

Gelijk blijven .....❑

Verslechteren.....❑

Geen mening.....❑

B. De betrouwbaarheid van het wegvervoer zal:

Verbeteren .....❑

Gelijk blijven ..... ❑

Verslechteren.....❑
Geen mening.....❑

C. De kosten van het wegvervoer zullen:
Stijgen.....❑
Gelijk blijven .....❑
Lager worden .....❑
Geen mening.....❑

V16 Bent u het eens of oneens met de volgende stellingen:
"Een verandering van de modal split ten gunste van spoor en binnenvaart in de haven van Rotterdam is goed".
Mee eens.....❑
Neutraal .....❑
Mee oneens.....❑
Geen mening.....❑

V17 "De afspraken met betrekking tot de "modal split verplichtingen" die het Havenbedrijf Rotterdam heeft afgesproken met de terminals zijn te realiseren".
Mee eens.....❑
Neutraal .....❑
Mee oneens.....❑
Geen mening.....❑

De volgende vragen gaan over zeehavens

V21 Koopt u maritiem containertransport in?
Ja.....❑
Nee .....❑

V22 In hoeverre bent u het eens met de volgende stelling:
"Rederijen onderscheiden zich alleen van elkaar op basis van prijs"
Volledig mee eens .....❑
Mee eens.....❑
Neutraal .....❑
Mee oneens.....❑

Volledig mee oneens.....❑

V23 Hieronder staan 10 mogelijke factoren vermeld waarop containerrederijen zich van elkaar kunnen onderscheiden. Kunt per onderdeel aangeven in hoeverre u verschil ervaart tussen containerrederijen? (Antwoordmogelijkheden: veel verschil, enigszins verschillend en geen verschil)

1. Frequentie van afvaarten per rederij
2. Transittijd van zeetransport
3. Customer service
4. Beschikbaar stellen van actuele informatie over de locatie en status van de container
5. Aankomstbetrouwbaarheid van schepen en containers
6. De prijs van het zeetransport
7. Inleveren van empty containers bij inlandterminals
8. Flexibiliteit
9. Duurzame bedrijfsvoering zoals CO2 footprint reduceren
10. Intermodaal transport van/naar inlandterminal

V24 Kunt u de potentiële onderscheidende factoren van rederijen rangschikken op basis van het belang dat u daaraan hecht.

De belangrijkste factor sleept u bovenin, helemaal onderin zet u de minst belangrijke factor. Als alles staat zoals u het wil zet u onderaan de pagina een vinkje.

Frequentie van afvaarten
Transittijd
Customer service
Actuele informatie, Container tracking en tracing
Betrouwbaarheid
Prijs
Inleveren empty containers bij inland terminals
Flexibiliteit
Duurzame bedrijfsvoering zoals CO2 footprint
Intermodaal transport van/naar inlandterminal

V25 In hoeverre bent u het eens met de volgende stelling:

"Mijn ervaringen met intermodaal achterlandvervoer zijn positief".

Volledig mee eens .....❑

Mee eens .....❑

Neutraal .....❑

Mee oneens.....❑

Volledig mee oneens .....❑

Containertransport wordt doorgaans aangeboden op basis van 'haven-haven' of deur-deur'. Een andere mogelijkheid is het aanbieden van containertransport waarbij het zeetransport gecombineerd wordt met het landtransport tot aan de inlandterminal. De 'laatste kilometer' wordt vervolgens door de ontvanger of de logistieke dienstverlener van de ontvanger georganiseerd. Hoe aantrekkelijk is deze optie voor u?

V26 Een transportdienst die het zeetransport combineert met het transport van of naar een inlandterminal, vind ik:

Zeer interessant.....❑

Interessant .....❑

Enigszins interessant .....❑

Niet interessant .....❑

V27 Kunt u in procenten aangeven welke type boekingen u maakt bij rederijen (het totaal moet op 100% uitkomen)?

