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The relationship between seaports and the inter-modal hinterland in light of global supply chains

European challenges

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THE RELATIONSHIP BETWEEN SEAPORTS AND THE INTERMODAL HINTERLAND IN LIGHT OF GLOBAL SUPPLY CHAINS: EUROPEAN CHALLENGES

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Abstract

The seaport-hinterland interaction plays an increasingly important role in shaping supply chain solutions of shippers and logistics service providers. Scarcity concerns combined with concerns over the reliability of transport solutions have led seaports and hinterland corridors to take up a more active role in supply chains. This contribution looks at port developments and logistics dynamics in Europe and proposes some steps towards a further integration between seaports and the hinterland. The key point put forward in this paper is that the competitive battle among ports will increasingly be fought ashore. Hinterland connections are thus a key area for competition and coordination among actors.

The paper approaches port-hinterland dynamics from the perspective of the various market players involved, including port authorities, shipping lines, terminal operators, transport operators (rail, barge, road and short sea) and logistics service providers. The paper will address the impact of horizontal and vertical relations in supply chains on the structure of these chains and on the relationships between seaports and the intermodal hinterland. Who takes or should take the lead in the further integration of ports and inland ports and what actions have been taken so far by the market players in this respect, will be examined. The incentives for market players to vertically or horizontally integrate will be analyzed against the backdrop of the nature of the market in which the various players operate.

1. INTRODUCTION: GATEWAYS AND HINTERLANDS

A hinterland is the area over which a port draws the majority of its business. It is very hard or even not feasible to delimit the hinterland of a port as the hinterland varies with respect to commodity (cf. bulk versus containers), the time (cf. seasonal impact, economic cycles, technological changes, changes in transport policy, etc..) and transport mode. Moreover, market dynamics make it dangerous to have a static concept of ports hinterlands as being god-given and everlasting.

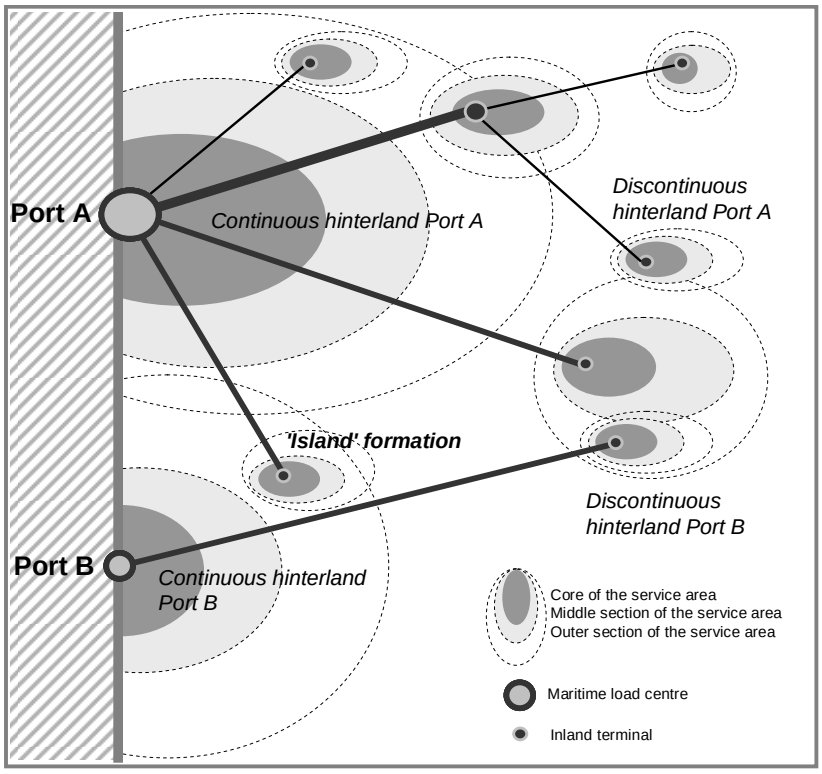
Literature on gateway/hinterland relationships acknowledged that containerization has expanded the hinterland reach of ports and has thus intensified inter-port competition (see e.g. Hayuth, 1981 and Starr and Slack, 1995). The expanding hinterland coverage and the associated shift from *captive* hinterlands to *shared* or *contestable* hinterlands changed the perception on port markets from being monopolistic or oligopolistic to competitive. As a result, most European container ports now act as *gateways* to often extensive inland networks. These gateways are nodal points where intercontinental transport flows are being transshipped onto continental areas and vice versa (Fleming and Hayuth, 1994 and Van Klink et al, 1998).

A number of factors have facilitated the rise of gateways that vie for contestable hinterlands.

First of all, containerization and the deployment of ever larger container vessels have gone hand in hand with a concentration of vessel calls in a limited number of load centres, especially on the main long-distance routes where economies of scale at sea are most apparent. Price fixing systems ensured that the reduction of port calls had no negative price impacts on the customer base (Gilman, 1997). For example, shipping lines put port equalization systems in place to compensate inland customers for the longer inland transport distances they might incur when sending or receiving cargo via container load centres.

Secondly, the development of intermodal corridors by rail and barge and of inland terminals allowed for a deep hinterland penetration via shuttle trains and barges. The full liberalization of barge transport in Europe since 2000 and the advanced stage of liberalization in European rail (started in 1991 and now in a lower or higher stage of completion, depending on the member state considered) proved to be instrumental to increasing the efficiency of transport services on inland corridors. The rise of intermodality and associated transport corridors had a major structuring effect on the hinterland reach of seaports. Not only has intermodality given incentive for ports to expand their hinterland reach. Hinterlands also became more discontinuous in nature, especially beyond the immediate hinterland of the port (figure 1). Such a process can even lead the formation of ‘islands’ in the distant hinterland for which the load centre achieves a comparative cost and service advantage vis-à-vis rival seaports (Notteboom and Rodrigue, 2005). Conventional perspectives based on distance-decay are ill-fitted to address this new reality. Hence, high-volume intermodal corridors typically offer a more favourable relation between transport price, lead time and distance than the conventional/continuous inland transport coverage. A port’s service area by rail and barge now consists of sets of overlapping service areas of individual inland terminals. The size of each of the inland service areas depends on the service frequency and the tariffs of intermodal shuttle services by rail and or barge, the extent to which the inland terminal acts as a gateway and the efficiency and price of pre- and endhaul by truck. The more intermodality serves as a weapon in port competition, the more ports become dependent on the intermodal carriers offering services along the intermodal corridors. A highly volatile intermodal market, in terms of organizational and operational factors, is thus not very conducive to creating a stable and sustainable competitive position of a port vis-à-vis the hinterland segments served through the corridors.

Figure 1. **Discontinuous hinterlands and corridor-based 'island' formation**



Source: Notteboom and Rodrigue (2005).

The rise of corridors is a highly relevant development to any policies aimed at generating a modal shift from road haulage to inland navigation, rail and short sea shipping. Intermodal solutions based on barges or rail prove to be competitive on a number of high-density traffic corridors (e.g. the Rhine axis, some Alpine routes, etc.) or in specific niche markets, but cannot serve as a European-wide alternative for road haulage.

2. GLOBAL SUPPLY CHAINS, PORT SELECTION AND HINTERLAND CONNECTIONS

Academic literature on port selection identifies a multitude of port service-related and cost factors that influence shipping lines' and shippers' decisions: see, e.g., Murphy *et al.* (1992); Murphy and Daley (1994); Malchow and Kanafani (2001); Tiwari *et al.* (2003); Nir *et al.* (2003); Chou *et al.* (2003); Song and Yeo (2004); Lirn *et al.* (2004); Barros and Athanassiou (2004); and Guy and Urli (2006). The traditional view on port selection primarily considers standalone physical attributes of a port, such as:

(a) the physical and technical infrastructure (nautical accessibility profile, terminal infrastructure and equipment, hinterland accessibility profile),
(b) the geographical location (vis-à-vis the immediate and distant hinterlands and vis-à-vis the main shipping lanes),
(c) port efficiency,
(d) interconnectivity of the port (sailing frequency),
(e) quality and costs of auxiliary services such as pilotage, towage, customs, etc.,
(f) efficiency and costs of port management and administration (e.g. port dues),
(g) availability, quality and costs of logistic value-added activities (e.g. warehousing),

(h) availability, quality and costs of port community systems,
(i) port security/safety and environmental profile of the port,
(j) port reputation and, very relevant in the context of this paper, and
(k) the reliability, capacity, frequency and costs of inland transport services by truck, rail and barge.

The focus on standalone physical attributes of a port when assessing the competitiveness of a port does not mirror the reality of (global) supply chains. The container facilitated multinational enterprises to adopt flexible multi-firm organization structures on a global scale. Many of the world's largest enterprises manage extensive networks of globally dispersed inputs. The broad geographic distribution of sourcing and production (back end) versus less broad geographic distribution of sales (customer end) is reflected onto trade patterns, supply chain management needs and shipping requirements. Service expectations of customers are moving towards a push for higher flexibility, reliability and precision. Average product life cycles and supply chain cycles have decreased. There is a growing demand from the customer for "make-to-order" or "customized" products, delivered at maximum speed, with supreme delivery reliability, at the lowest possible cost. The focus is on supply chain excellence, with superior customer service and lowest cost to serve.

As a result, European ports are increasingly competing not as individual places that handle ships but as crucial links within (global) supply chains (Robinson, 2002, Carbone and Gouvernal, 2007 and Notteboom and Winkelmans, 2001). The need for a more supply chain oriented approach to port selection is echoed in recent work. More than ever, the supply chain has become the relevant scope for analyzing port competitiveness. This implies that a port's competitiveness becomes increasingly dependent on external co-ordination and control by outside actors. Port choice becomes more a function of network costs. Port selection criteria are related to the entire network in which the port is just one node. The ports that are being chosen are those that will help to minimize the sum of sea, port and inland costs, including inventory considerations of shippers. Along the same lines, Magala and Sammons (2008) and Sammons and Magala (2007) argue that port choice is to be considered as a by-product of a choice of a logistics pathway. Port choice becomes more a function of the overall network cost and performance.

The supply chain focus on port competition holds clear implications on the role of hinterland connections. Port hinterlands have become a key component for linking more efficiently elements of the supply chain, namely to insure that the needs of consignees are closely met by the suppliers in terms of costs, availability and time in freight distribution. Through a set of supply / demand relationships involving physical flows, efficiencies, and thus economies, are achieved through the principle of flow (Hesse and Rodrigue, 2004).

In this setting, the out-of-the-pocket costs of transporting goods between origins and destinations and the port (including cargo handling costs) constitute just one cost component in supply chain routing decisions. The more integrated supply chain decision-making becomes, the more the focus is shifted to the generalized logistics costs. The implications on port and modal choice are far-reaching: shippers or their representatives might opt for more expensive ports or a more expensive hinterland solutions in case the additional port-related and modal out-of-the-pocket costs are overcompensated by savings in other logistics costs. These other costs typically consist of:

(a) Time costs of the goods (opportunity costs linked to the capital tied up in the transported goods and costs linked to the economic or technical depreciation of the goods);
(b) Inventory costs linked to the holding of safety stocks;
(c) Indirect logistics costs linked to the aggregated quality within the transport chain and the willingness of the various actors involved to tune operations to the customer's requirements, e.g. in terms of responsiveness to variable flows, information provision and ease of administration (see also Ojala, 1991).

These three cost categories have gained in significance as more and more high value products are being shipped worldwide (i.e. impact on time costs) and as market players show increasing concerns

over perceived inefficiencies in segments of the chain as well as reliability issues. There are two major points to be made in relation to this shift.

First of all, growing concerns on capacity shortages in ports and inland infrastructures have made supply chain managers base their port and modal choice decisions increasingly on reliability and capacity considerations next to pure cost considerations. Port congestion along the US West Coast and in many European ports, such as in the summer of 2004, demonstrated how scarcity of port facilities and intermodal throughput capacity can impact a broader economic system. Freight transportation has become the most volatile and costly component of many firms' supply chain and logistics operations. Managers have to deal with delays in the transport system, with rising oil prices, complex security issues, and with labour and equipment shortages and imbalances. Each of these problems adds risk to the supply chain, and the problems are likely to get worse before they improve. Managers in the logistics industry, including the port and maritime industry, are spending more and more of their time handling freight transport missteps and crises. Scarcity in markets can lead to more efficient use of resources, which is positive. But when scarcity reaches a continuous high level, logistics players start to consider capacity problems as the new normal. They can adjust their logistics networks by increasing time buffers in the system (a measure which comes at an extra cost) or by finding alternative routes with a lower 'resistance' to their needs in terms of costs and reliability. Seaports who find themselves on inefficient or capacity-tight corridors obviously are in a disadvantageous position.

Secondly, the logistics actors and transport operators have designed more complex networks that need a high level of reliability. The current development and expansion of global supply chains and the associated intermodal transport systems relies on the synchronization of different geographical scales. The efficiency of transport systems can be seriously hampered if shipments would significantly be delayed, although having low transport costs. But when the synchronization level increases, the sea-land network as a whole becomes more instable (Rodrigue, 1999). This leads to extra costs to find alternative routes. In view of reducing the risk of major disruptions, logistics players tend to opt for a flexible network design offering various routing alternatives. This 'not all eggs in one basket' approach implies a specific port-corridor combination seldom finds itself in a position where the market will forgive major flaws in system performance.

The multitude of port selection factors and modal choice criteria implies that modelling port-related hinterland flows and associated port market shares remains a very difficult exercise. For example, Veldman et al (2005) developed a logit model for the routing of West European container flows in the context of the assessment of the economic impact of a river deepening project. Variables in the model include the hinterland transport cost and the transit time of routing via port p and hinterland mode m, a maritime resistance cost of port p and the quality of service aspects of port p related to the frequency of services offered. The model attempts to explicitly incorporate quite some dimensions of a generalized logistics cost approach. But obviously, one should always take into account the assumptions and simplifications that lie at the heart of a model when interpreting the model results.

To add to the complexity, it is worth mentioning that the competitive position of a port vis-à-vis a specific hinterland region can not always be narrowed down to cost and quality factors only (Van Klink and Van den Berg, 1998). Historical, psychological, political and personal factors can result in the routing of container flows that diverges from a perfect market-based division. Bounded rationality, inertia and opportunistic behaviour are among the behavioural factors that could lead to a deviation from the optimal solution (Notteboom, 2001).

Given all of the above considerations, it becomes clear the success of a port will depend on the ability to integrate the port effectively into the networks of business relationships that shape supply chains. In other words, the success of a seaport no longer exclusively depends on its internal weaknesses and strengths. It is being more and more determined by the ability of the port community to fully exploit synergies with other transport nodes and other players within the logistics networks of which they are part. The synergies that can be envisaged relate to efficient capacity utilization and an efficient

operational synchronization and integration. To be successful the port community has to think along with the customer, trying to figure out what his needs are, not only in the port but throughout the supply chains and logistic networks.

3. TRADE PATTERNS, DISTRIBUTION NETWORKS AND LOCATIONAL SHIFTS IN EUROPE

The previous sections provided a conceptual approach to the issue of port competition and hinterland connections. Form this section onward, this paper will discuss the European situation in more detail. Europe's economic development and external trade forms the starting point for understanding port competition and hinterland connections in Europe. A closer look at external trade data and GDP data provided by Eurostat (annex 1 and 2) leads to the following conclusions.

First of all, rising external trade of European countries seems to go hand in hand with increasing concerns over trade imbalances. The extra EU trade of the European Union has increased significantly over the last decade in terms of the volume and the value of the goods exchanged. Only a handful of countries (i.e. Germany, the Netherlands, Ireland and Sweden) realize rather substantial trade surpluses, while a lot of countries are facing substantial trade deficits relative to total external trade volumes (i.e. the United Kingdom, Greece and Spain to name but a few).

Secondly, intra-EU trade represents two thirds of the EU's trade total, meaning that despite the globalization trend intra-European trade remains very significant. The volume of intra-EU trade increased significantly with the consecutive rounds of enlargement of the EU, since the newest member states are typically strongly geared to the EU market. The share of intra-EU trade varies widely from one member state to another. For small open economies such as the Benelux countries, the Czech Republic and Denmark the shares of intra-EU trade in total exports are very substantial. At the import side, the overall picture is mixed: the Netherlands, Greece, Italy and the United Kingdom are among the countries with a strong reliance on non-EU imports, while for most other countries the share of non-EU imports ranges between 20 and 30%.

