Zeitschrift für Wirtschaftsgeographie	Jg. 51 (2007)	Heft 2, S. 108-123

Theo Notteboom, Antwerpen/Belgien

Spatial dynamics in the container load centers of the Le Havre-Hamburg range

This paper discusses the spatial dynamics in the Le Havre – Hamburg range. By applying existing spatial models on port system development, changes in the range's port hierarchy are discussed. It is demonstrated that the existing port hierarchy in the range is unlikely to be structurally challenged in the foreseeable future and that port authorities and market players are designing strategies in view of better meeting the market requirements in terms of port services provision, logistics integration and hinterland penetration.

Introduction

With a total maritime container throughput of 34.6 mio. TEU (twenty-foot equivalent unit)[1] handled along a shoreline of merely 500 nautical miles, the Le Havre-Hamburg range ranks among the busiest and most competitive container regions in the world (Tab. 1, Fig. 1). The ports in the Le Havre-Hamburg range are gateway ports serving extended shared hinterlands. But yet, the range can not to be considered as a homogenous set of container ports. It features established large container load centers such as Rotterdam, Antwerp, Hamburg, Bremerhaven and Le Havre, 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. The unique blend of different port types and sizes combined with a vast economic hinterland shapes port competition in the region.

Container port competition in general and in the Le Havre – Hamburg range in particular is highly complex and dynamic. Analyzing the object of competition, the players involved and the way port authorities are dealing with competitive challenges is not an easy task. The organizational and institutional environment in which the gateway ports operate has changed dramatically in the last decennia. *World Trade Organization*'s (WTO) impact on free trade, deregulation and privatization 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 the Le Havre - Hamburg range. These developments have not only made port competition more intense, but have even affected the core object of port competition. The load centers in the range are designing appropriate strategies to respond to these new challenges.

This paper discusses the spatial dynamics in the Le Havre – Hamburg range. More in particular, it seeks answers to the questions: how did port hierarchy in the range evolve in the past and is this expected to be structurally challenged in the future? The first section of the paper discusses past and present port hierarchy in the range in light of existing models on port system development. The second section deals with the expected future development of port hierarchy and spatial dynamics in the range. Both supply factors (i.e. terminal capacities) as well as demand factors (i.e. organizational/institutional factors such as logistics integration, terminalization of port operations, liner shipping networks, hinterland networks, stakeholder relations management in port planning, etc..) are taken into consideration.

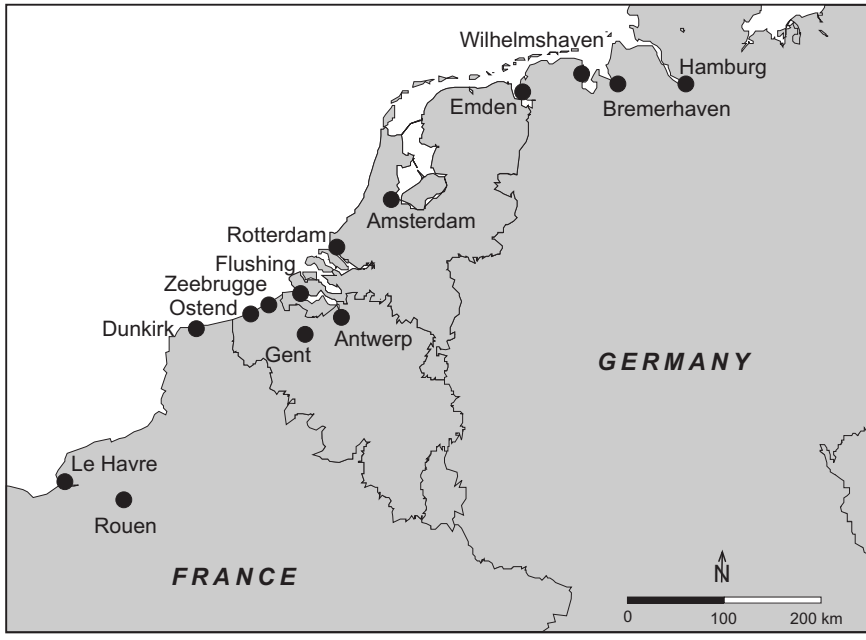
Spatial dynamics and changing port hierarchy in the range