In procenten:

Van haven naar haven:_____

Van deur tot deur:_____

Tot de achterlandterminal:_____

Appendix C:

Full questionnaire send to relevant EVO member (shippers)

Onderzoek containertransport Europese achterland

Geachte heer/mevrouw,

Mede namens Havenbedrijf Rotterdam en TU Eindhoven wil EVO u vragen deel te nemen aan een enquête over containertransport naar het Europese achterland. De vragen hebben betrekking op de organisatie van het transport en het gebruik van en uw mening over de verschillende vervoersmodaliteiten en aanbieders.

Ontwikkeling containertransport van/naar het Europese achterland

De uitkomsten zijn niet alleen voor Havenbedrijf Rotterdam en TU Eindhoven, maar ook voor EVO zeer waardevol om meer inzicht te krijgen in de potentiële ontwikkeling van containertransport van/naar het Europese achterland van Rotterdam. Het onderzoek maakt deel uit van het Dinalog (logistieke topinstituut van Nederland) onderzoeksproject ULTIMATE. Dit project heeft als partners onder andere Havenbedrijf Rotterdam, Havenbedrijf Amsterdam, ECT, Portbase en Keyrail.

Het invullen van de enquête duurt ongeveer 10 minuten. U krijgt, indien u dit wenst, de resultaten van het onderzoek toegestuurd. Klik hier voor deelname aan de enquête

Voor elke volledig ingevulde enquête wordt € 2,50 naar Unicef overgemaakt.

Uw antwoorden zullen vertrouwelijk behandeld worden.

Mocht u nog vragen hebben kunt u ook een e-mail sturen.

Alvast hartelijk dank voor uw medewerking.

Met vriendelijke groet,

Marco Wiesehahn

Beleidsadviseur

Controle vragen

V01 Maakt u gebruik van vervoer over zee voor het transport van uw goederen? Bij geen gebruik vult u '(Nagenoeg) nooit' in.

(Vrijwel) altijd…… ❑

Regelmatig…… ❑

Soms…… ❑

(Nagenoeg) nooit… ..... ❑

Indien het antwoord: (nagenoeg) nooit, dan direct einde vragenlijst

V02 Worden uw goederen overzees in containers vervoerd?

Ja.....❑

Nee .....❑

Indien het antwoord: nee, dan is het direct einde van de vragenlijst

V03 Om hoeveel containers gaat dit?

Aantal per week: .....

Aantal per maand: .....

Aantal per jaar: .....

Weet niet.....

De volgende vragen gaan over de organisatie van het containertransport

V04 Maakt u gebruik van een expediteur voor de organisatie van uw maritieme containertransport?

Ja.....❑

Nee .....❑

V04a Indien ja:

Sluit uw bedrijf zelf de contracten af met de rederijen die door uw expediteur gebruikt moeten worden?

Ja.....❑

Nee .....❑

V04b Indien nee:

Sluit uw bedrijf de contracten met de rederijen op basis van merchant inspired carrier haulage?

Ja.....❑

Nee .....❑

V05 Maakt u gebruik van een expediteur voor de organisatie van het voor- en/of natransport van het maritieme container transport?

Ja.....❑

Nee .....❑

De volgende vragen gaan over duurzaamheid.

V06 Is duurzame bedrijfsvoering één van uw bedrijfsdoelstellingen?

Ja.....❑

Nee .....❑

In ontwikkeling…….....❑

V07 In hoeverre verlangt u van uw logistieke dienstverleners duurzame (transport)oplossingen?

Altijd.....❑

Soms .....❑

Nooit .....❑

V08 In hoeverre verlangt u van uw logistieke dienstverleners inzicht in de impact van de geleverde diensten op het milieu?

Altijd.....❑

Soms .....❑

Nooit .....❑

V09 In hoeverre verwacht u dat het belang van duurzame logistiek in de komende 5 jaar zal wijzigen?

Belang zal zeker toenemen.....❑

Belang zal waarschijnlijk toenemen.....❑

Belang zal waarschijnlijk niet toenemen.....❑

Belang zal zeker niet toenemen..... ❑

Weet niet .....❑

De volgende vragen gaan over wegvervoer

V10 Welke verwachtingen heeft u ten aanzien van het wegvervoer?