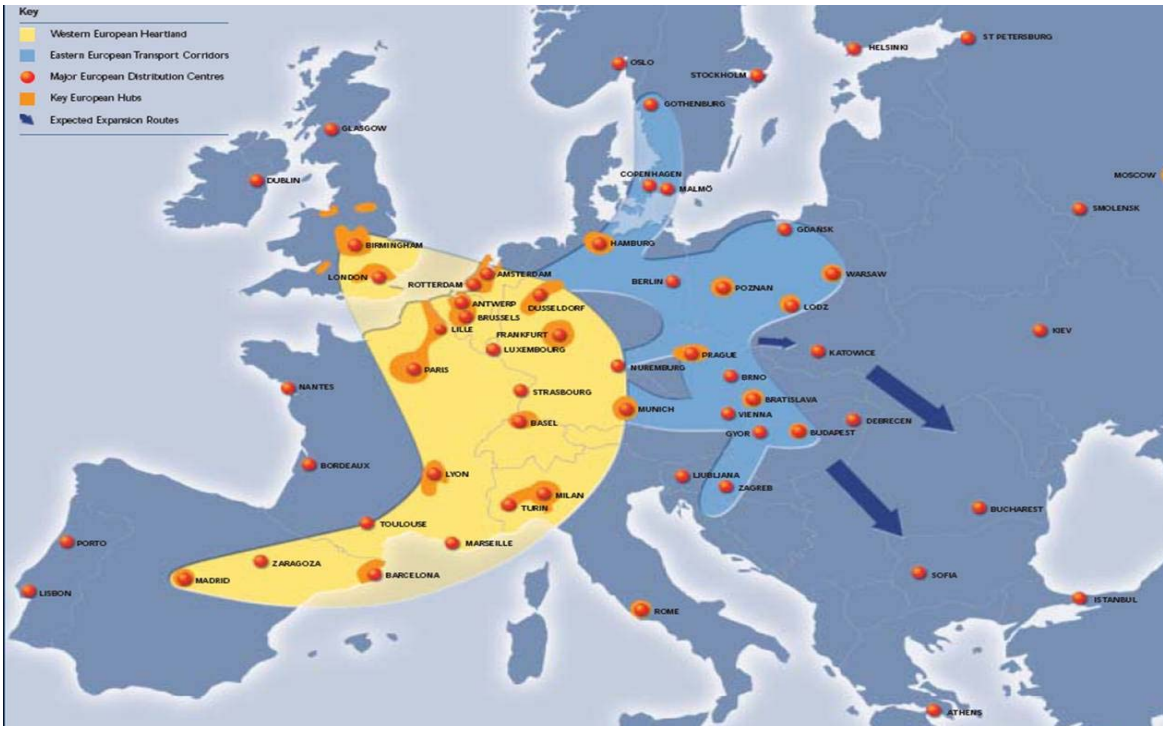
Third, the West-European markets are becoming mature. The total market volume in Europe's most important countries and in traditional market sectors such as consumer goods or automotive are showing moderate growth rates which contrast the boom in these markets of the 1970s and 1980s. GDP growth rates in the core of the EU are expected to reach between 1.5 and 2.5% in the coming years (see annex 2). Greece, Luxemburg and Ireland are among the fastest growers among the former EU-15 countries. After the crisis that followed the dissolution of Comecon, the central and east European countries (CEECs) quickly redirected their trade towards the EU markets. Economic development in newer EU member states in Central and Eastern Europe and in the Baltic is expected to continue its strong growth path in the near future, with annual GDP growth rates typically between 5% and 7%. The enlargement of the European Union from 15 to 25 members states in 2004 meant a 20 % rise in population (an additional 75 million citizens – Eurostat figures), while adding only 5% (€ 500 billion) to the Union's real GDP. The economic gap remains substantial. However at the current growth rates, more advanced countries such as the Czech Republic could reach the GDP per capita level of West-European countries in fifteen years.

In trade, two categories of CEECs can be identified: Hungary, the Czech Republic and Slovakia are increasingly exporting more technology-driven or high-skill products. By contrast countries like Latvia remains focused on low-skill or labour-intensive products. Due to the fact that the EU market has expanded and because it will add some high growth markets it is not unlikely that international companies will be keen to invest in the new Europe. This might for instance imply a move of global plants to the European Union. This tendency will generate larger bi-directional East-West flow within the European Union of raw materials and consumer products. The East-West flows require an

extensive infrastructure to be in place (road, rail, inland waterways and short sea). A large part of this transportation will take the form of inland waterway transport, especially over the Danube River. Germany, the Czech Republic, Poland, Slovenia and Hungary have access to elaborate rail networks while road networks in the Eastern European countries are less developed. Transport in Eastern European countries will therefore favour rail transport. A rise in multimodal transport infrastructures is expected on the borders between Eastern and Western Europe particularly on the borders of Germany, with Germany having both well developed road and rail transport infrastructures.

Given the trends outlined above, the traditional 'blue banana' is approaching the shape of a boomerang as a result of extensions to central and east Europe and significant investments in the Mediterranean (Spain in particular), see figure 2. The expansion of the 'blue banana' goes hand in hand with a strong development of trade flows in the Baltic area, Central Europe and the Latin arc (stretching along the coastline from southern Spain to northern Italy).

Figure 2. **The 'blue banana' and its extensions**



Source: Cushman & Wakefield, Healey & Baker.

The enlargement of the European Union and the strong economic growth of regions situated somewhat at the periphery of the internal market might have implications on the design of European distribution networks. When it comes to European distribution of their overseas goods, a general-applicable distribution structure does not exist. Companies can opt for direct delivery without going through a distribution centre, distribution through an EDC (European Distribution Centre), distribution through a group of NDCs (National Distribution Centres) or RDCs (Regional Distribution Centres) or a tiered structure in which one EDC and several NDCs/RDCs are combined to form a European distribution network. The choice between the various distribution network configurations depends on among other things the type of product and the frequency of deliveries. In the fresh food industry for example, worldwide or European distribution centres are rare because the type of product (mostly perishables) dictates a local distribution structure. In the pharmaceuticals industry, European distribution centres are common but regional or local distribution centres are not present, because the pharmaceutical

products are often manufactured in one central plant and delivery times are not very critical (hospitals often have own inventories). However, in the high tech spare parts industry, all of the distribution centre functions can be present because spare parts need to be delivered within a few hours and high tech spare parts are usually very expensive (which would require centralized distribution structures).

Before the creation of the EU, the distribution structure of most companies was based on a network of national distribution centres in the major countries in which they were present. Over the last fifteen years or so many barriers for cross-border transactions between countries within the EU have decreased. As a result many companies consolidated their distribution operations into one central European Distribution Centre (EDC) covering all European Union countries. The rise of EDCs meant longer distances to the final consumers and in some market segments local market demand has led companies to opt for RDCs. A certain degree of decentralisation of European distribution structures has taken place. At present, the tiered structure consisting of one EDC in combination with some smaller local warehouses, 'merge in transit' concepts or 'cross docking' facilities offers the best results for many companies in terms of high level of service, frequency of delivery and distribution cost control. Companies today often opt for a hybrid distribution structure of centralized and local distribution facilities. For instance, they use an EDC for medium- and slow-moving products and RDCs for fast-moving products. These RDCs typically function as rapid fulfilment centres rather than holding inventories. The classical or multi-country distribution structures are being replaced by merge-in-transit, cross-docking or other fluid logistics structures.

The geographical centre of gravity within the expanded EU has slightly moved eastwards from the Benelux region to Germany and this is causing some companies to reconsider their location behaviour of European Distribution Centres (EDCs). The rather recent waves of EU enlargements might further promote a two-tiered European distribution structure consisting of an EDC together with regional distribution centres in Northern Europe, UK/Ireland, Southern Europe, Eastern Europe and Italy/Greece. Favourite regions for locating such a RDC include northern Germany and Finland for northern access, Hungary, Southern Germany and Austria for central access, northern Italy and the north Adriatic region for southern access and the Czech republic and Poland for eastern access. The new European Union covers a much larger geographical area making it more difficult to deliver all EU countries out of one EDC within two to three working days. Northern ports, in particular Hamburg, are likely to benefit the most from the recent waves of EU enlargement, whereas new development opportunities arise for secondary port systems in the Adriatic and the Baltic Sea.

Some observers argue that growth of investments in EDCs in North West Europe might slow down. At the moment, this region still offers the best access to the EU core markets and infrastructure. The majority of EDCs is still opting for a location in the Benelux region or northern France. Next to dedicated transport services companies, companies in the automotive, food, retail, chemicals, electronics and pharmaceuticals industries are the main investors in distribution activities. Flanders, northern France and the Netherlands remain the top locations for EDCs, but more and more regions are vying for a position as attractive location for RDCs and potentially EDCs.

Supply chains across Europe are being redesigned to respond to varying customer and product service level requirements. The variables which affect site selection are numerous and quite diverse and can be of a quantitative or qualitative nature: centrality, accessibility, size of the market, track record regarding reputation/experience, land and its attributes, labour (costs, quality, productivity), capital (investment climate, bank environment), government policy and planning (subsidies, taxes) and personal factors and amenities. Many companies fall back on intuition and rules of thumb in selecting an appropriate site.

In order for the established EDC regions to keep their attractiveness, it is primordial to keep labour costs within acceptable margins, to overcome the scarcity of land issue and to guarantee a smooth (congestion-free) transfer through the maritime gateways and association inland corridors. North-Western Europe faces the fact that no new major corridor infrastructures will be developed in the foreseeable future (the rail-dedicated Betuweroute in the Netherlands being one of last major

accomplishments). The focus will thus be on stretching existing capacity on the corridors via advanced traffic management systems and the implementation of effective cargo bundling and cargo coordination systems. In Eastern Europe the focus is more on developing the much-needed corridors in the first place, a need that is reflected in the list of priority axes and projects of the Trans-European Transport Network (TEN-T) of the European Commission. Efficient long-distance corridors can have a downside to well established EDC regions: they make it easier for logistics service providers to move distribution facilities inland closer to the customer base without having to sacrifice a good accessibility to the maritime gateways.

4. THROUGHPUT DYNAMICS IN THE EUROPEAN CONTAINER PORT SYSTEM

To accommodate maritime extra-EU and intra-EU trade flows, Europe is blessed with a long coastline reaching from the Baltic all the way to the Med and the Black Sea. The European port system cannot be considered as a homogenous set of ports. It features established large gateway ports, hub ports as well as a whole series of medium-sized to smaller ports each with specific characteristics in terms of hinterland markets served, commodities handled and location qualities. This unique blend of different port types and sizes combined with a vast economic hinterland shapes port competition in the region. There is no lack of port competition in Europe. Battles are fought on many fronts: maritime and hinterland access, terminal capacity, but above all the accommodation of supply chains.

With a total maritime container throughput of around 90 million TEU in 2007, the European container port system ranks among the busiest container port systems in the world. Growth has been particularly strong in the last few years with an average annual growth rate of 10.5% in the period 2005-2007, compared to 6.8% in the period 1985-1995, 8.9% in 1995-2000 and 7.7% in 2000-2005. Europe counts many ports. For example, there are about 130 seaports handling containers of which around 40 accommodate intercontinental container services (ESPO/ITMMA, 2007). In the US/Canada there are only 35 seaports involved in containerization and only 17 of them are involved in the deepsea container trades.

Table 1. **The top 15 European container ports** (1985-2007, in 1000 TEU)

in 1000 TEU

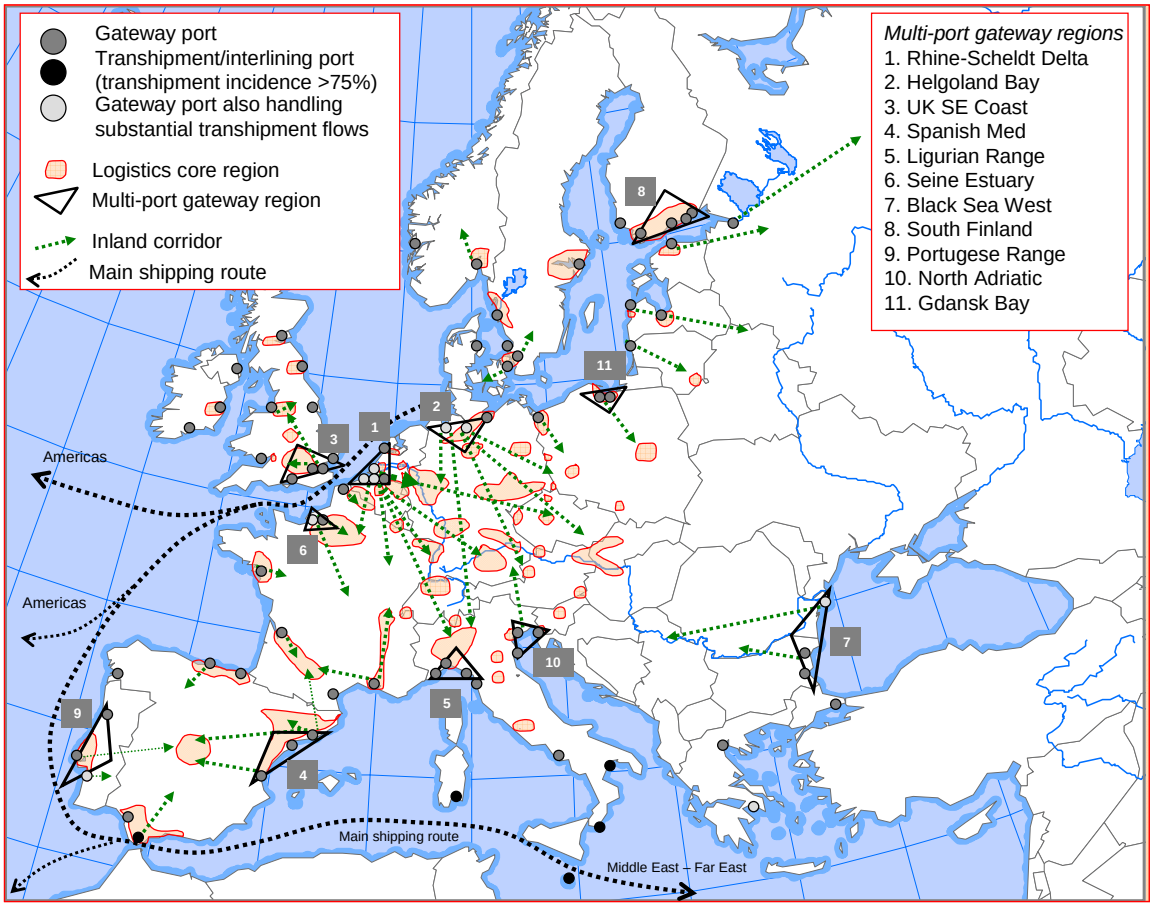
R	1985		1995		2000		2005		2006		2007	*R*
1	Rotterdam	2655	Rotterdam	4787	Rotterdam	6275	Rotterdam	9287	Rotterdam	9690	Rotterdam	10791	*1*
2	Antwerp	1243	Hamburg	2890	Hamburg	4248	Hamburg	8088	Hamburg	8862	Hamburg	9890	*2*
3	Hamburg	1159	Antwerp	2329	Antwerpen	4082	Antwerpen	6488	Antwerpen	7019	Antwerpen	8177	*3*
4	Bremen	986	Felixstowe	1924	Felixstowe	2793	Bremen	3736	Bremen	4450	Bremen	4912	*4*
5	Felixstowe	726	Bremen	1518	Bremen	2752	Gioia Tauro	3161	Algeciras	3245	Gioia Tauro	3445	*5*
6	Le Havre	566	Algeciras	1155	Gioia Tauro	2653	Algeciras	2937	Felixstowe	3080	Algeciras	3415	*6*
7	Marseille	488	Le Havre	970	Algeciras	2009	Felixstowe	2700	Gioia Tauro	2938	Felixstowe (**)	3200	*7*
8	Leghorn	475	La spezia	965	Genoa	1501	Le Havre	2287	Valencia	2612	Valencia	3043	*8*
9	Tilbury	387	Barcelona	689	Le Havre	1465	Valencia	2100	Barcelona	2317	Le Havre	2641	*9*
10	Barcelona	353	Southampton	683	Barcelona	1388	Barcelona	2096	Le Havre	2310	Barcelona	2610	*10*
11	Algeciras	351	Valencia	672	Valencia	1310	Genoa	1625	Genoa	1657	Zeebrugge	2021	*11*
12	Genoa	324	Genoa	615	Piraeus	1161	Piraeus	1450	Zeebrugge	1653	Marsaxlokk (**)	1900	*12*
13	Valencia	305	Piraeus	600	Southampton	1064	Marsaxlokk	1408	Southampton	1500	Genoa	1855	*13*
14	Zeebrugge	218	Zeebrugge	528	Marsaxlokk	1033	Southampton	1395	Marsaxlokk	1485	Southampton (*)	1800	*14*
15	Southhampton	214	Marsaxlokk	515	Zeebrugge	965	Zeebrugge	1309	Piraeus	1399	Constanza	1411	*15*
	TOP 15	10450	TOP 15	20841	TOP 15	34698	TOP 15	50067	TOP 15	54217	TOP 15	61111	
	TOTAL Europe	17172	TOTAL Europe	33280	TOTAL Europe	51000	TOTAL Europe	73729	TOTAL Europe	79840	TOTAL Europe	89990	
	Share R'dam	*15%*	*Share R'dam*	*14%*	*Share R'dam*	*12%*	*Share R'dam*	*13%*	*Share R'dam*	*12%*	*Share R'dam*	*12%*	
	Share top 3	*29%*	*Share top 3*	*30%*	*Share top 3*	*29%*	*Share top 3*	*32%*	*Share top 3*	*32%*	*Share top 3*	*32%*	
	Share top 10	*53%*	*Share top 10*	*54%*	*Share top 10*	*57%*	*Share top 10*	*58%*	*Share top 10*	*58%*	*Share top 10*	*58%*	
	Share top 15	*61%*	*Share top 15*	*63%*	*Share top 15*	*68%*	*Share top 15*	*68%*	*Share top 15*	*68%*	*Share top 15*	*68%*	

(*) Estimate based on growth first 8 months
(**) Estimate

Source: author based on traffic data respective port authorities.