Most theoretical models on gateway port system development suggest that large ports, which invested early in container infrastructure, attract more and more container traffic. The resulting port concentration can cause degradation of minor ports in the network (see e.g. BIRD 1970). The spatial models of HAYUTH (1981) and BARKE (1986) refer to a deconcentration tendency caused by the growth of former non-hub ports and the emergence of new ports. A distinction should be made between deconcentration within a port and deconcentration within a port system. The first type basically refers to the infrastructural extension of port areas away from the historical core to less urban downstream sites. Scale expansion in shipping and the use of new transhipment technologies are some of the factors that have resulted in the abandoning of older port sites. The second type, i.e. deconcentration within a port system, occurs when some of the cargo is shifted from large ports to neighboring smaller or new ports, or when the large load centers only absorb a small portion of the container growth in the port system. HAYUTH (1981) calls this phenomenon the peripheral port challenge (see also NOTTEBOOM 2005). He argues that as the port system develops, diseconomies of scale in some large load centers emerge in the form of a lack of space for expansion and port congestion. This encourages smaller ports or even new ports to attract cargo. The peripheral port challenge concept thus implies that those ports which existed before the container revolution and invested early in the new technology are gradually losing market share to new or upgraded ports which try to gain load center status.

Cargo concentration in the range

Given the above conceptual considerations on port system development, it is interesting to address concentration patterns and changing port hierarchies in the Le Havre-Hamburg. Rotterdam, Hamburg, Antwerp, Bremerhaven and Le Havre have always been and still are the main container load centers in the region see. Their joint market share in the total container throughput of the range evolved from 90 % in the late seventies to 95 % in the last two decennia. Rotterdam's market share in the range had fluctuated between 35 % and 40 % since the late seventies, but fell sharply in the new mil-

Fig. 1: The Le Havre - Hamburg port range in North-West Europe



lennium to a level of about 28 % in 2006. Antwerp and Hamburg benefited the most from the setback of the Dutch container port. In absolute volume terms, Hamburg decreased the gap with Rotterdam from about 1.8 mio. TEU in 1994 to about 0.8 mio. TEU in 2006. Small and medium-sized ports face a slightly declining impact on the container flows in the region.

Using Gini coefficients, NOTTEBOOM (2005) demonstrated that traffic concentration levels in the Le Havre-Hamburg range exceed those of all other European port ranges. A sneaking trend towards concentration started in the early eighties, but abruptly ended in the late nineties with a twist towards a more evenly distributed system. The deterioration of the position of Rotterdam is an important reason for the sudden decline in the cargo concentration level in the range. Fluctuations in the concentration levels remain however rather small, indicating that the container port hierarchy in the range has not been structurally affected in the last 30 years.

Net shift analysis applied to the Le Havre-Hamburg range

It is useful to examine the volume of container shifts among ports in order to get a more detailed insight in throughput dynamics. The net shift analysis provides a good tool for measuring container shifts. The net shift reflects the total TEU an individual port or a port group has actually lost to or won from competing units. A net shift of zero would mean that the port or port group would have the same growth rate as the total seaport system. Additional relevant information can be obtained by calculating the net volume of containers shifted between individual ports and port groups. Periods characterized by high net volume shifts refer to a considerable degree of dynamics and competition within the container port system.

The results of the net shift analysis applied to the Le Havre-Hamburg range for eight consecutive periods are represented in Tab. 2. NET SHIFTtotal is the average annual total net volume of TEU shifted between container ports in the range. NET SHIFTinter indicates the average annual net volume of TEU shifted between ports situated in different countries. Finally, NET SHIFTintra represents the average annual net volume of TEU shifted between ports situated in the same country. The sum of NET SHIFTinter and NET SHIFTintra equals NET SHIFTtotal. The average annual net shift figures for the port groups indicate a gain (positive sign) or a loss (negative sign) of potential container traffic i.e. compared to the situation under which the considered port group would have grown at the same average growth rate as the total range.