A. De positie van het wegvervoer zal:

Verbeteren .....❑

Gelijk blijven .....❑

Verslechteren.....❑

Geen mening.....❑

B. De betrouwbaarheid van het wegvervoer zal:

Verbeteren .....❑

Gelijk blijven .....❑

Verslechteren.....❑

Geen mening.....❑

C. De kosten van het wegvervoer zullen:

Stijgen .....❑

Gelijk blijven .....❑

Lager worden .....❑

Geen mening.....❑

V11 Bent u het eens of oneens met de volgende stellingen:

"Een verandering van de modal split ten gunste van spoor en binnenvaart in de haven van Rotterdam is goed"

Mee eens.....❑

Neutraal .....❑

Mee oneens.....❑

Geen mening.....❑

V12 "De afspraken met betrekking tot de "modal split verplichtingen" die het Havenbedrijf Rotterdam heeft afgesproken met de terminals zijn te realiseren".

Mee eens .....❑

Neutraal .....❑

Mee oneens.....❑

Geen mening.....❑

De volgende vragen gaan over het transport via zeehavens

V13 In hoeverre bent u het eens met de volgende stelling:

"Rederijen onderscheiden zich alleen van elkaar op basis van prijs"

Volledig mee eens .....❑

Mee eens .....❑

Neutraal .....❑

Mee oneens.....❑

Volledig mee oneens.....❑

V14 Hieronder staan 10 mogelijke factoren vermeld waarop containerrederijen zich van elkaar kunnen onderscheiden. Kunt per onderdeel aangeven in hoeverre u verschil ervaart tussen containerrederijen?

(Antwoordmogelijkheden: veel verschil, enigszins verschillend en geen verschil)

1. Frequentie van afvaarten per rederij
2. Transittijd van zeetransport
3. Customer service
4. Beschikbaar stellen van actuele informatie over de locatie en status van de container
5. Aankomstbetrouwbaarheid van schepen en containers
6. De prijs van het zeetransport
7. Inleveren van empty containers bij inlandterminals
8. Flexibiliteit
9. Duurzame bedrijfsvoering zoals CO2 footprint reduceren
10. Intermodaal transport van/naar inlandterminal

V15 Kunt u de potentiële onderscheidende factoren van rederijen rangschikken op basis van het belang dat u daaraan hecht.

Selecteert u s.v.p. alle factoren met behulp van de pijlen in het midden (of door erop te dubbelklikken). Daarna kunt u met de pijlen rechts de factoren in de juiste volgorde zetten. Als alles staat zoals u het wil, klikt u onderaan de pagina op 'Verder'.

Frequentie van afvaarten .

Transittijd

Customer service

Actuele informatie, Container tracking en tracing

Betrouwbaarheid

Prijs

Inleveren empty containers bij inland terminals

Flexibiliteit

Duurzame bedrijfsvoering zoals CO2 footprint

Intermodaal transport van/naar inlandterminal

De volgende vragen gaan over het gebruik van intermodaal vervoer

V16 Maakt uw bedrijf gebruik van intermodaal vervoer?

Ja.....❑

Nee .....❑

Indien het antwoord op de bovenstaande vraag: 'ja' dan naar vraag 16 a,b en c. Bij 'nee' door naar vraag 17.

V16a In hoeverre bent u het eens met de volgende stelling:

"Mijn ervaringen met intermodaal achterlandvervoer zijn positief".

Volledig mee eens .....❑

Mee eens.....❑

Neutraal .....❑

Mee oneens.....❑

Volledig mee oneens .....❑

V16b Wat zijn uw verwachtingen ten op zichten van het gebruik van intermodaal vervoer?

"Ik verwacht dat het gebruik van intermodaal vervoer door ons bedrijf in de toekomst zal":

Stijgen .....❑

Gelijk blijven .....❑

Lager worden .....❑

V16c. Kunt u aangeven welk percentage van het transport tussen de haven en uw warehouse intermodaal vervoerd wordt?