Table 1 provides an overview of the fifteen largest container load centres in Europe. A number of these ports act as almost pure transhipment hubs with a transhipment incidence of 75% or more (i.e. Gioia Tauro, Marsaxlokk, Algeciras) while other load centres can be considered as almost pure gateways (e.g. Valencia, Genoa, Barcelona) or a combination of a dominant gateway function with sea-sea transhipment activities (e.g. Hamburg, Rotterdam, Le Havre, Antwerp and Constanza). About two thirds of the total container throughput in the European port system passes through the top fifteen load centres, compared to 61% in 1985. One-third of all containers is handled by the top three ports, whereas this figure was 29% in 1985. Worth mentioning is that the dominance of market leader Rotterdam has somewhat weakened, while upstream ports Antwerp and Hamburg were able to strengthen their position (respectively from 7.1% in 1985 to 9.1% in 2007 and 6.7% to 11%). Concentration studies report that the cargo concentration index in Europe is rather high compared to the US/Canada and Asia, but slightly decreasing in the last decade, implying an increasing number of European ports is present on the competitive scene (Notteboom, 2006). This is in sharp contrast to North-America where more and more cargo is being channelled through only a few ports. The European port scene is therefore becoming more diverse in terms of number of ports involved and the scope of port functions and services, leading to more routing options to shippers.

Figure 3. **The European container port system and logistics core regions in the hinterland**



Source: Notteboom – ITMMA.

Comparisons of container throughput figures are typically based on individual ports. This might be misleading when analyzing the gateway function of specific port regions. An alternative approach consists in grouping load centres within the same gateway region together to form multi-port gateway regions. The locational relationship to nearby identical traffic hinterlands is one of the criteria that can be used to cluster adjacent load centres. In cases there is no coordination between the ports concerned,

the hinterland is highly contestable as several neighbouring gateways are vying for the same cargo flows. The often complex linkages in the governance and management of port areas and terminals within the same multi-port gateway region received quite some attention in academic literature. A good example is the port governance book edited by Brooks and Cullinane (2006) discussing the situation in many gateways and hubs, also in Europe. Charlier (1996) and Notteboom (2007) paid special attention to the Rhine-Scheldt Delta in the Benelux.

Figure 3 provides an overview of the main multi-port gateway regions in Europe as well as transhipment hubs and stand-alone gateways. Table 2 gives the associated container volumes, while Figure 4 contains pie charts for 1985 and 2007. The following conclusions can be drawn:

- The Rhine-Scheldt Delta and the Helgoland Bay ports, both part of the so-called Le Havre-Hamburg range, together represent 40% of the total European container throughput. The market share of the Rhine-Scheldt Delta is quite stable, while the North-German ports have gained market share, mainly because of Hamburg's pivotal role in feeder flows to the Baltic and land-based flows to the developing economies in East and Central Europe.

- The Seine Estuary, the third region in the Le Havre-Hamburg range, suffered from a long decline in its market share. The tide was turned only very recently as a result of the 'renaissance' of Le Havre in the aftermath of the opening of the first 'Port 2000' terminals, combined with port productivity improvements. Le Havre's revival goes hand and hand with the ambition of the port to stretch its hinterland reach beyond the Seine basin (its core hinterland) and even across the French border, mainly supported by rail services.

- Among the major winners, we find the Spanish Med ports (from 3.9% in 1985 to 6.3% in 2007) and the Black Sea ports (from virtually no traffic to a market share of 1.7% in 2007). These ports have particularly benefited from the extension of the Blue Banana as outlined earlier (see later in this paper for a more detailed analysis).

- The Gdansk Bay ports and Portuguese port system were less successful so far. The Polish load centres are still bound by their feeder port status, competing heavily with main port Hamburg for the Polish hinterland. Portuguese ports Lisbon and Sines are trying very hard to expand business by developing a modest transhipment role as well as tapping into the market surrounding Madrid through rail corridor formation and dry port development (e.g. Lisbon's Puerta del Atlântico logistical platform in Mostoles in the outskirts of Madrid).

- Ligurian and North-Adriatic ports are typically challenged by the physical limitations to terminal capacity extensions (i.e. the locked-in geographical situation of the respective coastal port cities) and by the limited success so far in attracting a lot of business from the Alpine region and Southern Germany.

- Many of the load centres along the Southeast coast of the United Kingdom faced capacity shortages. To avoid delays, quite a number of shipping lines opted for the transhipment of UK flows in mainland European ports (mainly RS Delta and Le Havre) instead of calling at UK ports directly. With the prospect of new capacity getting on stream soon (e.g. London Gateway, Bathside Bay and Teesport) there is hope for more direct calls and potentially a slight increase in market share. Much will depend on whether the UK economy remains strong and will not be affected too much by the economic hick-ups of its main trading partner the US.

- Except for Piraeus, the larger stand-alone gateways in Europe have lost market share for various reasons. For example, despite its proximity to the economic centres along the Rhône corridor and Southern France, Marseille suffered from labour disputes and its rather remote location vis-à-vis the main shipping route (high diversion distance).

- Transhipment hubs in the Mediterranean have substantially increased their role in the container market. After a steep increase of the market share from 5.1% in 1995 to 11.2% in 2000, the market position further evolved to a peak of 12.2% in 2005. However, the last few years have brought a small decline to 11.4%. A more detailed discussion of the mechanism underlying this observation follows later in this paper.

Table 2. **Container throughput figures for the main multi-port gateway regions in Europe, the European transhipment hubs in the Mediterranean and a number of important stand-alone gateways** (1985-2007, in 1000 TEU)

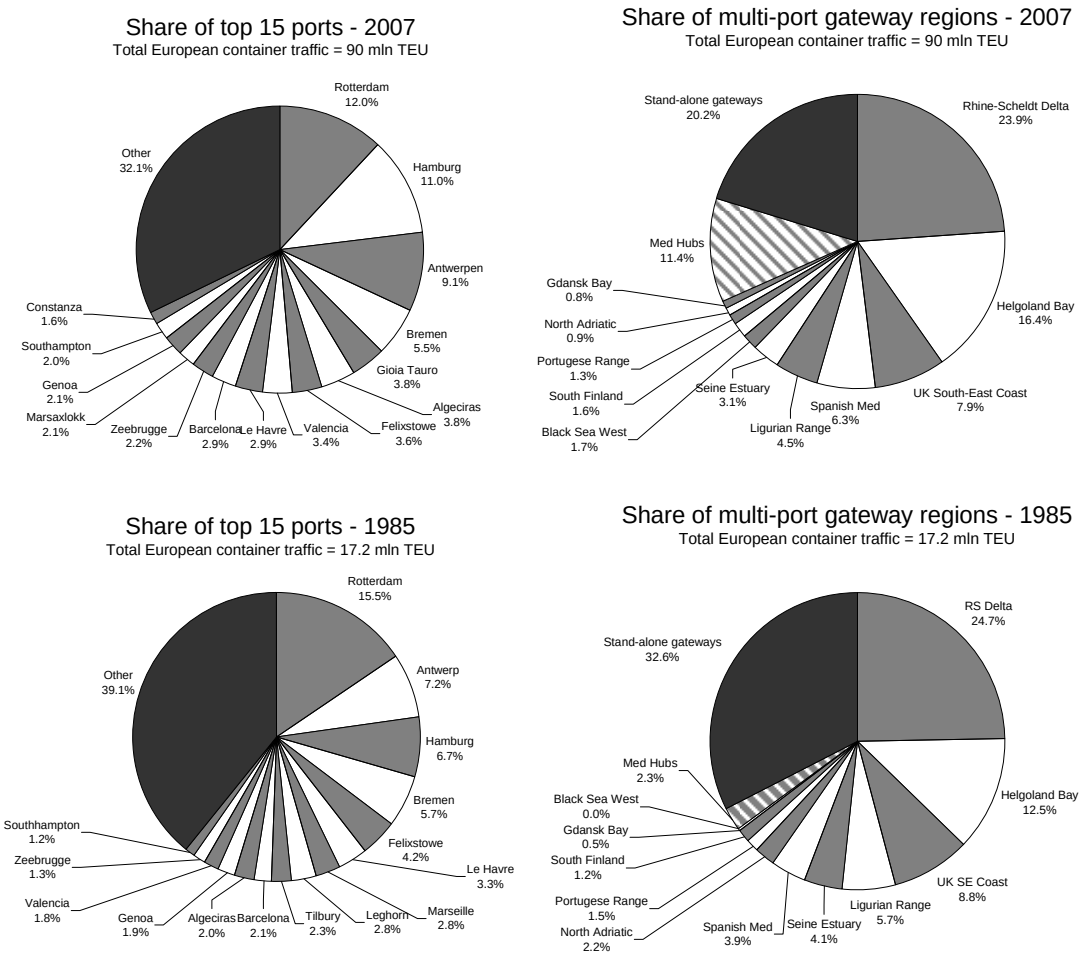
R	1985		1995		2000		2005		2006		2007	*R*
Main multi-port gateway regions in Europe												
1	RS Delta	4241	RS Delta	7747	RS Delta	11388	RS Delta	17327	RS Delta	18749	RS Delta	21463	*1*
2	Helgoland Bay	2145	Helgoland Bay	4430	Helgoland Bay	7110	Helgoland Bay	11871	Helgoland Bay	13382	Helgoland Bay	14802	*2*
3	UK SE Coast	1508	UK SE Coast	3543	UK SE Coast	5080	UK SE Coast	5722	UK SE Coast	6405	UK SE Coast (*)	7100	*3*
4	Ligurian Range	986	Ligurian Range	2051	Ligurian Range	2949	Spanish Med	4490	Spanish Med	4942	Spanish Med	5700	*4*
5	Seine Estuary	701	Spanish Med	1398	Spanish Med	2742	Ligurian Range	3528	Ligurian Range	3683	Ligurian Range (*)	4070	*5*
6	Spanish Med	676	Seine Estuary	1090	Seine Estuary	1610	Seine Estuary	2280	Seine Estuary	2295	Seine Estuary	2800	*6*
7	North Adriatic	376	South Finland	562	South Finland	773	South Finland	1120	South Finland	1221	Black Sea West	1561	*7*
8	Portugese Range	266	Portugese Range	470	Portugese Range	670	Portugese Range	916	Black Sea West	1182	South Finland	1395	*8*
9	South Finland (*)	200	North Adriatic	468	North Adriatic	606	Black Sea West	902	Portugese Range	1013	Portugese Range	1138	*9*
10	Gdansk Bay	83	Gdansk Bay	142	Gdansk Bay	206	North Adriatic	663	North Adriatic	688	North Adriatic (*)	788	*10*
11	Black Sea West	n.a.	Black Sea West	n.a.	Black Sea West	143	Gdansk Bay	470	Gdansk Bay	540	Gdansk Bay	711	*11*
Transhipment/interlining hubs in West and Central Med												
	Med Hubs	393	Med Hubs	1711	Med Hubs	5732	Med Hubs	9017	Med Hubs	9251	Med Hubs	10293	
Some important stand-alone gateways												
	Marseille	488	Piraeus	600	Piraeus	1161	Piraeus	1395	Piraeus	1399	Piraeus	n.a.	
	Gothenborg	317	Marseille	498	Marseille	722	Marseille	908	Marseille	941	Marseille	987	
	Piraeus	197	Gothenborg	461	Gothenborg	686	Gothenborg	788	Gothenborg	812	Gothenborg	n.a.	
	Bilbao	150	Liverpool	406	Liverpool	540	Liverpool	626	Liverpool	645	Liverpool	n.a.	
	Liverpool	133	Bilbao	297	Bilbao	434	Bilbao	504	Bilbao	523	Bilbao	555	

(*) Estimate

Notes:
Rhine-Scheldt Delta: Rotterdam, Antwerp, Zeebrugge, Amsterdam, Ghent, Zeeland Seaports, Ostend
Helgoland Bay: Hamburg, Bremen/Bremerhaven, Cuxhaven, Emden, Wilhelmshaven
UK South East Coast: Felixstowe, Southampton, Thamesport, Tilbury, Hull
Spanish Med: Barcelona, Valencia, Tarragona
Ligurian range: Genoa, Savona, Leghorn, La Spezia
Seine Estuary: Le Havre, Rouen
Black Sea West: Constanza, Burgas, Varna
South Finland: Helsinki, Kotka, Rauma, Hamina, Turku
Portugese range: Lisbon, Leixoes, Sines
North Adriatic: Venice, Trieste, Ravenna
Gdansk Bay: Gdynia, Gdansk

Source: author, based on traffic data respective port authorities.

Figure 4. **The decomposition of container throughput in the European container port system: an individual port perspective (left) versus a gateway region perspective (right)**



Source: author on the basis of data of the respective port authorities.

5. KEY HINTERLAND DEVELOPMENTS FOR THE COMPETITION IN AND BETWEEN GATEWAY REGIONS

5.1. The immediate hinterland as the backbone for port rivalry in a gateway region

While corridor development to distant hinterlands attracts more and more attention, local or immediate hinterlands remain the backbone of ports' cargo bases. Even large European gateways such as Rotterdam and Antwerp have a high proportion of container flows that is generated by the port city and its immediate region. About 40% of containers leaving or arriving at Antwerp by truck are coming from or going to markets within a radius of 50km of the port. The most significant distance class for Rotterdam is the 150-200km radius. This is directly related to the port's role as a cargo generating location linked to the strong manufacturing base of the immediate hinterland.

A major concern in many ports is the strong reliance of more local container volumes on trucks. While road haulage has always played a major role in shaping competition among load centres of the same multi-port gateway region for the immediate hinterland, intermodal transport is slowly but surely acquiring a strategic role as well, particularly as a means to create cargo islands (see earlier figure 1). Logistics sites in the immediate hinterland typically value the flexibility a multi-port gateway system offers in terms of available routing options for import and export cargo. In a logistics world confronted with mounting reliability and capacity issues, routing flexibility is one of the keystones for the logistics attractiveness of a region. For example, the logistics attractiveness of large parts of Belgium and the Netherlands for EDCs is partly due to the reality of having several efficient gateways at disposal.

A port with a strong local cargo base will sooner or later be tempted to increase the inland penetration of its intermodal offer so as to increase its capture area. From that moment on the existing dense network of direct shuttles to nearby destinations might be complemented by indirect inland services to more distant destinations built around one or more inland hubs. Extensive cargo concentration on a few trunk lines opens possibilities to economies of scale in inland shuttles (through the deployment of longer trains or larger inland barges) but even more likely to higher frequencies. Containers for the more distant hinterland benefit from a port's strong local cargo base as local containers often provide the critical mass for allowing frequent deepsea liner services.

5.2. Gateway regions increasingly vie for distant contestable hinterlands

In line with the first section of this paper, port competition in Europe has intensified as inland corridor formation has allowed load centres to access formerly captive hinterlands of other ports. Moreover, the rise of economic centres in Eastern and Central Europe creates opportunities for different multi-port gateway regions and standalone gateways to develop water-based and land-based transport networks to these areas. Major contestable hinterlands are increasingly being served not only by the ports of one gateway region, but by several multi-port gateway regions (see table 3). The Black Sea port region, Constanza in particular, could develop into a new gateway region to Europe. Constanza is strategically located at the eastern end of the pan-European waterway transport Corridor VII, which links the North Sea and the Black Sea as well as pan-European transport Corridor IV, linking Berlin and Istanbul over land. From the Suez Canal to Constanza is only 950 nm compared to 3400 nm to Rotterdam and many shipping lines have introduced direct services from the Far East with vessels in the range of 2000 to 3500 TEU (e.g. Bosporus Express of CMA-CGM and Tiger Service of MSC). The trend for Constanza to develop further into a major gateway for the region worries its Bulgarian competitors, but also opens up opportunities for land-locked countries such as the Czech Republic, Hungary and Austria to connect developing gateways in the east.