Tab 1: Container throughput for ports in the Le Havre – Hamburg range ('000 TEU)

	1975	1980	1985	1990	1995	2000	2002	2004	2005	2006
Rotterdam (NL)	1,079	1,901	2,655	3,666	4,787	6,275	6,515	8,281	9,287	9,690
Hamburg (D)	326	783	1,159	1,969	2,890	4,248	5,374	7,003	8,087	8,862
Antwerp (B)	297	724	1,243	1,549	2,329	4,082	4,777	6,064	6,488	7,019
Bremen/ Bremerhaven (D)	405	703	986	1,163	1,518	2,752	2,982	3,469	3,736	4,450
Le Havre (F)	232	507	566	858	970	1,465	1,720	2,150	2,100	2,130
Zeebrugge (B)	151	181	218	334	528	965	959	1,197	1,408	1,653
Dunkirk (F)	38	63	71	71	71	149	161	200	205	206
Rouen (F)	14	98	135	93	120	146	144	139	161	165
Amsterdam (NL)	32	72	79	69	91	53	45	52	66	304
Flushing (NL)	28	83	35	26	6	3	9	27	39	40
Cuxhaven (D)	0	0	0	3	16	24	27	36	35	40
Gent (B)	10	10	10	10	6	10	21	35	31	35
Ostend (B)	0	0	0	0	0	0	9	15	9	6
Wilhelmshaven (D)	0	0	0	0	6	29	41	43	3	5
Emden (D)	0	0	0	0	0	57	69	1	0	1
Total	2,612	5,125	7,158	9,811	13,338	20,257	22,856	28,713	31,655	34,606

Source: based on data resp. port authorities

On the basis of Tab. 2 a few conclusions can be put forward. In recent years, port competition in the Le Havre-Hamburg range has increased considerably in absolute terms (see NET SHIFTtotal). In relative terms the net container shifts between ports in the range fluctuated between 1 % and 2.75 %. In the last two observation periods, the net shifts between ports in different countries represented between 55 % and 68 % of the total net shifts in the range (see NET SHIFTinter). The remainder relates to competition between ports within the same country (e.g. Bremerhaven versus Hamburg). The figures for the individual ports confirm that Hamburg in particular is among the main winners in terms of net shifts. More detail on the net container shifts between port groups of different countries is given in Fig.2. Since the end of the nineties, the net volumes shifted between national container port groups fluctuate between 250,000 and 300,000 TEU. In the last period of observation, the Dutch container ports were able to reverse the negative trend that could be observed in the two earlier periods. After a long history of rather neutral development (i.e. net volume shifts near to zero), German load centers significantly improved their competitive position in the last ten years. In general, the position of the French ports in the Hamburg-Le Havre range deteriorated the most, with a negative shift effect (or missed growth) in the last observation period of nearly 200,000 TEU.

Given increasing requirements on maritime accessibility for the ever large container vessels and the minimization of diversion distances for these vessels, one could expect that coastal ports are gaining market share at the expense of upstream ports (see e.g. BAIRD 1996). However, this is not confirmed: Up to now upstream ports, i.e. basically Antwerp and Hamburg, have gradually gained market share at the expense of coastal ports. The market share of upstream ports steadily increased from 26 % in 1975 to 47.3 % in 2006.

Is port hierarchy in the range likely to be structurally challenged in the future?

In the previous sections it was demonstrated that the container port hierarchy in the range has not been structurally affected in the last 30 years. The big five keep on dominating the market, with upstream ports Hamburg and Antwerp getting an ever larger market share and French ports losing some market share. The impact of small and medium-sized ports is still marginal. The question remains, whether the port hierarchy in the range is likely to be structurally challenged in the future. To shed light on this issue, the next two sections will analyze the supply and demand factors respectively that will shape future port competition dynamics in the range.

Terminal supply: new load centers and the peripheral port challenge

New terminal facilities in the ports of the Le Havre – Hamburg range are aimed at capturing flows from their traffic-generating local hinterlands. But more importantly, new terminals are constructed to secure and further strengthen the ports' role as transit points with respect to pairs of distantly-located traffic-generating regions. Using the terminology of HAYUTH/FLEMING (1994), the former objective builds upon the ports' centrality, whereas the latter position is more based on the ports' intermediacy.

The existing large load centers are developing new terminals to meet future demand for container handling capacity. Following the model of *Bird* introduced earlier, new container terminal capacity is developed downstream away from the historical core of the city. In the eighties the sustained growth of container throughput in Rotterdam led to the construction of massive container facilities on the Maasvlakte, an area that was reclaimed on the sea. The Maasvlakte terminals handled more than 5 mio. TEU in 2005. Antwerp has witnessed the same kind of development in the nineties, when the Antwerp port community and the Flemish government decided to build container capacity along the river Scheldt in front of the locks, thereby allowing considerable savings in the port turnaround time of container vessels. The first Scheldt terminal (*Europaterminal*) started operations in 1990. The second Scheldt terminal (*Noordzeeterminal*) followed in 1997. In 2005, the two Scheldt terminals handled about 40 % of Antwerp's container throughput. Hamburg operator *Hamburger Hafen und Logistik AG* (HHLA) developed its *Container Terminal Altenwerder* (CTA) at the start of the new millennium. At present, the terminal of 1,400 m has a capacity of some 1.9 mio.TEU and handled 0.8 mio. TEU in 2006.