….%

V17. “De partij die volgens mij het best gepositioneerd is om intermodale verbindingen te ontwikkelen (dwz nieuwe diensten op te zetten) is”:

De barge / rail operator ..... ❑

De zeehaventerminal ..... ❑

De inlandterminal..... ❑

De deep sea rederij ..... ❑

De expediteur ..... ❑

V18 Containertransport wordt doorgaans aangeboden op basis van ‘haven-haven’ of deur-deur’. Een andere mogelijkheid is het aanbieden van containertransport waarbij het zeetransport gecombineerd wordt met het landtransport tot aan de inlandterminal. De ‘laatste kilometer’ wordt vervolgens door de ontvanger of de logistieke dienstverlener van de ontvanger georganiseerd. Hoe aantrekkelijk is deze optie voor u?

Een transportdienst die het zeetransport combineert met het transport van of naar een inlandterminal, vind ik:

Zeer interessant ..... ❑

Interessant ..... ❑

Enigszins interessant .... ❑

Niet interessant ..... ❑

V19. Wat is uw mening over de volgende stellingen met betrekking tot het aanbod van intermodale transportoplossingen van rederijen

V19A “Rederijen zijn in staat betrouwbare intermodale transportoplossingen aan te bieden tussen haven en inland terminal.”

Volledig mee eens ..... ❑

Mee eens ..... ❑

Neutraal ..... ❑

Mee oneens..... ❑

Volledig mee oneens ..... ❑

V19B “Rederijen zijn in staat kostenefficiënte intermodale transportoplossingen aan te bieden tussen haven en inland terminal.”

Volledig mee eens ..... ❑

Mee eens ..... ❑

Neutraal .....❑

Mee oneens.....❑

Volledig mee oneens.....❑

V20 Kunt u in procenten aangeven welke type boekingen u maakt bij rederijen (het totaal moet op 100% uitkomen)?

In procenten:

Van haven naar haven:.....

Van deur tot deur:.....

Tot de achterlandterminal:.....

De onderstaande vragen hebben betrekking op de locatie van uw activiteiten.

V21. Kunt u aangeven op hoeveel kilometer van uw centrale warehouse zich een zeehaven bevindt?

"Mijn warehouse bevindt zich in een binnen een straal van":

25 km .....❑

50 km .....❑

100 km .....❑

200 km .....❑

> 200 km .....❑

V22 Kunt u aangeven op hoeveel kilometer van uw centrale warehouse zich een inland terminal bevindt?

"Mijn warehouse bevindt zich in een binnen een straal van":

25 km .....❑

50 km .....❑

100 km .....❑

200 km .....❑

> 200 km .....❑

V23. Havenbedrijf Rotterdam en TU Eindhoven ontwikkelen een maatstaaf die de kwaliteit van de verbondenheid tussen havens (bijvoorbeeld Rotterdam – Shanghai) weergeeft. Met behulp van deze maatstaaf kunnen we havens met elkaar vergelijken (welke haven is beter verbonden?) en ontwikkelingen door de tijd heen waarnemen (raken havens beter verbonden over een bepaalde periode?). We hebben vier onderdelen geïdentificeerd voor deze maatstaaf.

Wilt u 100 punten verdelen over de volgende 4 onderdelen van verbondenheid (hoe meer punten u toewijst aan een onderdeel, hoe belangrijker dat onderdeel). Uw antwoord bepaalt de uiteindelijke weging van de onderdelen.