The multiplication of corridors brings about a change in the relationship between gateways and their hinterland. On the one hand, the inland penetration strategy is part of maritime gateways' objective of increasing their cargo base. On the other hand, interior regions are recognizing that it is in their interest to establish efficient links to as many gateways as possible. For example, the Czech Republic is upgrading its trans-European travel corridors intensively (in particular, the 4th corridor connecting Germany with South-Eastern Europe (Istanbul). This strategy not only prevents these regions from becoming captive to one specific gateway. It also improves the locational qualities of these interior economic centres. Hence, the linking up to more gateways implies more routing options and flexibility for shippers and logistics service providers who want to set up business in the region. The performance profile of each of the corridors in terms of infrastructure provision (capacity), transport operations (price and quality of the shuttle services) and the associated logistical control (i.e. the management in a supply chain context) is a key attribute for this kind of competitive play among various multi-port gateway regions.

Table 3. **The position of major multi-port gateway regions vis-à-vis important contestable hinterland areas in Europe**

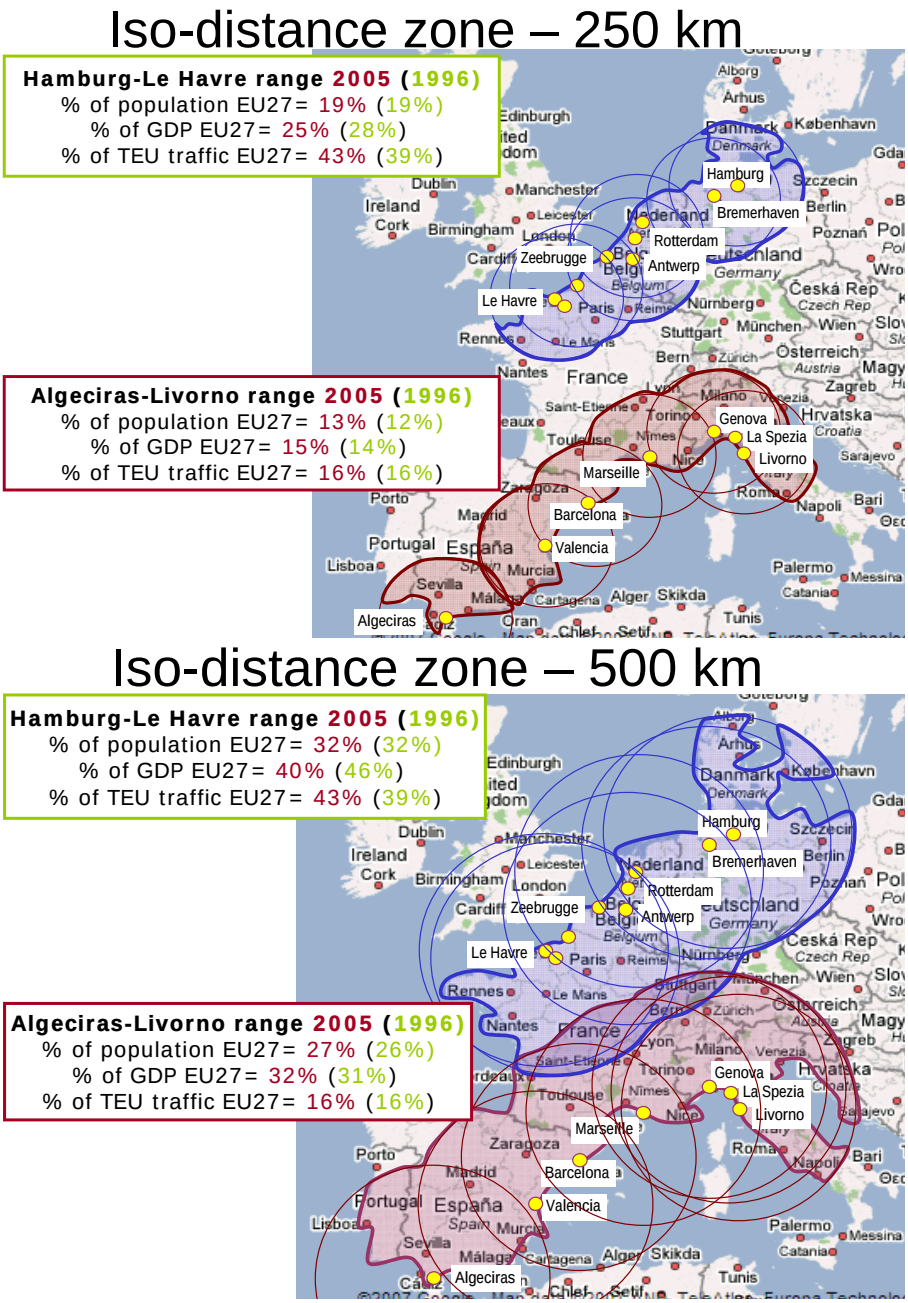
	West Germany (Ruhr area, Baden-Württemberg, ..)	South Germany Alpine countries	Madrid and surroundings	Southern Poland Czech Republic Hungary	Northern Italy	Southern France
Rhine-Scheldt Delta	+	+	-	+ (Rott.) / °	+	+ (Antw.) / -
Helgoland Bay	+	+	-	+	+	-
Spanish Med			+			- / + (Barc.)
Ligurian Range		x / °			+	x
Seine Estuary	°	-				+
Black Sea West		°		° / +		
Portugese Range			°			
North Adriatic		x / °		x / °	+	
Gdansk Bay				x / °		

+ = major hinterland region for gateway region, successful intermodal services
x =potentially major hinterland region for gateway region, but success limited
- = minor hinterland region for gateway region
° =potential hinterland region for gateway region, intermodal services planned or started-up recently

5.3. The North-South balance in perspective

The dominance of ports in the Le Havre – Hamburg range (particularly the Rhine-Scheldt Delta and the Helgoland Bay) in Europe is very apparent when looking at throughput statistics (see earlier). This observation fuels a decades-old debate on what some observers call the 'unhealthy' balance between North and South. Evidence provided in figure 5 demonstrates the imbalance not only exists, it has even grown stronger in the last decade despite an increasing participation degree of mainland Med ports in international shipping networks. While the share of the immediate hinterland of the northern range ports in the GDP of the EU27 decreased in the period 1996-2005, the container cargo share increased significantly. The joint market share of the Le Havre-Hamburg range ports in liner services between the Far East and Europe is estimated at 76%, compared to 24% for West Med ports (Milà, 2008). In the 1980s the Europe–Far East trade was still totally concentrated on Northern range ports. The more local gateway function of mainland Med ports versus a sometimes European wide gateway position (including transhipment flows and land-based intermodal corridors) of ports such as Hamburg, Rotterdam and Antwerp is a major cause for the observed imbalance.

Figure 5. **The relative shares of iso-distance zones for the Hamburg-Le Havre range and the Algeciras-Livorno range** (1996 versus 2005)



Source: compiled on the basis of GDP and population statistics of Eurostat (Nuts II- level) and traffic figures provided by the respective port authorities.

In theory, mainland Mediterranean ports offer transit time advantages over the north European ports for accommodating cargo flows between Asia/Middle East and large parts of Southern and Central Europe (time savings for vessels of up to 5 days). In practice, only Spanish Med ports have been successful (in large part due to the strong economic growth in Catalonia) while Italian and French Med ports lag behind in growth (see figures outlined earlier).

Italy is somewhat a special case for intra-med trade. While France and Spain are mainly involved in North–South trade, Italy could also represent a gateway for trades with Eastern Europe (Ferrari et al, 2006). However, Cazzaniga and Foschi (2002) demonstrate that north Italian ports collect only a very small portion of the merchandise of the area extending from Bavaria to Hungary. Even worse, significant flows of Italian cargo do not sail from Italian ports but from ports in the Rhine-Scheldt Delta and the Helgoland Bay. There is improvement though. Cazzaniga and Foschi (2002) indicate that North Italian ports increased their market share in total Northern Italian container flows on the Far East trade from 70% in 1995 to 81% in 2001 compared to a reduction of the market share of the Northern ports from 30% to 19% (no recent figures are available). About half of the latter flows (Northern Europe–North Italy) is going by rail (a share that is still increasing) and the remainder by truck. Note that rail has a market share of 25% in Genoa and La Spezia. The percentages of cargo shipped via northern Europe are thus showing a tendency to decrease, but some observers argue this process is far too slow considering that many shipping lines now have direct mainline vessel calls in the Med.

Gateway ports in the west Med have indeed gained a much better connectivity in the global shipping networks than before, which gives these ports the opportunity to benefit from a higher critical mass and the economies linked to larger vessels. But so far, they seem to have difficulties in substantially extending their hinterland reach north through rail services (Gouvernal et al, 2005). While Spanish ports face a major technical problem in setting up rail shuttles to France (i.e. the difference in gauge), the North-South paradox for North-Italian cargo is mainly linked to a weaker intermodal organizational performance for intra-Italian rail products, and existing (but converging) differences in port efficiency between Northern ports and North Italian ports. Moreover, a smaller critical rail volume makes that frequent rail services are hard to maintain and sometimes disappear soon after introduction.

Several initiatives are underway with the objective of improving the position of the Med ports. Next to major terminal expansion plans in ports such as Barcelona, Valancia, Marseille and Genova, West Med ports' latest investment strategies include a range of logistics platforms both in seaports and in strategic inland locations (e.g. the tm-concept of the Barcelona port authority, see later in this paper), but at the moment these inland operations are mostly modest generating only small volumes. To attract Asian trade distribution to the region, the ports of Barcelona, Marseilles and Genoa have joined their marketing efforts under the umbrella of the association Intermed. The range of actions also includes corridor formation. Next to south-north corridors (mainly rail) included in DG TREN's TEN-T program, the FERRMED association aims at the development of a reticular and polycentric railway axis reaching from the southern part of Spain all the ways to the core economic regions in the Benelux and Germany and further north to Stockholm. The FERRMED axis wants to offer an alternative to the high-volume Rhine-Rhône-Occidental Mediterranean axis.

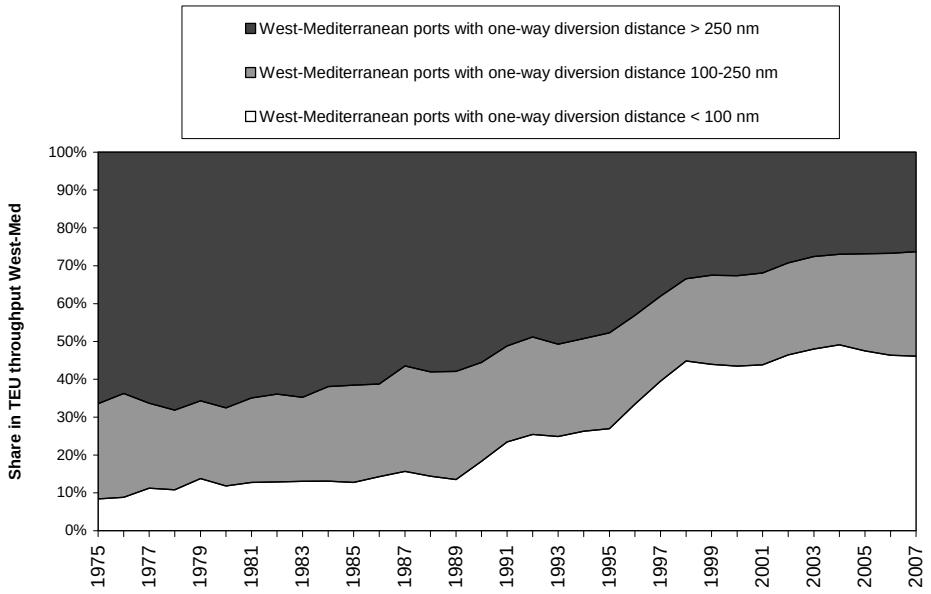
All these initiatives are taken in a market environment where northern range ports are also very active in intensifying their intermodal networks, mainly to inland service areas in France, Germany, the Alpine region and East and Central Europe. The range and diversity of the intermodal service offer of the large load centres in the north is still far bigger and more established than their Mediterranean counterparts. As it is highly unlikely this gap is going to be bridged in the foreseeable future, the 'presence' of northern load centres in south European container markets remains a market-driven reality.

5.4. Transhipment hubs under scrutiny and its impact on inland freight distribution

Not all ports in Europe are gateways. A number of terminals mainly rely on their role as turntables or hubs in extensive maritime hub-and-spoke/relay/interlining networks. In the Mediterranean, extensive hub-feeder container systems and short sea shipping networks emerged since the mid 1990s to cope with the increasing volumes and to connect to other European port regions (figure 6). Terminals are typically owned, in whole or in part, by carriers which are efficiently using these facilities.

Marsaxlokk on Malta, Gioia Tauro, Cagliari and Taranto in Italy and Algeciras in Spain act as turntables in a growing sea-sea transhipment business in the region. These sites were selected to serve continents, not regions, for transhipping at the crossing points of trade lanes, and for potential productivity and cost control. They are typically located far away from the immediate hinterland that historically guided port selection.

Figure 6. **The market shares of ports in the West Mediterranean. Ports grouped according to the diversion distance from the main shipping route (1975-2007)**



Source: aggregation by author based on statistics respective port authorities.

The market share of the transhipment hubs in total European container throughput peaked in 2005 (12.2%) but since then started to decline to 11.4% as volume growth in mainland ports allowed shipping lines to shift to direct calls. While some shipping lines still rely on the hub-and-spoke configuration in the Med, others decided to add new line-bundling services calling at mainland ports directly. Maersk Line, MSC and CMA-CGM are modifying their service patterns, giving increasing priority to gateway ports. In reaction, mainly Italian transhipment hubs are reorienting their focus, now serving Central and East Med regions. Algeciras (stronghold of APM Terminals of the AP Moller Group) relies a lot on east-west and north-south interlining and is facing competition from newcomer Tangermed where APM Terminals has also set up business recently. The net result of the above developments has been a slight decline in the market share of the West Med hubs in recent years (figure 6). The transhipment business remains a highly 'footloose' business. This has led some transhipment hubs such as Gioia Tauro and Algeciras to develop inland rail services to capture and serve the economic centres in the distant hinterlands directly, while at the same time trying to attract logistics sites to the ports.

The creation of 'offshore' hubs does not occur in all port systems. Northern Europe up to now does not count any real transhipment hub, let alone an offshore hub. Hamburg, the North-European leader in terms of sea-sea flows, has a transhipment incidence of merely 40%, far below the elevated transhipment shares in the main south European hubs (85% to 95%). It is generally expected that the transhipment shares of future newcomers Flushing and Wilhelmshaven might slightly exceed 40%. The only somewhat concrete plan for a real North-European offshore hub relates to a proposed transhipment facility at the natural deep-water harbour at Scapa Flow in the Orkney Islands.

Baird (2006) argued that alternative port sites such as Scapa Flow could provide a superior and more competitive location from which to support the fast expanding transhipment markets of northern Europe. Notwithstanding such a plea, market players have not adopted the idea of bringing a northern offshore hub into reality.

The dynamics in the transhipment business has implications on freight distribution patterns in Europe. A hub-and-spoke based network means less cargo concentration in mainland destination ports and as such a more dispersed or fragmented inland transport system. Alternatively, traffic growth can lead to an undermining of the position of transhipment hubs in favour of a limited number of large-scale mainland ports, each connected to intermodal corridors. This brings us back to the discussion on inland services of the Med ports as outlined in the previous section.

5.5. The challenge of the periphery

The geographical literature on the development patterns in seaport systems suggests an increasing level of port concentration as certain hinterland routes develop to a greater extent than others in association with the increased importance of particular urban centres (Taaffe et al, 1963). The geographical system would evolve from an initial pattern of scattered, poorly connected ports along the coastline to a main network consisting of corridors between gateway ports and major hinterland centres. These models thus suggest that large ports, which invested early in container infrastructure, attract more and more container traffic. The resulting port concentration would cause degradation of minor ports in the network. In the 1980s, some authors suggested cargo concentration will reach a limit giving rise to smaller ports or new ports to acquire a place in the market (Barke, 1986 and Hayuth, 1981). The challenge of the periphery supports the transition of a single gateway situation to a multi-port gateway region. Many gateway regions in Europe have witnessed a recent multiplication of load centres or will witness a multiplication in the future. The main challengers in each gateway region are listed in the last column of table 4.