1. Het aantal verbindingen tussen twee havens (d.w.z. per week):

2. De transittijd van de verbinding tussen deze havens:

3. De grootte van het schip dat gebruikt wordt voor de verbinding tussen deze havens:

4. Het aantal concurrerende rederijen dat verbindingen aanbiedt tussen deze havens:

Totaal moet optellen tot 100

Summary

Strategies and new business models in intermodal hinterland transport

Intermodal hinterland transport is increasingly seen as an important feature for port competitiveness. It has been argued that it helps to reduce road congestion, makes more distant hinterlands reachable at competitive prices, reduces the difference between growing call sizes at ports and fragmented inland transport systems and decreases the impact of the transportation sector on the environment. Key players within the port industry maintain an arm's length relationship with intermodal hinterland transport. In most cases, intermodal hinterland transport is not included in their core business. It does, however, increasingly influence their core business. Although suggestions have been made by academics to utilize intermodal transport and shipping lines, terminal operating companies and port authorities have identified this as a possibility for improving their competitive position, limited research has been performed on the benefits, potential and implementation of strategies and business models related to intermodal transport. The goal of the research presented in this dissertation is to provide empirical evidence and theoretical contributions for intermodal strategies and business models which contribute to the competitive position of a port and, more specifically, port authorities, shipping lines and terminal operating companies. To reach this goal, the perspectives of the key customers of shipping lines (i.e. shippers and forwarding companies) are also included. Chapter 1 provides a first introduction into the container shipping industry. Furthermore, the conceptual framework, research questions and research design are introduced.

Ports can realize growth of container throughput through extending the hinterland of a port into new regions. Intermodal transport is key in connecting the port with more distant, contestable, hinterlands. Therefore, port authorities should shift their focus from the sea-side to the land-side. However, limited empirical research on hinterland strategies of port authorities exists. In chapter 2 a case study is provided of the hinterland strategy developed and implemented by the Port Authority of Barcelona as an example of a successful hinterland strategy. Most efforts were spent by the Port Authority of Barcelona on the development of intermodal transport services, through investments in hinterland infrastructure and the service itself. The port authority even became operationally involved. The implemented strategy proved to be successful because the extension of the intermodal rail network contributed to a significant modal shift from road to rail. The case also shows the changing focus of the port authority. Although operational involvement is not included in the business model of a landlord port authority, it does fit in with the aim of a port authority to develop a vital port. The longer planning horizon and lower required return on investments of port authorities, compared to private companies, give the

port authority the position to invest in the hinterland. Another contribution of this case is that it proposes another perspective: a port as a two-sided market. Port authorities provide a platform where cargo can be transferred between different modes. In most two-sided markets, one side is subsidized, but enables more revenue streams from the other side of the platform. Chapter 7 builds on this by analysing how pricing strategies of port authorities may enhance the competitiveness of the port as a platform.

Chapter 3 analyses a new measure taken by the Port Authority of Rotterdam to influence the share of intermodal transport. Not so much by being active outside of the port area (as discussed in chapter 2) but within the port area through contractual agreements with terminal operators. Chapter 3 focuses on the impact of a new clause incorporated in concession contracts to stimulate intermodal transport by assessing how terminal operating companies will cope with this. The Port Authority of Rotterdam is the first to incorporate such modal split obligations in the concession contracts. Therefore, the Port of Rotterdam was selected as a case. An exploratory analysis of the effects is performed as the modal split obligations become effective as of 2015. The performed case study includes a description of the instrument implemented by the Port Authority of Rotterdam, supported by the results from a survey among shippers and forwarders. Three terminal cases are developed based on in-depth interviews with the responsible managers. The impact of the concession clause is analysed and positioned in a developed theoretical framework. The findings suggest that the impact of the modal split obligations have the largest impact when port authorities incorporate these clauses in new concession contracts. The terminal operators recognise that by becoming more active in the hinterland, either by organizing the transport themselves or through partnerships with inland terminals, they can increase competitiveness and throughput and realise additional revenue streams. The concession clauses have contributed to the development of the intermodal hinterland network of the terminals. It can even result in operating a second business model; in addition to a traditional terminal value proposition also an inland network value proposition. Furthermore, three theoretical contributions have resulted from the analysis.