Table 4. **Evolution of the share of the market leader in the multi-port gateway region** (in %)

	1985	1995	2007	Trend for market share of leader	Main challengers in the periphery
RS Delta	62.6	61.8	50.3	Decreasing, leader unchanged (Rotterdam)	Zeebrugge (+), Amsterdam (-), Flushing (?)
Helgoland Bay	54.0	65.2	66.8	Increasing, leader unchanged (Hamburg)	Wilhelmshaven (°), Cuxhaven (x)
UK SE Coast	48.1	54.3	47.3	Fluctuation, leader unchanged (Felixstowe)	London Gateway (°), Bathside Bay-Harwich (°) Dibden Bay (X), Teesport (?)
Spanish Med	52.2	49.3	53.4	Fluctuation, change in leader (Valencia overtook Barc.)	-
Ligurian Range	48.2	30.0	45.6	Fluctuation, change in leader (Genoa overtook Leghorn)	-
Seine Estuary	80.8	89.0	94.3	Increasing, leader unchanged (Le Havre)	-
Black Sea West	n.a.	n.a.	90.4	Increasing, leader unchanged (Constanza)	-
South Finland	n.a.	60.3	40.9	Decreasing, change in leader (Kotka overtook Helsinki)	Kotka (+)
Portugese Range	57.9	58.4	48.7	Recent decrease, leader unchanged (Lisbon)	Sines (+)
North Adriatic	50.5	41.3	41.3	Fluctation, change in leader (Venice overtook Ravenna)	Trieste (+)
Gdansk Bay	100.0	99.6	86.4	Decreasing, leader unchanged (Gdynia)	-

(+) (some) terminal(s) already in operation; strong results
(-) (some) terminal(s) already in operation; moderate results
(°) Terminal under construction
(?) No container terminal yet, planning phase
(x) Container terminal was planned, but plans abandonned or rejected

Source: based on data respective port authorities and specialized press.

Centripetal forces that support the so-called 'peripheral port challenge' include (a) the new requirements related to deep-sea services (e.g. good maritime and inland accessibility, availability of terminal and back-up land and short vessel turnaround times), (b) strong growth in the container market and (c) potential diseconomies of scale in the existing load centres in the form of lack of space for further expansion or congestion (see e.g. Hayuth, 1981, Slack & Wang, 2002, Notteboom, 2005, Frémont & Soppé, 2007). The markets also exert a range of centrifugal forces favouring a sustained

strong position of established large load centres vis-à-vis medium-sized and new terminals. First, the planned additional terminal supply in small and medium-sized ports is typically overshadowed by massive expansion plans in established larger seaports. For example, Notteboom (2007) demonstrated that in the best case scenario, the market share of the small and medium-sized ports in the Le Havre-Hamburg range could increase from 7.1% in 2006 to approximately 16% past 2015, with 75% of the capacity bring added by the large load centres. Major shifts in existing port hierarchy are unlikely. Second, new entrants in the terminal market often have to overcome major issues such as securing hinterland services, their relative inexperience in dealing with stakeholder-related procedures linked to large terminal projects and a weak cargo-generating and cargo-binding potential (typically as a result of a lack of associated forwarders' and agents' networks). New transhipment hubs generally face less of these problems given their remote locations, their weak reliance on hinterland connectivity and their strong link with one or few shipping line(s) that will use the facilities as turntables in their liner networks (operational push instead of market pull).

The hinterland connectivity issue deserves special attention. Large load centres to a greater or lesser extent experience a virtuous cycle. The concentration of large deepsea container volumes in one place makes it easier to build up an extensive network of intermodal services and this in itself attracts even more cargo (partly triggered by economies of scale and density). Small-scale container ports often lack volumes to develop a network of frequent shuttle trains. This in itself can contribute to a perceived lower attractiveness of the port. In view of escaping this imminent vicious cycle, smaller ports tend to shuttle substantial container flows to larger ports in the region (inter-port traffic) in view of linking up to the extensive hinterland network available there. The development of inland hubs in the immediate hinterland opens opportunities for smaller ports to use the extensive hinterland networks even without having to rely on the established load centres directly. The inclusion of such bundling points in the hinterland thus promotes the formation of a multi-port gateway region and increases the complexity and range of possible routing patterns. The minimum cargo volume needed to set up a network of direct shuttles is affected by the level of cargo dispersion in the service area of the port. A port that only serves a dense local economic cluster will obviously face less difficulty in developing a regular inland service than a port handling containers for a large number of final destinations dispersed over a vast hinterland.

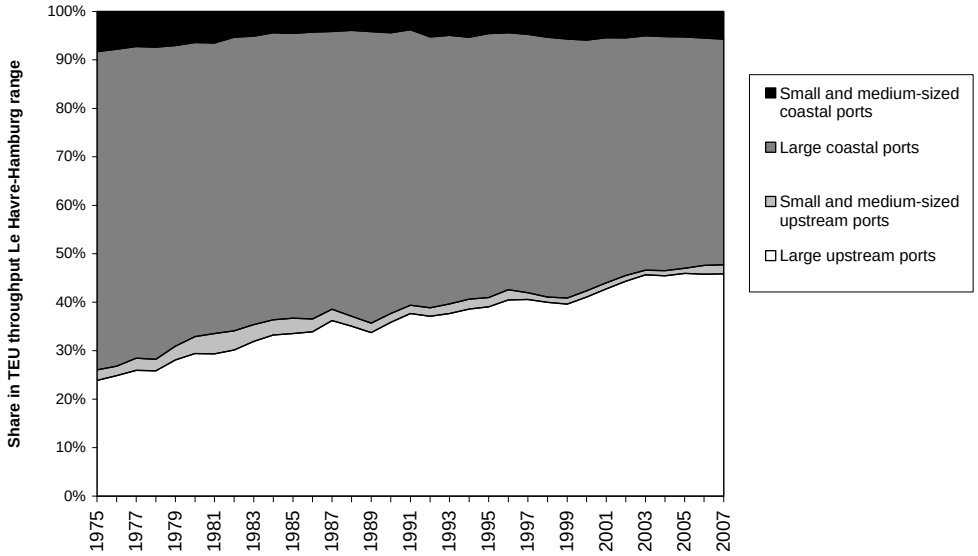
5.6. Port competition and the role of upstream ports

With a growing demand for a good nautical accessibility and a fast turnaround time for the ever larger container vessels one could assume that the days for upstream ports are counted (see e.g. Baird, 1996). While in the Med, transhipment hubs with a low diversion distance have succeeded in gaining a position in the market, the north European port system seems to have been going another direction. Large upstream ports, i.e. basically Antwerp and Hamburg, have gradually gained market share at the expense of coastal ports (see figure 7). Since 2003, however, the share has stabilized at around 46%, mainly due the rise of Zeebrugge, the recent revival of Le Havre and a regained growth path in Rotterdam after several years of stagnation.

Although the discussion on downstream versus upstream load centres can not be generalized, there still exists a competitive potential for upstream ports in northern Europe. First of all, the growing gap between inland transport costs and maritime freight costs supports direct calls at an upstream port, certainly when the port's immediate hinterland has a strong cargo-generating power (as is the case for Antwerp and Hamburg) and when the upstream port succeeds in outperforming downstream ports in terms of terminal productivity, prices and integrated value-added services, all this in order to compensate for the extra sailing time. Antwerp and Hamburg have gained a status of 'must call' port in the eyes of quite a number of shipping lines. A relatively high proportion of container traffic is handled for a multitude of smaller shippers. Major freight forwarders utilize these ports major groupage centres. Merchant haulage is particularly strong in Antwerp with small and large forwarders controlling about 70-75% of the inland movements, attracting shipping lines to this cargo base. Draft limitations remain the worst threat to the position of upstream ports mainly on the Europe-Far East

trade. Both Antwerp and Hamburg have responded to the realities in the liner market by engaging in extensive dredging programmes to guarantee access for the largest generation of post-panamax vessels.

Figure 7. **Evolution of the market shares in the Le Havre-Hamburg range**



Source: aggregation by author based on data respective port authorities.

The future outlook will largely depend on the balance of power between the 'cargo follows ship' principle versus the 'ship follows cargo' principle. Shipping lines are massively prepared to call at upstream ports Antwerp and Hamburg in large part because of their high cargo generating performance and the savings they can make in onward inland transportation distances. This demonstrates the design of liner services is not only function of carrier-specific operational factors, but also of shippers' needs (for transit time and other service elements) and of shippers' willingness to pay for a better service.

6. THE ROLE OF RELEVANT ACTORS IN THE STRUCTURING OF HINTERLAND NETWORKS

6.1. Co-operation, logistics integration and market pull in the intermodal offer

It was already mentioned earlier, the ultimate success of a port will depend on the ability to integrate the port effectively into the networks of business relationships that shape supply chains. In other words, the success of a seaport is being more and more determined by the ability of the port community to fully exploit synergies with other nodes and other players within the logistics networks of which they are part. A study by Song and Panayides (2008) revealed that the most important parameters that contribute to port/terminal integration in supply chains relate to technology, value added services, the relationship with clients and liner operators, the facilitation of intermodal transport and channel integration practices. Many of these factors go beyond the narrow geographical limits of the port, thereby confirming the need for an increasing focus on the notion of the *borderless mainport* (Van Klink, 1995) and on *port regionalization* as the newest phase in the functional development of

load centres and port systems (Notteboom and Rodrigue, 2005). Regionalization expands the hinterland reach of the port through a number of strategies linking it more closely to inland freight distribution centres. The port regionalization phase is characterized by a strong functional interdependency and even joint development of a specific load centre and (selected) multimodal logistics platforms in its hinterland, ultimately leading to the formation of a regional load centre network or logistics pole. The port system consequently adapts to the imperatives of distribution systems as supply chain management strategies finally permeate to transport operations and transport infrastructure.

This plea for creating synergies beyond the port perimeter and across market players is particularly relevant in the context of hinterland connections. In an attempt to expand the port's cargo base, to generate revenue and to add value to the customers, ports have all implemented ways of moving cargo as efficiently as possible through the port and on to intermodal corridors. None of the ports has been able to achieve these outcomes alone. They are all dependent on the development of an innovative range of relationships and network formations with transport operators, logistics service providers and other transport nodes. Coordination and cooperation is needed to form an integrated intermodal service that complies with the requirements imposed by the supply chains that pass through the port. Van Der Horst and De Langen (2008) made a detailed analysis of the coordination problems in hinterland chains of seaports and arrangements to resolve these problems. They distinguish four main categories of arrangements to improve coordination: the introduction of incentives (e.g. a bonus or penalty), the creation of an inter-firm alliance (e.g. through the introduction of standards for quality and service or a joint capacity pool), changing the scope of the organization (e.g. through vertical integration or the introduction of a chain manager) and collective action (e.g. through the governance by a port authority or a concerted action by a branch association, see also De Langen and Chouly, 2004).

The dynamics in contemporary port-hinterland relationships is thus not taking place in a vacuum, but is articulated by the joint strategic and operational decisions of the actors involved. This need for coordination is also rooted in the belief that the private interests of individual companies will not lead to the creation of efficient and extensive pan-European intermodal networks (Stone and Verbeke, 1997). Companies cannot be expected to be the promoters of an intermodal network system that leads to higher efficiency at the macro-level rather than the level of the firm.

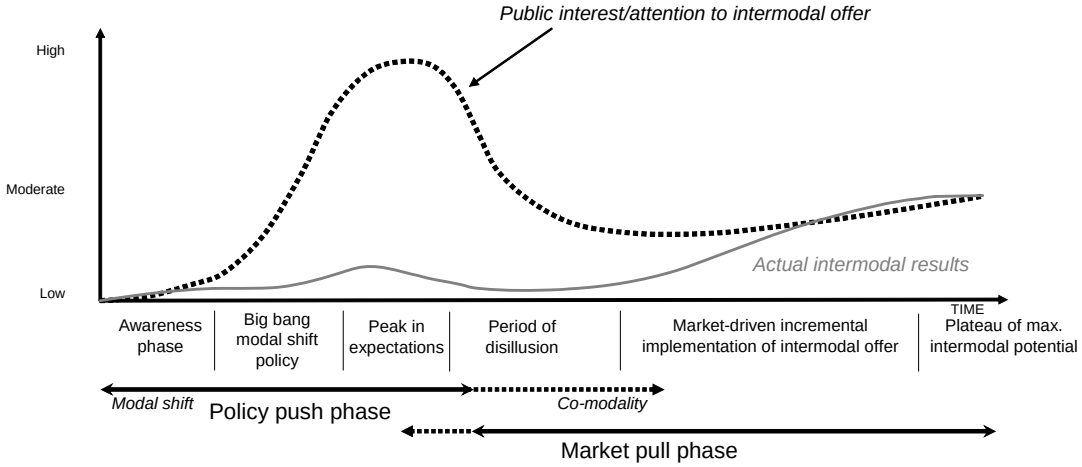
The call for cooperation and coordination is materializing against the backdrop of large scale consolidation and vertical integration in the logistics industry. Most actors have responded to the globalization and outsourcing trends by providing new value-added services in an integrated package, through a vertical integration along the supply chain, and by significantly expanding the scale of operations via a series of mergers and acquisitions. The observed vertical integration strategies of the market players have blurred the traditional division of tasks within the logistics chain but at the same time improved the coordination between segments of the chain, see e.g. Robinson (2002) and Notteboom and Winkelmans (2001). Customers' need for a wider array of global services and for truly integrated services and capabilities (design, build and operate) triggered a shift from transportation-based 3PLs to warehousing and distribution providers and at the same time opened the market to innovative forms of non-asset based logistics service provision, i.e. 4PL (Fourth Party Logistics). Mergers and acquisitions have permitted the emergence of large logistics operators that control many segments of the supply chain. Through a vertical and horizontal integration of their activities market players such as shipping lines, forwarders, transport operators and logistics groups seek to reduce costs, to improve efficiency, to generate revenue and to deliver value and a 'one-stop shop' service to the customer. The provision of integrated services does not always need to coincide with the ownership of the related assets. In many cases, the integration is achieved through close partnerships with other players.

Each of the actors involved approaches hinterland issues from their respective viewpoints and objectives. Logistics service providers and transport operators all have their specific operational and commercial reasons to get involved in the shaping of hinterland networks. Notwithstanding potential objective struggles and varying levels of logistics integration, they have some shared interests when it

comes to hinterland issues. First of all, logistics service providers, shipping lines, terminal operators and transport operators are facing major challenging in the cost structure (e.g. pricing systems, fuel costs) and the reliability and synchronization of inland transport services. Secondly, all these market players expect government regulation and liberalization to support their efforts to create efficient hinterland transport networks.

In the 1990s, European and national policy makers showed a strong urge to almost 'force' a modal shift, backed by the liberalization (or at least the start of it) of the barge and rail markets, new pricing tools and extensive subsidy and supporting programs (e.g. PACT). The market players reacted only moderately to the incentives in this 'policy push' phase, even at the peak of the modal shift hype (figure 8). As a result, the modal split trends remained almost unchanged. The last years have seen a more bottom-up approach mirroring a clear market-driven interest from the users and suppliers of intermodal services (market pull) and more initiatives aimed at a better coordination. The market players are spontaneously launching new intermodal initiatives or jointly tackle existing obstacles, while at the same time the push component at the policy side has somewhat softened. In more recent policy documents, the European Commission has adopted the 'co-modality' concept to move away from the 'road against all other modes' connotation linked to the modal shift concept.

Figure 8 **Policy push and market pull in achieving a modal shift and co-modality**



Source: Author, combining insights from the Gartner Group on the hype cycle of emerging technologies and Button (2007) on transport policy development (big bang versus incremental).

The transition to a more market pull environment has allowed some ports to achieve a partial modal shift in hinterland transport in recent years, but rail and inland navigation still have not reached their maximum potential (see modal split figures in annex 3). For example, container transport by barge is slowly becoming more important in navigation areas outside the Rhine and the Benelux countries with positive effects on barge traffic in ports such as Hamburg, Le Havre and Marseilles. Container transport by rail has seen a spectacular development in German ports and Zeebrugge, while other both small and large ports are implementing strategies (backed up by infrastructure and rail liberalisation) to significantly increase the market share of rail in the modal split after years of stagnation or relative decline. As mentioned earlier, smaller ports and new terminals often find themselves confronted with a vicious circle in the organization of hinterland transportation, which complicates a further modal shift in many ports around Europe and could impede the development of new multimodal corridors.

The following sections will discuss the impact of horizontal and vertical relations in supply chains on the structure of these chains and on the relationships between seaports and inland ports. It will be identified who takes or should take the lead in the further integration of ports and inland ports and what actions have been taken so far by the market players in this respect. We will analyze in particular the role of shipping lines, terminal operators, land transport operators and port authorities.