After the discussion of the strategies of port authorities and business models of terminal operating companies, chapter 4 focuses on the value proposition of shipping lines. It introduces an evolving third value proposition, in addition to the port-to-port and door-to-door value propositions. This third value proposition is centred around the inland terminal (ILT). The value proposition consists of the maritime leg and the leg to/from ILTs – but not the 'last mile' to the distribution centre or factory gate. Shipping lines can still win on the inland leg as this can still be improved substantially, whereas the efficiency of the maritime leg has improved over the last decades. The aim of chapter 4 is to assess the potential of this third value proposition to shipping lines. The assessment is made through

qualitative research, including an extensive literature review, interviews with relevant players in the supply chain and an analysis of several empirical examples. The suggested value proposition can have advantages over the port-to-port value proposition as well as the door-to-door value proposition. Three advantages have been identified over the port-to-port value proposition. First, it enables better repositioning of empty containers and leverages the economies of scale of intermodal transport. Second, it contributes to terminal efficiency, through better information on inland destinations of containers. Thirdly, it provides a relationship with the inland terminals which becomes increasingly important to the shipper as an 'extended storage area'. Compared to the door-to-door value proposition, two advantages have been identified. First, shipping lines maintain an orientation on 'scheduled transport' with a limited number of origins and destinations. This leads to a more coherent 'capability set' than also managing the last mile of trucking which is required in a door-to-door service. Second, the intermodal value proposition is better aligned with the position of forwarders in supply chains as it does not provide a substitute to the services offered by forwarders. Terminal operators also develop an ILT-centred value proposition and demand already exists among shippers. Modal split targets by port authorities (also discussed in chapter 3) and the increasing attention paid to sustainable transport may provide an environment in which the demand for an intermodal value proposition will grow.

To determine the overall potential of the ILT-centred value proposition, the customer's point of view needs to be considered as well. Therefore, chapter 5 focuses on the carrier selection processes of shippers and forwarders, with additional attention for the inland terminal value proposition. Chapter 5 follows a much more deductive approach, in contrast to chapter 4 which follows an inductive approach for defining the ILT-centred value proposition. For testing theory, a survey is used and a questionnaire was sent to freight forwarders and shippers in the Netherlands. The results from the survey indicate that providing a door-to-door value proposition is not (any longer) a source of differentiation for shipping lines. The findings also indicate that price is most important to shippers and forwarders, regardless of the type of booking (door-to-door or port-to-port). When they evaluate shipping lines, differences are only perceived for items which they consider relevant. This means that shipping lines need to carefully communicate relevant service characteristics to relevant market segments. As a result, shipping lines can create value for a part of their customers by offering an intermodal value proposition. However, the survey results also showed that these bookings are likely to go at the expense of door-to-door bookings. From the survey several significant differences between shippers and forwarders are found. For example, shippers focus more on reliability compared to forwarders, forwarders mainly book on a port-to-port basis and shippers have a substantial larger share of door-to-door bookings.

The better environmental performance of intermodal transport, compared to unimodal road transport, could be an important driver for port authorities, terminal operators and shipping lines to include this in their strategies and business models. The goal of chapter 6 is to determine the attitude of shippers and forwarders, as purchasers of freight transport, to environmental sustainability. Several hypotheses have been developed and tested through the same survey used in chapter 5. The main conclusions drawn from the survey are that shippers and forwarders still have a rather limited interest in sustainability; shippers more often demand sustainable solutions; the size of a shipper influences the demand for transparency of the environmental performance; companies which have a focus on sustainability on a strategic level also translate this into tactical and operational measures; the overall expectation is that the importance of sustainability will increase. Although the results suggest an ongoing transition towards more sustainable purchasing of international container transport, there is still a large group of companies which has not incorporated sustainability in their operations. Shippers and forwarders indicate that sustainability will become more important, but still do not act upon this and regard sustainability as relatively unimportant. A transition of the existing mental frames (i.e. improved environmental performance is only of added value when costs remain on the same or lower level) towards a new mental frame (i.e. value is created through sustainable transport operations) is required to create a competitive advantage over the ones staying in their old mental frames.