6.2. Shipping lines and the hinterland

In recent years, substantial take-over activity took place both on the shipping lines' side, where mergers have created a handful of gigantic companies controlling several hundred ships. The top twenty carriers controlled 26% of the world TEU-slot capacity in 1980, 41.6% in 1992, 54% in 1999 and 81.4% in 2007. AP Moller-Maersk started the latest consolidation wave with the takeover of P&O Nedlloyd in August 2005. TUI AG (Hapag-Lloyd's parent company) responded with the purchase of CP Ships, while French line CMA CGM acquired the shipping interests of Bolloré (including Delmas, OTAL, Setramar and Sudcargos). Maersk Line had a market share of more than 16% in 2007 based on the number of TEU slots deployed worldwide and has more than double the fleet size of runner-up MSC and more than three times the fleet size of CMA CGM. Between them, these three carriers controlled more than 33% of the cellular TEU-capacity in 2007 (figures ASX Alphaliner). This obviously gives them enormous bargaining power vis-à-vis terminal operators and port authorities. Some industry observers argue that we could be on the verge of further consolidation in the liner shipping industry in the years to come. In March 2008, TUI announced that they might consider selling Hapag-Lloyd, with NOL/APL as the most likely buyer. However, a further massive consolidation would be unlikely to escape the scrutiny of regulatory bodies such as the European Commission.

Container shipping lines are well aware of the growing importance of the land leg. Scale increases in vessel size and alliance co-operation have lowered ship system costs, but at the same time intermodal costs share an increasing part of the total cost. The portion of inland costs in the total costs of container shipping typically ranges between 40% and 80%. The shift from vessel costs to landside costs is enhanced by transport price evolutions. For example, the freight rate and additional charges (including BAF, CAF and THC, but excluding administrative costs and time costs) on a port-to-port basis with a post-panamax vessel between Shanghai and the Rhine-Scheldt Delta amount to some Euro 0.12 per FEU-km (Euro 2300 for 11000nm), while inland haulage per truck from north European ports usually ranges from Euro 1.5 to 4 per FEU-km depending on distance and weight. By barge the price ranges between € 0.5 and 1.5 per FEU-km (excluding handling costs and pre- and endhaul by truck - CCS figures). The price difference per FEU-km between inland transport and long-haul liner shipping ranges from a factor 5 to a factor 30, further supporting the notion that inland logistics could be one of the most vital areas still left to cut costs.

Moreover, shipping lines have to meet shippers' requirements in terms of frequency, punctuality, reliability and geographical coverage (Slack et al, 1996). Shipping lines are facing a poor schedule reliability, mainly caused by port terminal congestion (Notteboom, 2006b). Drewry (2006b) reports that on the Far East - Europe trade only 44% of the vessels made it according to their schedule. Among the late arrivals, 50% was one day late, 20% two days late, roughly 10% three days late and the remaining 20% four or more days late. Maersk Line recorded an average worldwide schedule integrity of 70%. MSC is amongst the poorest performers with only 41%. In an effort to better control costs and operational performance and as a measure to remedy against the effects of ever-decreasing schedule integrity, container shipping lines have been very active in securing (semi-)dedicated terminal capacity in strategic locations in recent years. Nowadays a substantial number of container terminals in North and South Europe feature a shipping line among their shareholders (in most cases as a minority shareholder). In particular MSC and CMA CGM, the world's second and third biggest container shipping lines, are very active in this field, with involvements in 15 and 10 container terminals, respectively. Maersk Line's parent company, AP Moller-Maersk, operates a large number of container terminals in Europe (and abroad) through its subsidiary APM Terminals. APM Terminals

is currently involved in the management of container terminals in the ports of Aarhus, Bremerhaven, Rotterdam, Zeebrugge, Dunkirk, Gioia Tauro, Algeciras, Constanza and Le Havre.
But the ambitions of many shipping lines do not stop at the terminal. Much literature has addressed the involvement of container shipping lines in inland transport and logistics (see e.g. Konings, 1993, Baird & Lindsay, 1996, Graham, 1998, Cariou, 2001, Frémont, 2006). A number of shipping lines stick to the shipping business and try to enhance network integration through structural or ad hoc co-ordination with independent inland transport operators and logistics service providers. They do not own inland transport equipment. Instead they tempt to use trustworthy independent inland operators' services on a (long-term) contract base. Other shipping lines combines a strategy of selective investments in key supporting activities (e.g. agency services or distribution centres) with sub-contracting of less critical services. With only a few exceptions, the management of pure logistics services is done by subsidiaries that share the same mother company as the shipping line but operate independently of liner shipping operations, and as such also ship cargo on competitor lines (Heaver, 2002). A last group of shipping lines are increasingly active in the management of hinterland flows. The focus is now on the efficient synchronization of inland distribution capacities with port capacities.

A number of shipping lines, such as Maersk Line, have gone rather far in providing rail services. Maersk Line owns European Rail Services (ERS) and has a shareholding in BoxXpress (joint-venture with Eurogate). ERS operates a vast network of shuttle trains mainly out of the port of Rotterdam to inland destinations across Europe. Started at 3 shuttles a week in 1994, ERS now offers 200+ shuttles a week and handled a rail volume of 620,000 TEU in 2006. CMA CGM and MSC are moving along the same path. For example, Rail Link, the CMA CGM rail subsidiary, was founded in 2001 and handled 51,000 TEU in 2006 on links from Marseille/Fos, Lyon, Dourges and Le Havre to destinations in France, the Benelux and Germany. Carriers often buy capacity from the different national railway companies. They often complain about the elevated traction cost and the long preparations and negotiations with the railway companies needed to install fast direct rail services.

In the past, barge services were solely maintained by independent barge operators (Charlier and Ridolfi, 1994), but recently a few deepsea carriers got directly involved in inland navigation. For example, CMA CGM set up River Shuttle Containers a few years ago and now offers barge services on the Seine and the Rhône-Saône (volume of 59,736 TEU in 2006). MSC and Maersk also offer barge services from Le Havre. These shipping lines develop own rail, barge and truck products through own companies or through strategic partnerships with major third party operators, to safeguard quality and efficiency.

The inland strategy of shipping lines also includes inland terminals and inland depots. Inland terminals and rail and barge services are combined to push import containers as fast as possible from the ocean terminal to an inland location, from where final delivery to the receiver will be initiated at a later stage. The push concept is initiated by the shipping line, yet prioritized based on the required delivery date. Export containers are pushed from an inland location to the ocean terminal, initiated by the shipping line, yet prioritized based on available inland transport capacity and the ETA of the mother vessel. The function of inland terminals thus changes to a distribution node, where containers will be accumulated until customer required delivery (customer pull process). Rodrigue and Notteboom (2008) provide an extensive analysis of this *extended gate* concept.

In order to streamline such as an inland distribution system, shipping lines and alliances between them seek to increase the percentage of carrier haulage on the European continent. The share of carrier haulage presently is about 30% on an average, but large differences can be observed among routes and regions: the UK is a typical example of a strong carrier base while merchant haulage remains very dominant in the Benelux and in particular Switzerland. Carrier haulage has a positive influence on the modal split (see example in table 5), as it provides shipping lines with a better overview of the flows so that intermodal bundling options come into play. If the inland leg is based on merchant haulage then the carrier often loses control of and information on its boxes.

Table 5. **Modal split for Maersk volumes**

	Maersk Intermodal volumes in ..					
	Rotterdam			Bremerhaven		
	Road	Rail	Barge	Road	Rail	Barge
Carrier haulage	25%	42%	32%	35%	64%	0%
Merchant haulage	65%	27%	9%	68%	32%	0%

Source: Maersk Line data 2006 and Q1 2007.

Carriers are confronted with some important barriers to further improve inland logistics. Landside operations are management intensive and generally involve a high proportion of bought-in services. Moreover, inland movements generate some under-remunerated activities such as the repositioning of empty units, network control and tracking. Other important barriers relate to volume and equipment-type of imbalances, (unforeseen) delays in ports and the inland transport leg as well as the uncertainty of forecasts. Carriers have very little room to increase the income out of inland logistics. If the carrier haulage tariffs edge above the open market rates, the merchant haulage option might become more attractive. The resulting competitive pressures partly explain the weak level of price contention between carrier and customer when it comes to charges in the inland leg.

Carriers are using IT solutions to face the challenges in inland logistics and to manage global container flows taking into account the effects of global trade imbalances. Operators also try to get information on other lines' regular flows, so as to know where useful surpluses and/or deficits may arise. Moreover, they have learned to lessen equipment surpluses/deficits through container cabotage, inter-line equipment interchanges, chassis pools and master leases. Container cabotage makes it possible to considerably cut the costs related to the repositioning of empty containers: carriers will build up relationships with inland transport operators which move their equipment to where it is needed free of charge. In return the inland operator gets free one-way use of the box. Master leases allow carriers to pick up/drop off equipment at will, placing the repositioning problem to the leasing company. The pick up/drop off charges reflect imbalances. Equipment interchange agreements are often, but not always, maintained among some liner conference members and some members of the same strategic alliance (e.g. New World Alliance). So-called 'grey box' agreements are quite rare: the concept has not proven workable partly because many carriers attach too much attention to company branding via the equipment used.

Customer requirements and behaviour often impede carriers from minimizing inland logistics costs. Shippers often insist on receiving/loading containers early in the morning and at the end of the week. This logistics requirement of the customers leads to money-wasting peaks in inland logistics costs. Late bookings are costly as well, because instead of going by train or barge, they must go by truck to catch the ship, for no extra revenue.

The danger of cost under-recovery on second moves is another serious problem in inland logistics. For example, where the line issues a B/L to Antwerp but the vessel only calls at Rotterdam, it pays the full cost of moving the cargo to Antwerp. Less ports of call means more second moves and more substituted service and as such possibly large landside container interchanges between adjacent ports. For instance, large volumes of container are exchanged over land between Rotterdam and Antwerp.

The formation of global alliances has taken inter-carrier co-operation to new heights, with members sharing inland logistics information, techniques and resources as well as negotiating collectively with suppliers (terminals, rail operators, feeders, barge operators, etc..).

6.3. (Independent) terminal operators and the hinterland

Against the background of supply chains, competitive forces are shifted to groups of spatially-dispersed but functionally-integrated terminals in different ports. Large global terminal operators have emerged in container handling in order to offer the customers a more differentiated service range. The extensive terminal networks can also be considered as an effective means to counterbalance the power of carrier combinations, to realize economies of scale and to optimize the terminal function within supply chains. Partly in response to the financial and operational needs of modern terminal activities, the container terminal operating industry has witnessed an increased amount of consolidation in recent years. Whereas a few years ago the container handling sector was still rather fragmented and characterized by about ten large players, the picture looks drastically different today. The market share of the top-10 players in terms of throughput increased from 42% in 2001 to 55% in 2005 (Drewry 2003 and 2006). Recent examples are the acquisition of CSX World Terminals in 2005 and P&O Ports in 2006 by Dubai-based DP World, and PSA's stake of 20% in Hutchison Port Holding's global terminal portfolio. The worldwide container handling industry is nowadays dominated by four worldwide operating companies (PSA, HPH, DP World and APM Terminals), representing some 42% of total worldwide container handling. As far as the concentration of market power is concerned, the current situation in the terminal operating sector is somewhat comparable to that of the liner shipping industry, where the four largest shipping lines also control some 40% of the market (see earlier). The industry structure has become sufficiently concentrated to raise a fundamental question about whether market forces are sufficient to prevent the abuse of market power. EU competition law has already affected Hutchison's expansion within North Europe, and it is likely that any future moves by PSA or DP World will also be carefully scrutinized by regulatory authorities. More and more financial suitors such as banks, hedge funds, private equity groups and investors are entering the terminals business (Babcock and Brown, Macquarie Infrastructure and American International Group to name a few).

The consolidation in the container handling industry has a large impact on port competition. The large terminal operators are becoming more footloose in spatial terms as the network approach loosens their former strong ties with one particular seaport. In many cases, global terminal operators in upstream ports have extended their operations to medium-sized or new coastal container ports in order to offer the customers a more differentiated product range. In developing a global expansion strategy, HPH, PSA, APM Terminals and DP World try to keep a competitive edge by building barriers to prevent competitors from entering their domains or against them succeeding if they do. These barriers are partly based on the building of strongholds in selected ports around the world and on advanced know how on the construction and management of container terminals. It is increasingly difficult for new entrants to challenge the top global terminal operating companies.

Global terminal operators are increasingly hedging the risks by setting up dedicated terminal joint ventures. The relation between PSA and MSC provides a good example. The recent linkages include the MSC Home Terminal in the Belgian port of Antwerp (50/50 joint-venture), a BOT-arrangement in the Portuguese port of Sines and the MSC PSA Asia Terminal in the Pasir Panjang area in Singapore (50/50 JV). Another modern way of enhanced cooperation in the container terminal industry consist of offering long term contracts to shipping lines with gain sharing clauses. Shipping lines are taking advantage of this situation by choosing the most interesting offer received for the particular node. Shipping lines can and sometimes do make a totally different choice for the next node (footloose behaviour).

As terminal operators are urged towards a better integration of terminals in supply chains and shipping lines are acquiring container terminal assets worldwide, leading terminal operating companies are developing diverging strategies towards the control of larger parts of the supply chain. The door-to-door philosophy has transformed a number of terminal operators into logistics organizations and or organizers/operators of inland services.

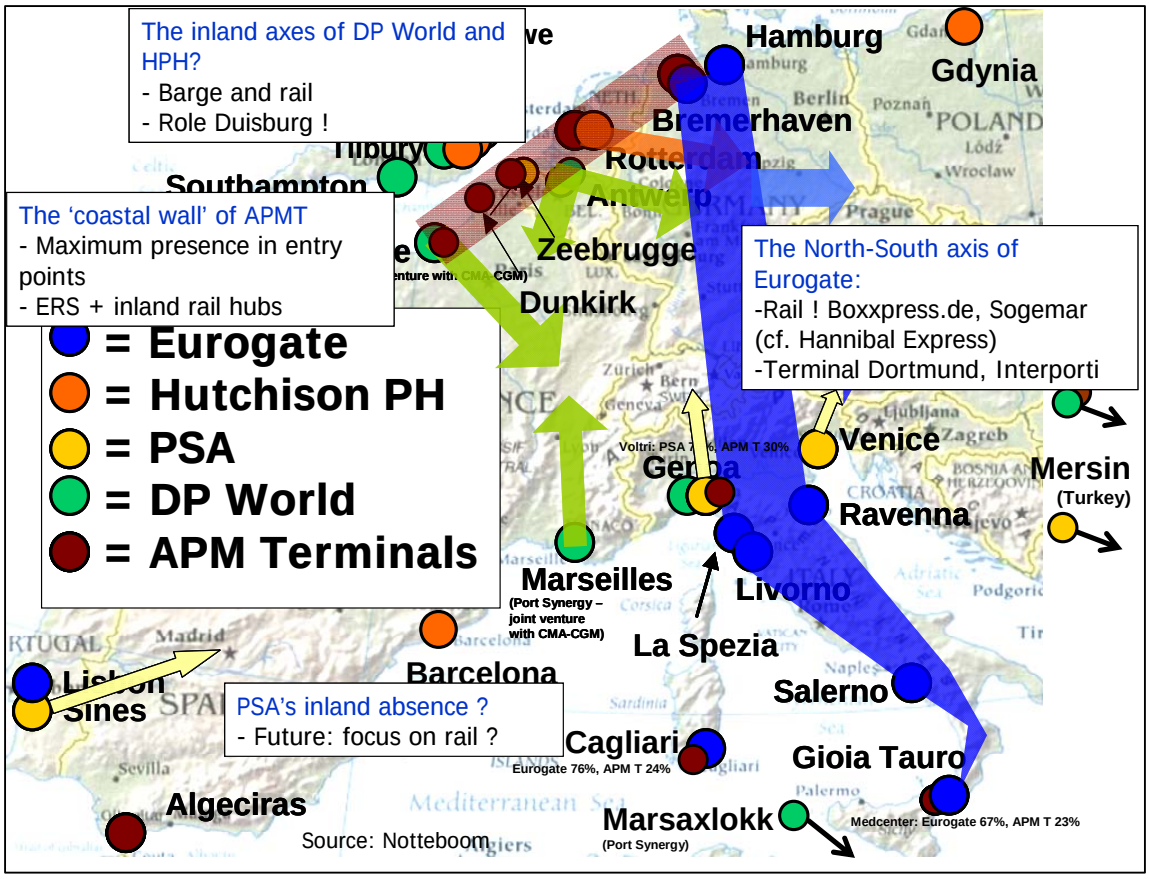
As discussed earlier, Maersk Line wants to push containers into the hinterland supported by its terminal branch APM Terminals and its rail branches. HPH-owned ECT in Rotterdam has followed an

active strategy of acquiring key inland terminals acting as extended gates to its deepsea terminals, e.g. a rail terminal in Venlo (the Netherlands), DeCeTe terminal in Duisburg (Germany) and TCT Belgium in Willebroek (Belgium).

DP World is following a similar strategy. DP World is working in partnership with CMA CGM to streamline intermodal operations on the Seine and Rhône axes, while the large terminals of Antwerp Gateway (open since 2005) and London Gateway (future) are both linked to inland centres in the hinterland. DP World has set up Hintermodal in joint venture with the intermodal transport organizer Shipit to give concrete content to the concept of *terminal operator haulage* from the Antwerp Gateway terminal to the hinterland. The terminal operator haulage concept is aimed at a more active involvement of the terminal operator in hinterland connections by establishing closer relationships with shipping lines and inland operators. Terminal operators can play an instrumental role in bringing together intermodal volumes of competing lines and as such create a basis for improved or even new intermodal services.

Eurogate has created a north-south axis connecting the rail activities of subsidiary Sogemar in the south to its extensive BoXxpress network in the north. The major private terminal of Melzo, owned by Eurogate and located in the suburbs of Milan, is where the Hannibal services between northern Europe and Gioia Tauro and La Spezia are routed. While the intention is to offer a trans-European landbridge to its customer base, the volumes actually crossing the Alps remain low (see discussion earlier on the North-South balance). Singapore-based PSA is the only global terminal operator which has not presented a clear inland strategy yet, though they are working on it. A first indication is the ambition of its terminal in Sines to provide direct rail services to the cargo base in the Madrid area. PSA shows an increasing awareness that the additional volumes generated by its Deurganckdock terminal in Antwerp and future new terminals in Zeebrugge and potentially also Flushing will put strong pressure on the inland segment of the chain. The exact nature of their future involvement in the provision of inland services or the operations of inland terminals remains to be seen.

Figure 9. **Terminal operators and the hinterland: the hinterland strategy of the main European container terminal operators**



Source: Notteboom – ITMMA.

In summary, terminal operators are expected to increase their influence throughout supply chains by engaging into inland transport. They seem to do so mainly by incorporating inland terminals as extended gates to seaport terminals and by introducing an integrated *terminal operator haulage* concept for the customers. Customs can qualify an inland terminal as an extension of a deepsea terminal, so custom clearance can be done there. The terminal operator typically remains responsible en route between the deepsea terminal and the inland terminal. The advantages of the extended gate system are substantial: customers can have their containers available in close proximity to their customer base, while the deepsea terminal operator faces less pressure on the deep-sea terminals due to shorter dwell times and can guarantee a better planning and utilization of the rail and barge shuttles. However, the success of both extended gates and terminal operator haulage largely depends on the transparency of the goods and information flows. Unfortunately, terminal operators often lack information on the onward inland transport segment for containers that are discharged on the terminal. A close coordination with shipping lines, forwarders and shippers is needed to maximize the possibilities for the development of integrated bundling concepts to the hinterland.

6.4. Rail transport operators

European rail logistics are highly complex. A geographically, politically and economically fragmented Europe prevented the realisation of greater intermodal scale and scope economies (Charlier and Ridolfi, 1994). Until 1993, cross-border rail traffic of maritime containers in Europe was the exclusive

right of Intercontainer. In the past, ICF initially concentrated its strategy on the intermodal container flows within the blue banana. The ongoing rail liberalisation process should lead to real pan-European rail services on a one-stop shop basis. All over Europe, new entrants are emerging while some large former national railway companies have joined forces (cf. Railion).

The rail operating industry is still somewhat hindered by the shelter-based strategies of former national railway companies in a number of countries and the high entry costs. Rail operators continue to face profitability issues. Launching new rail services is very costly and finding the necessary critical mass is not an easy task, surely when facing a fragmented cargo base controlled by many forwarders. This has opened the door to an increasing involvement of major shipping lines, terminal operators (mainly in Italy and Germany) and port authorities (cf. Barcelona and Marseille). Direct shuttle trains constitute the backbone of rail services out of European ports. These shuttle trains can only be exploited in a profitable way on a number of high-density traffic corridors such as the Rhine axis and the trans-Alpine route. Some rail operators have resolved the problems related to the fluctuating volumes and the numerous final destinations by bundling container flows in centrally located nodes in the more immediate hinterland. Numerous hub-and-spoke railway networks emerged in the 1990s. The nodes within these networks were connected by frequent shuttle trains with capacities for a single train combination ranging from 40 up to 95 TEU. An example was the Qualitynet of Intercontainer-Interfrigo (ICF) with Metz-Sablon in the north-east of France as master hub linking up the Rhine-Scheldt delta ports with the rest of Western Europe.

Such hub-and-spoke networks revealed to be vulnerable, as the volumes on the spokes can be affected by (1) newcomers entering the market in the aftermath of European rail liberalization and (2) increasing intermodal volumes in seaports. New railway operators often engage in cherry picking by introducing competing direct shuttle trains on a spoke of an established hub-and-spoke network of a competitor. This has a negative affect on cargo volumes on the spoke and might lead to a collapse of the whole hub-and-spoke system. This is what happened to ICF's Qualitynet in 2004. ICF launched its new strategy in December 2004. The intermodal traffic of the former Qualitynet hub in Metz are now handled by a set of direct shuttles trains to less destinations. For East- and Southeast Europe, services are cantered around the hub in Sopron (Hungary).

At present, a wide array of rail operators together make up the supply of hub-based networks, direct shuttles and inter-port shuttles out of the large load centres. Hamburg's rail connections outperform all other ports in numbers (i.e. more than 160 international and national shuttle and block train services per week) and in traffic volumes by rail (i.e. over 1 million TEU in 2005). Rotterdam and Antwerp each have between 150 and 200 intermodal rail departures per week. Smaller container ports in the range tend to seek connection to the extensive hinterland networks of the large load centres by installing shuttle services either to rail platforms in the big container ports or to master rail hubs in the hinterland.

The market evolution has led to increased competition among operators and a higher degree of choice available to customers. For a long time, there were no obvious drivers for change in the intermodal rail industry other than the (former) national railway companies. These national railway companies lacked commitment and commercial attitude. Major complaints related to their perceived bureaucratic attitude, unannounced rate changes, the long lead time required to make bookings, the poor documentation management, the limited tracking and tracing possibilities, limited cost-effective integration in door-to-door transport chains and the fact that in most cases no service guarantees were given. The emergence of a new generation of rail operators not only made incumbent firms to act in a more commercial way, but also led to an improvement in the endogenous capabilities of the railway sector which in time could make rail a more widespread alternative in serving the European hinterlands, at least if some outstanding technical and operational issues facing cross-border services can be solved.

6.5. Barge operators

Barge container transport in Europe has its origins in transport between Antwerp, Rotterdam and the Rhine basin, and in the last decade it has also developed greatly along the north-south axis between the Benelux and northern France (Notteboom & Konings, 2004). Antwerp and Rotterdam together handle about 95% of total European container transport by barge. Volumes on the Rhine have increased from 200,000 TEU in 1985 to some 1.8 million TEU in 2006 leading to higher frequencies and bigger vessels (figures Central Commission for Navigation on the Rhine). At present the liner service networks offered on the Rhine are mainly of the line bundling type with each rotation calling at 3 to 8 terminals per navigation area (Lower Rhine, Middle Rhine, Upper Rhine). The inland vessels used on the Rhine have capacities ranging from 90 to 208 TEU, although some bigger units and push convoys of up to 500 TEU can be spotted occasionally. Rotterdam has a strong position on barge traffic from/to the lower Rhine and middle Rhine, whereas Antwerp and Rotterdam are equally strong on the upper Rhine.

The number of terminals in the Rhine basin is steadily increasing. This is the result of new terminal operators arriving on the market and of new terminals appearing along the Rhine and its tributaries. The growing realization of the potential offered by barge container shipping has led to a wave of investment in new terminals over the past ten years, in northern France, the Netherlands and Belgium. The Benelux and northern France now have more than 30 container terminals, about as many as in the Rhine basin. In 1991 there was still no terminal network on the north-south axis (only two terminals). The next step is to establish a network of liner services connecting the various terminals outside the Rhine basin on a line bundling basis.

Barge services and inland terminals are also being developed outside the Rhine-Scheldt-Meuse basins. The barge container market is booming on the Rhône (55,807 TEU in 2005) and the Seine (159000 TEU in 2007 via barge services operated by Logiseine, River Shuttle Containers, Marfret, MSC and Maersk). Hamburg is slowly developing barge services on the Elbe, with annual volumes in 2006 exceeding 140,000 TEU compared to only 30,000 TEU in 2000. And there are even initiatives to introduce small-scale barge services on the Mantova–Adriatic waterway in Northern Italy.

The bulk of the barge services is controlled by independent barge operators. They have always shown a keen interest in the exploitation of inland terminals. About two thirds of all terminals in the Rhine basin are operated by inland barge operators or the logistics mother company of a barge operator. The remaining terminals are operated/owned by stevedoring companies of seaports, inland port authorities (e.g. Port Autonome de Strasbourg) or logistic service providers.

The new millennium brought rising pressure on the existing co-operation agreements on the Rhine as more and more operators are eager to start services independently from their partners. For instance, CCS withdrew from the Fahrgemeinschaft Niederrhein collective on 1 January 2000. In 2006, the Fahrgemeinschaft Oberrhein (OFG) nearly ceased to exist when Rhinecontainer and Haeger & Schmidt decided to step out of the OFG partnership and to start up the Upper Rhine Container Alliance (URCA). A major restructuring of the barge services within OFG took place once Interfeeder was taken over by Contargo in October 2006. Collaborative agreements are making their appearance in other navigation areas such as shuttle services between the Antwerp and Rotterdam. Joint ventures, mergers and takeovers form a relatively new aspect, aimed at increasing the geographical scope of the services offered, and at developing the operators' own barge transport networks. The initiatives being developed in this connection are aimed at increasing the geographical scope of the services offered, and at developing the operators' own barge transport networks. Danser Container Line, for instance, which offers services on the Rhine and Neckar and between Rotterdam and Oss, acquired Eurobarge from Nedlloyd Rijn & Binnenvaart in 1999. Eurobarge mainly operates barges on the Antwerp-Rotterdam route. Since January 2006, Danser Container Line controls the barge services of Natural Van Dam AG, an operator formerly owned by the logistics group Cronat from Basel. In 2000, Rhinecontainer acquired Container Exploitatiemaatschappij (CEM), a main player on the Antwerp-Rotterdam axis. In the same year, CCS and SRN Alpina came under the same

ownership, as a result of Rhenus (the parent company of CCS - SRN Alpina) acquiring the Swiss holding company Migros. Since 2004, Rhenus Logistics integrated Combined Container Service (CCS) in its container transport division Contargo.

In addition, the leading barge container carriers are increasingly trying to achieve a functional vertical integration of the container transport chain by extending the logistical services package to include complete door-to-door logistical solutions. In the 1990s, three logistics holdings got a strong grip on the barging market. Wincanton controlled 33% of containers moved by barge in the Rhine basin in 2004. Wincanton is the mother company of Rhenania with subsidiary Rhinecontainer (375,000 TEU in 2004). Rhenus Logistics, mother company of Contargo (including SRN Alpina and CCS), reached a market share of 22% and Imperial Logistics Group, mother company of Alcotrans, 15% (Zurbach, 2005). Alcotrans transported around 220,000 TEU on the Rhine in 2006. The Contargo network, comprising of 19 inland container terminals in Germany, the Netherlands, France and Switzerland, handled some 840,000 TEU in 2006. The integration of leading barge operating companies in the structures of highly-diversified logistics groups further strengthens the functional integration in the logistics chain.

A last and fairly new aspect of the vertical integration strategy followed by barge operators is the desire to fully exploit the complementarity with rail transport, by forging closer links with existing rail companies, or if required even acting as rail operator themselves. The present market consolidation in European rail transport leaves a certain limited scope for barge operators to position themselves as rail shuttle operators, allowing them to overcome the restricted geographical coverage of the European inland waterway network. On top of barge operations via Rhinecontainer, the Wincanton group has set up its own railway company Railcontainer that uses main hubs in Neuss and Mannheim and cooperates with ERS, IFB, MSC and others. Rhenus Logistics offers similar services through the RheinRail Service of CCS.

6.6. Port authorities and the hinterland

Nowadays, landlord port authorities are viewed as independent commercial undertakings aiming at full cost recovery and a rapid response to the customer. Port managers aim at making the port attractive to users, by providing a competitive supply of services for carriers and shippers. Inland services are an integral part of that supply. However, the traditional tools in the hands of port authorities are confined to the port area itself: investments in docks/berths, concession policy and tariff policy as regards port dues. Given the local nature of revenue sources, port authorities tend to have a rather local focus and strongly promote activities within the port perimeter that could increase the local revenue base.

Landlord port authorities throughout Europe are facing some serious challenges with respect to the hinterland connections. In previous sections it became clear that market players are very active in setting up inland services and broader hinterland networks. Market consolidation has resulted in large port clients who possess a strong bargaining power vis-à-vis terminal operations and inland transport operations. The loyalty to the home port tends to fade as large players are expanding their reach over more than one port. In such an environment, it is up to port authorities to safeguard the overall efficiency and performance of the port-hinterland interface as individual market players will primarily cater for the performance of specific sectors and or their specific network, not an individual port.

Port authorities thus have a role to play in shaping efficient hinterland networks. But they have to start from the knowledge that their impact on cargo flows and on hinterland infrastructure development is limited to that of facilitator.

Port authorities can add value by setting up task forces together with various stakeholders (carriers, shippers, transport operators, labour and government bodies) to identify and address issues affecting logistics performance. These issues can relate to the bundling of rail and barge container flows in the

port area and the development of rail and barge shuttles. A successful example of the task force approach is Antwerp Intermodal Solutions (AIS) – a joint project by the Antwerp Port Authority and the cargo handling companies PSA HNN and DP World, with support from the rail track operator Infrabel. The project brought all the parties round the table in view of concentrating the rail volumes. This has led to among other things the introduction of new rail links by market players. Most of them are common-user trains on which anyone can book container space, while a few are closed trains dedicated to one or more parties. The ultimate objective is for 15% of cross-border shipping containers to be carried by rail. Although AIS has an important role to play in creating new rail links to and from the port of Antwerp, the initiative lies with the rail partners. The port authority solely acts as facilitator. What AIS does is to concentrate the demand for container transport by rail, inviting the market players to react accordingly. The rail operators continue to bear the market risks associated with the new rail links. Apart from port authorities, also branch associations are adopting a role as facilitator in dealing with inland transport issues (cf. Alfaport in Antwerp and Deltalinqs in Rotterdam).

Most port authorities still stand at the sideline when it comes to inland terminal developments and the creation of logistics zones along hinterland corridors. However, the attitude of larger load centres seems to changing. Ports such as Rotterdam, Barcelona, Le Havre, Marseille and more recently also Antwerp and Lisbon have become more active in this field (table 5). There are a number of reasons for this change in attitude.

Table 5. **A selection of initiatives of port authorities in view of establishing links with inland ports and dry ports**

Port authority	Project	Aim
Antwerp	Trilogiport - Liège Other locations (future)	Joint development of a 100ha logistics platform along the Albert Canal Status: joint entity under the legal status of an 'economic interest grouping'
Lisbon	Puerta del Atlântico - Mostoles	Development of a logistical platform in Mostoles in the outskirts of Madrid. Status: contract signed, January 2008
Rotterdam	EIT - European Inland Terminals	Minority shareholding in inland terminals in immediate hinterland via separate holding. Status: abandonned
Barcelona	tm-concept (Terminal Maritima)	Joint partnerships to set up dry ports/logistics zones in hinterland Status: tmT (Toulouse), tmZ (Zaragozza), tmM (Madrid) are operational New projects in Perpignan, Montpellier and Lyon
Marseille	inland port Lyon	Development of Lyon as a multimodal satellite port of Marseille Status: Sociéte d'économie mixte founded in 1997. Port authority is one of shareholders. Joint barge and rail services between Lyon and Marseille.
HHLA - Hamburg	Rail terminals	HHLA has participations in rail terminals (Melnik, Budapest, etc..) to support its rail products via Polzug, Metrans and HHCE

Source: Port authorities' websites and specialized press.

First of all, port authorities understand that with the creation of logistics poles, port benefits might leak to users in inland locations. A port strategy solely based on the local port area is not suited to address this threat in an adequate manner. An active port regionalization strategy makes it possible to benefit the most from the reshaped networking among nodes.

Second, port users' focus on logistics networks makes a wider approach to port management imperative. As was outlined earlier, the success of a port will depend on its capability to fit into the networks that shape supply chains. In other words, the port community has to fully benefit from synergies with other transport nodes and other players within the networks of which they are part. This supports the development of a broader regional load centre network, serving the large logistics poles.

Third, the port authority is facing a wide array of local constraints (road congestion, lack of available land, environmental issues, etc..). These external effects of port activities are not enhancing

community support. Ports must demonstrate a high level of environmental performance and sustainability not only in view of community support, but also in view of attracting trading partners and potential investors. A port with a strong environmental record and high level of community support is likely to be favoured. Inland locations can help the port to preserve its attractiveness and to fully exploit potential economies of scale. The corridors towards the inland terminal network can create the necessary margin for further growth of seaborne container traffic. Inland terminals as such acquire an important satellite function with respect to the port, as they help to relieve the seaport area from potential congestion.