Chapter 2 introduced the idea of a port as a two-sided market, with the sea-side on the one side and the land-side on the other side. Chapter 7 first shows, based on several empirical cases, that large differences exist between the pricing strategies of port authorities (i.e. the inconsistency of the types of customers being charged). Second, the two-sided market theory is introduced and analysis is carried out whether ports meet the criteria for two-sided markets. The result of the analysis suggests that ports, just like airports, are not two-sided markets as the three criteria for two-sided markets are not met. Mainly due to two important differences: the relation between seaport users is vertical and cross group externalities are non-existent, and the price setter – the port authority – is not a platform operator but a multiproduct company that sells its products and services to a number of vertically related seaport users. Based on this result six pricing principles for port authorities have been derived and are supported by empirical examples.

All previously discussed chapters addressed a strategy and/or business model related to intermodal transport of a port authority, shipping lines or terminal operator. Chapter 8 provides an overview of the conclusions and answers the research question of every chapter. Furthermore, overall conclusions are drawn in relation to the competitive advantage which can be realized by port authorities, terminal operators and shipping lines through strategies and

business models related to intermodal transport. Competitive advantage can be realized through rare and valuable organizational resources, by being a first-mover through resource advantages and it becomes a sustained advantage when the resource cannot be duplicated by others, by being imperfectly imitable and not substitutable. The extent to which this applied to the strategies and business models applied by the different players is discussed in the second part of chapter 8. The chapter ends with suggestions for further research. The suggestions mainly stem from the nature of the performed research which has been primarily explorative. More in-depth case studies would contribute to the knowledge on port strategies related to intermodal transport and further improve the strategies that can be implemented. Also replication of the survey in other countries would contribute to the generalizability of the results. Furthermore, follow-up research on the impact of the modal split concession clause in Rotterdam will provide answers to questions regarding the effect which could not yet be answered as the terminals had not started their operations. Finally, additional questions have been raised with regard to the impact of the followed strategies and implemented business models on port competitiveness. Research which can quantify and measure the impact would be an interesting research avenue.

Curriculum Vitae

Roy van den Berg (1983) was born and raised in Maassluis, the Netherlands. He finished his Bachelor in Small Business and Retail Management at the Rotterdam University of Applied Sciences in 2004. Afterwards he started a pre-master Business Administration degree at the Rotterdam School of Management, Erasmus University, which he completed in 2006. He received his MSc in Supply Chain Management at the same university in 2008. In October 2008, Roy started as business manager logistics at the Port Authority of Rotterdam. He was soon invited to start a PhD. He maintained his position at the Port Authority of Rotterdam and worked under the supervision of Peter de Langen as an external PhD. His research became part of the R&D project ULTIMATE of the Dutch Institute for Advanced Logistics (Dinalog). As business manager logistics, Roy co-developed the hinterland strategy of the port authority as well as InlandLinks, an online platform to promote intermodal transport within the hinterland network of Rotterdam. Furthermore, he maintained contact with shippers as logistics service providers to promote the Port of Rotterdam and stimulate and support them to realize a modal shift. He contributed to the development of the Rail Incubator project and the vision on Information in the Port as complement to the Port Vision 2030. These initiatives aim to stimulate new rail connections out of Rotterdam and sharing of relevant port-related data to optimize logistics through the Port of Rotterdam.

Roy published several blogs on Logistiek.nl, co-authored the revised version of the "Handboek Modal Shift". Between 2011 and 2014; he co-authored seven scientific papers which have been published in various academic journals. In 2013, his poster about his PhD research was awarded the second prize at the Erasmus Smart Port Poster Session.

Ever since his childhood, Roy has had a passion for sports. He has played football, mainly as a goal keeper, for 20 years. He discovered windsurfing at the age of 18 and loves to play squash or an 18 holes golf course. When possible, he goes for a run. In 2014, he finished two half marathons and an eight-stage triathlon.

Roy has been working as a volunteer for Unicef Rotterdam since 2007. He has held the position of treasurer and is now events coordinator. He started at Unicef after volunteering for three months at Macheo Children's Centre in Thika, Kenya in 2006. Roy has also been a volunteer at the football clubs where he trained junior goal keepers for several years.

Roy is husband of Eveline and proud dad of Celine.