The above elements form incentives to consider co-operation with inland ports in the field of traffic management, land issuing, hinterland connections and services, environmental protection and research & development (R&D). Notwithstanding these advantages, port authorities have always been rather reluctant to engaging in advanced forms of strategic partnerships with inland ports, e.g. through strategic alliances, (cross-) participation, joint-ventures or even mergers and acquisitions. Port managers fear to losing added value and employment by 'giving away' activities, to losing captive cargo (port related companies in the hinterland are less dependent on one port for their maritime import and export) and to losing clients as these might consider the cooperation with one specific hinterland location as a market restriction or distortion. More room is created for forms of indirect co-operation, for example through joint marketing and promotion, which are less binding and require less financial means. Large load centres generally have a broad financial base to engage in a well-balanced port networking strategy, although substantial differences exist even among the largest container ports. Smaller ports and new ports have to rely solely on very simple co-ordination actions to substantially improve inland freight distribution, with benefits for all parties involved. In spatial terms this implies that regional load centre networks are most likely to be developed around large load centres, whereas smaller ports either become part of these large regional load centre networks or remain isolated in a spatial and organizational sense.

The interaction between seaports and inland locations leads to the development of a large logistics pole consisting of several logistics zones. Seaports are the central nodes driving the dynamics in such a large logistics pole. But at the same time seaports rely heavily on inland ports to preserve their attractiveness. A well-balanced port networking strategy does not imply a loss of port activity. It should enable a port authority to develop new resources and capabilities in close co-operation with other transport nodes and with mutual interests served. Sometimes very simple co-ordination actions can substantially improve inland freight distribution, with benefits for all parties involved.

7. CONCLUSIONS AND AVENUES FOR FUTURE RESEARCH

Container shipping has been the fastest growing sector of the maritime industries during the last two decades. Organic growth resulting from increasing economic activity, trade liberalization, globalization and outsourcing is compounded by the fact that breakbulk cargo is increasingly being carried in containers (substitution effect), by changes in carriers' scheduling strategies (for example an increased focus on transhipment) and by port development. The very core object of container port competition in Europe has become highly complex and dynamic due to structural changes, some of which were outlined in earlier sections of this paper. The organizational and institutional environment in which ports operate has changed dramatically in the last decades. WTO's impact on free trade, deregulation in the transport industry and corporatization and privatization processes in ports and inland transportation are among the main institutional factors affecting port hierarchy. Logistics integration, scale increases in vessel size, the emergence of global terminal operators and structural changes in logistics and distribution networks are just some of the key organizational trends affecting port operations and spatial characteristics within Europe. Logistics market developments and the

discontinuous nature of complex logistics networks require a more functional approach to port competition and hinterland connections.

The key point put forward in this paper is that the competitive battle among ports will increasingly be fought ashore. It was demonstrated that quite a number of actors try to play the first violin in this battle, or even go a step further by vying for a position as conductor. Rising concerns about capacity issues have led market players to secure terminal and corridor capacity. As intermodality serves as a weapon in port competition, ports become dependent on the intermodal carriers. A highly volatile intermodal market, in terms of organizational and operational factors, is not very conducive to creating a stable and sustainable competitive position of a port vis-à-vis the hinterland segments served through the corridors. The success of the port is strongly affected by the ability of the port community to fully exploit synergies with other transport nodes and other players within the logistics networks of which they are part. This observation demands closer co-ordination with logistics actors outside the port perimeter and a more integrated approach to port infrastructure planning. A large number of port authorities promote or should promote an efficient intermodal system in order to secure cargo under conditions of high competition. This includes for example facilitation in the introduction of new shuttle services in close coordination with the market players. Port authorities can be catalysts in improving the port-hinterland interface and the structuring of hinterland networks, even though their direct impact on the routing of cargo flows is limited.

A special role is reserved for terminal facilities. Terminals, both in seaport as well as in inland ports, are expected to increase their role in supply chains, given increasing levels of vertical integration in the market and an increasing pressure on capacity. Terminals will take up a more active role in supply chains in the future by increasingly confronting market players with operational considerations through imposing berthing windows, dwell time charges, truck slots, etc.. , all this to increase throughput, optimize terminal capacity and make the best use of the land.

The issue of 'Port competition and hinterland connections' is certainly not a new topic. But, with this paper, we hope to have demonstrated that the changing nature of the interplay between markets, port competition and hinterland connections demands new approaches in dealing with the hinterland. This paper does not give answers to all outstanding issues. It is more a kind of '*status questionis'* combining various perspectives on the matter. Given the changing market environment, the topic of port competition and hinterland connections still offers plenty of challenges for further research. This paper concludes with a few suggestions in this regard bundled around three themes.

Vertical integration and the risk of foreclosure. Vertical integration might create concerns on either raising the costs of rivals or reducing the revenue of rivals. Raising rivals' costs typically involves *input foreclosure*. Input foreclosure occurs when the integrated firm either stops supplying competing downstream firms (complete foreclosure) or does so at a higher price (partial foreclosure), resulting in both cases in an increase in the price of the upstream input post-merger, raising the costs of competing downstream firms. This relaxes the competitive constraint on the integrated firm that has access to the input at a lower cost. The reduction of rivals' revenues typically involves *customer foreclosure*. Customer foreclosure occurs when, post-merger, the downstream division of the integrated firm no longer sources supply from independent upstream firms. If this leads to a reduction in sales volume and that sales volume reduction leads to an increase in the average cost or marginal cost of upstream competitors, then the competitive constraint these firms exert on the upstream division of the integrated firm will be reduced, leading to greater market power upstream and higher input prices. As far as we know, no research has been done on the impact of vertical integration of shipping lines, terminal operators and other market players on the risk of foreclosure in the provision of hinterland services.

Inland terminals. Inland terminals and dry ports are crucial for the further development of hinterland networks under conditions of high-volume growth. However, the possibilities of deploying inland cargo centres to relief the problems in seaports are not limitless. An increasing number of inland locations are facing strict environmental regulations and a lack of spare capacity. It is clear that both

the problem of limited expansion opportunities and the problem of overcapacity will eventually result in a worsening of the competitive position of inland ports and the commercial viability of intermodal transport services. While these issues have been well studied for seaports, (the implications of) the potential growing mismatch between the demand for intermodal services and the supply of inland terminal capacity needs more attention.

Reliability, port competition and hinterland connections. It was stated in the paper that port and modal choice is also affected by reliability and capacity issues next the pure cost considerations. While service integrity issues have received quite some attention in operations research in recent years, research on the impact of low reliability levels on port hierarchy and inland cargo distribution patterns has only just taken off.

ANNEXES

Annex 1. **External trade of the EU Member States and some non-EU states**

	Extra and intra EU-trade in 1000 million of ECU/EURO										
	Imports				Exports				Trade balance	Share of EU25 in	
	1995	2000	2003	2006	1995	2000	2003	2006	(Ex-Im) in 2006	Total imports	Total exports
EU (27 countries)		**993**	**935**	**1350**		**850**	**869**	**1157**	-193		
EU (25 countries)		**996**	**941**	**1354**		**858**	**883**	**1181**	-173	63.4	67.3
EU (15 countries)	**545**	**1033**	**993**	**1430**	**573**	**942**	**980**	**1310**	-120		
Belgium	126	192	208	280	136	204	226	292	12	71.4	76.3
Bulgaria		7	10	15		5	7	12	-4		
Czech Republic		35	46	74		32	43	76	1	80.0	84.0
Denmark	35	49	51	69	39	56	59	74	5	71.8	70.7
Germany	355	538	534	724	400	597	664	886	162	63.0	62.7
Estonia		5	6	11		3	4	8	-3	74.0	66.0
Ireland	25	55	48	58	34	84	82	88	30	68.2	63.5
Greece	20	36	40	50	8	13	12	17	-34	54.8	53.2
Spain	87	169	184	252	75	125	138	164	-88	60.6	70.5
France	221	367	353	426	230	355	347	391	-35	68.4	64.5
Italy	157	259	263	348	179	260	265	327	-21	55.3	58.2
Cyprus		3	4	6		0	0	1	-4	67.1	68.5
Latvia		3	5	9		2	3	5	-4	76.3	72.3
Lithuania		6	9	15		4	6	11	-4	62.4	63.2
Luxembourg		12	14	21		9	12	18	-3	70.2	89.5
Hungary		35	42	61		31	38	59	-2	66.7	74.0
Malta		4	3	3		3	2	2	-1	67.6	50.2
Netherlands	127	236	234	332	140	252	262	368	37	49.5	78.9
Austria	51	78	88	112	44	73	86	112	0	78.7	70.2
Poland		53	60	100		34	48	88	-13	72.0	77.3
Portugal	25	43	42	53	17	26	28	35	-19	75.5	77.2
Romania		14	21	41		11	16	26	-15		
Slovenia		11	12	19		10	11	19	-1	76.7	66.7
Slovakia		14	20	37		13	19	33	-3	75.0	85.1
Finland	23	37	38	55	31	50	47	61	7	63.7	57.0
Sweden	50	79	74	101	62	94	90	117	16	69.5	59.8
United Kingdom	204	372	353	485	182	309	270	358	-127	58.0	62.7
Norway	25	37	35	51	32	65	60	97	46	68.7	79.3
Switzerland	61	91	89	113	62	88	93	118	5	78.5	61.0
United States	589	1362	1154	1528	446	845	640	826	-702	17.7	20.6
Japan	257	411	339	461	339	519	417	515	54	10.3	14.5
Canada	126	260	212	279	146	300	241	309	30	12.3	6.5
China (excl. Hong Kong)	101	244	365	630	114	270	387	772	141	11.4	18.8

Note: Imports are expressed in value terms and measured CIF (cost, insurance, freight). Exports are expressed in value terms and measured FOB (free on board).

Source: based on external trade statistics of Eurostat.

Annex 2. **Real GDP growth rates - percentage change on previous year**

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EU (27 countries)	**2.9**	**3**	**3.9**	**2**	**1.2**	**1.3**	**2.5**	**1.8**	**3**	**2.9 (f)**	**2.4 (f)**	**2.4 (f)**
EU (25 countries)	**3**	**3**	**3.9**	**2**	**1.2**	**1.3**	**2.4**	**1.8**	**3**	**2.9 (f)**	**2.4 (f)**	**2.4 (f)**
EU (15 countries)	**2.9**	**3**	**3.8**	**1.9**	**1.1**	**1.2**	**2.3**	**1.6**	**2.8**	**2.7 (f)**	**2.2 (f)**	**2.2 (f)**
Belgium	1.7	3.4	3.7	0.8	1.5	1	3	1.7	2.8	2.7 (f)	2.1 (f)	2.2 (f)
Bulgaria	4	2.3	5.4	4.1	4.5	5	6.6	6.2	6.1	6.3 (f)	6.0 (f)	6.2 (f)
Czech Republic	-0.8	1.3	3.6	2.5	1.9	3.6	4.5	6.4	6.4	5.8 (f)	5.0 (f)	4.9 (f)
Denmark	2.2	2.6	3.5	0.7	0.5	0.4	2.3	2.5	3.9	1.8	1.3 (f)	1.4 (f)
Germany	2	2	3.2	1.2	0	-0.2	1.1	0.8	2.9	2.5	2.1 (f)	2.2 (f)
Estonia	5.4	-0.1	9.6	7.7	8	7.2	8.3	10.2	11.2	7.8 (f)	6.4 (f)	6.2 (f)
Ireland	8	10.4	9.4	6.1	6.6	4.5	4.4	6	5.7	4.9 (f)	3.5 (f)	3.8 (f)
Greece	3.4	3.4	4.5	5.1	3.8	4.8	4.7	3.7	4.3	4.1 (f)	3.8 (f)	3.7 (f)
Spain	4.5	4.7	5	3.6	2.7	3.1	3.3	3.6	3.9	3.8 (f)	3.0 (f)	2.3 (f)
France	3.5	3.3	3.9	1.9	1	1.1	2.5	1.7	2	1.9 (f)	2.0 (f)	1.8 (f)
Italy	1.4	1.9	3.6	1.8	0.5	0	1.5	0.6	1.8	1.5	1.4 (f)	1.6 (f)
Cyprus	5	4.8	5	4	2.1	1.9	4.2	4	4	4.4	3.9 (f)	3.9 (f)
Latvia	4.7	3.3	6.9	8	6.5	7.2	8.7	10.6	11.9	10.5 (f)	7.2 (f)	6.2 (f)
Lithuania	7.5	-1.5	4.1	6.6	6.9	10.3	7.3	7.9	7.7	8.8	7.5 (f)	6.3 (f)
Luxembourg	6.5	8.4	8.4	2.5	4.1	2.1	4.9	5	6.1	5.2 (f)	4.7 (f)	4.5 (f)
Hungary	4.9	4.2	5.2	4.1	4.4	4.2	4.8	4.1	3.9	1.4	2.6 (f)	3.4 (f)
Malta	:	:	:	-1.6	2.6	-0.3	0.2	3.3	3.4	3.1 (f)	2.8 (f)	2.9 (f)
Netherlands	3.9	4.7	3.9	1.9	0.1	0.3	2.2	1.5	3	3.5	2.6 (f)	2.5 (f)
Austria	3.6	3.3	3.4	0.8	0.9	1.2	2.3	2	3.3	3.3 (f)	2.7 (f)	2.4 (f)
Poland	5	4.5	4.3	1.2	1.4	3.9	5.3	3.6	6.1	6.5 (f)	5.6 (f)	5.2 (f)
Portugal	4.9	3.8	3.9	2	0.8	-0.8	1.5	0.7	1.2	1.8 (f)	2.0 (f)	2.1 (f)
Romania	:	-1.2	2.1	5.7	5.1	5.2	8.5	4.2	7.9	6.0 (f)	5.9 (f)	5.8 (f)
Slovenia	3.6	5.3	4.1	3.1	3.7	2.8	4.4	4.1	5.7	6.0 (f)	4.6 (f)	4.0 (f)
Slovakia	4.4	0	1.4	3.4	4.8	4.8	5.2	6.6	8.5	8.7 (f)	7.0 (f)	6.2 (f)
Finland	5.2	3.9	5	2.6	1.6	1.8	3.7	2.8	4.9	4.4	3.4 (f)	2.8 (f)
Sweden	3.8	4.6	4.4	1.1	2.4	1.9	4.1	3.3	4.1	2.6	3.1 (f)	2.4 (f)
United Kingdom	3.4	3	3.8	2.4	2.1	2.8	3.3	1.8	2.9	3.1	2.2 (f)	2.5 (f)

Note: (f) = estimate/provisional figures.

Source: based on Eurostat data.

Annex 3. **Modal split for inland transport of containers (selection of container ports)**

		Road	Rail	Barge
Amsterdam	2004	60	5	35
(Ceres Paragon)	2005	57	2	41
	2006	54	3	43
	2007	50	7	43
Antwerp	1998	64.5	7.8	27.7
	2000	60.6	10.1	29.3
	2002	59.5	9.3	31.2
	2007	59.8	8.0	32.2
Bremerhaven	2002	53.1	44.4	2.5
(Eurogate)	2005	43.0	53.0	4.0
	2006	39.6	56.3	4.1
Constanza	2000	56.0	44.0	0.0
	2002	53.0	47.0	0.0
	2004	61.6	38.4	0.0
	2005	33.9	65.8	0.3
	2006	47.6	47.3	5.1
Dunkirk	2002	82	14	4
	2002	72	25	3
	2005	88	8	4
	2006	88	8	4
Hamburg	1998	70.1	29.7	0.2
	2000	70.0	28.7	1.3
	2002	69.6	28.7	1.7
	2005	67.4	30.5	2.1
	2006	69.0	28.7	2.3
	2007	68.9	29.0	2.1
Le Havre	1995	82.5	16.9	0.6
	1998	84.6	14.3	1.3
	2000	85.1	12.2	2.7
	2002	85.4	11.7	2.9
	2005	87.4	6.2	6.4
	2006	86.8	5.1	8.1
Marseilles-Fos	2000	82.7	16.9	0.4
	2002	82.1	15.6	2.4
	2005	82.0	12.0	5.6
	2006	81.9	12.1	6.0
Rotterdam	1998	51.3	14.5	34.2
	2000	48.0	13.0	39.0
	2002	59.0	9.0	32.0
	2003	59.0	10.0	31.0
	2004	60.0	9.0	31.0
	2005	60.0	9.0	31.0
Zeebrugge	1990	70.5	26.9	2.6
	2000	79.8	17.7	2.5
	2002	78.3	20.5	1.2
	2005	62.0	36.6	1.4
	2006	61.2	37.6	1.2

Source: Data respective port authorities and Schiffahrt Hafen, Bahn und Technik (2/2007).

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