Tab. 2: Results for net shift analysis of Le Havre – Hamburg range

	1975–1982	1982–1987	1987–1991	1991–1994	1994–1997	1997–2000	2000–2003	2003–2006
Net shift$_{total}$ ('000 TEU) *% of traffic in t_0*	72 *2.75%*	98 *1.69%*	92 *1.16%*	131 *1.25%*	149 *1.17%*	343 *2.20%*	452 *2.23%*	369 *1.46%*
Net shift$_{inter}$ ('000 TEU) *% in net shift$_{total}$*	29 *40.3%*	78 *79.6%*	49 *53.3%*	104 *79.4%*	76 *51.0%*	275 *80.2%*	249 *55.1%*	251.45 *68.1%*
Net shift$_{intra}$ ('000 TEU) *% in net shift$_{total}$*	43 *59.7%*	20 *20.4%*	43 *46.7%*	27 *20.6%*	73 *49.0%*	68 *19.8%*	203 *44.9%*	117.6 *31.9%*
Winners in terms of total shift (in TEU)	Antwerpen 27,202 Hamburg 24,256 Rouen 15,387 Le Havre 3,583 Amsterdam 1,498 Vlissingen 23	Antwerpen 53,297 Hamburg 44,167	Hamburg 70,470 Rotterdam 8,944 Zeebrugge 7,284 Le Havre 3,807 Cuxhaven 1,827	Zeebrugge 79,622 Antwerpen 20,486 Hamburg 19,299 Amsterdam 5,442 Cuxhaven 3,160 Rouen 2,355 Wilhelmshaven 218	Antwerpen 89,809 Le Havre 39,151 Hamburg 12,651 Emden 4,970 Wilhelmshaven 2,270	Bremen 179,714 Antwerpen 76,427 Zeebrugge 41,417 Duinkerken 21,108 Emden 12,501 Wilhelmshaven 6,430 Rouen 5,778	Hamburg 273,799 Antwerpen 112,181 Le Havre 47,910 Vlissingen 6,874 Gent 5,433 Oostende 4,422 Wilhelmshaven 980	Hamburg 161,260 Zeebrugge 90,412 Amsterdam 80,709 Bremen 31,479 Cuxhaven 2,781 Vlissingen 2,414
Losers in terms of total shift (in TEU)	Rotterdam –31,322 Zeebrugge –22,116 Bremen –13,916 Duinkerken –2,469 Gent –2,125	Rotterdam –29,983 Rouen –17,050 Bremen –11,567 Le Havre –10,863 Vlissingen –9,038 Amsterdam –8,561 Zeebrugge –7,211 Duinkerken –2,642 Gent –549	Antwerpen –31,774 Bremen –23,247 Rouen –11,466 Vlissingen –9,767 Amsterdam –7,934 Duinkerken –7,618 Gent –526	Le Havre –82,169 Bremen –18,182 Rotterdam –16,840 Duinkerken –10,103 Vlissingen –2,714 Gent –573	Bremen –44,123 Rotterdam –34,687 Zeebrugge –32,267 Rouen –16,945 Amsterdam –15,108 Duinkerken –2,860 Vlissingen –2,111 Cuxhaven –394 Gent –357	Rotterdam –263,952 Hamburg –41,850 Le Havre –24,166 Amsterdam –10,154 Gent –1,291 Cuxhaven –1,131 Vlissingen –830	Rotterdam –248,535 Bremen –84,355 Zeebrugge –65,141 Emden –18,263 Rouen –17,734 Duinkerken –7,960 Amsterdam –7,228 Cuxhaven –2,382	Le Havre –189,509 Antwerpen –138,002 Wilhelmshav. –16,277 Emden –7,442 Duinkerken –5,041 Oostende –4,095 Rouen –3,817 Rotterdam –3,472 Gent –1,399

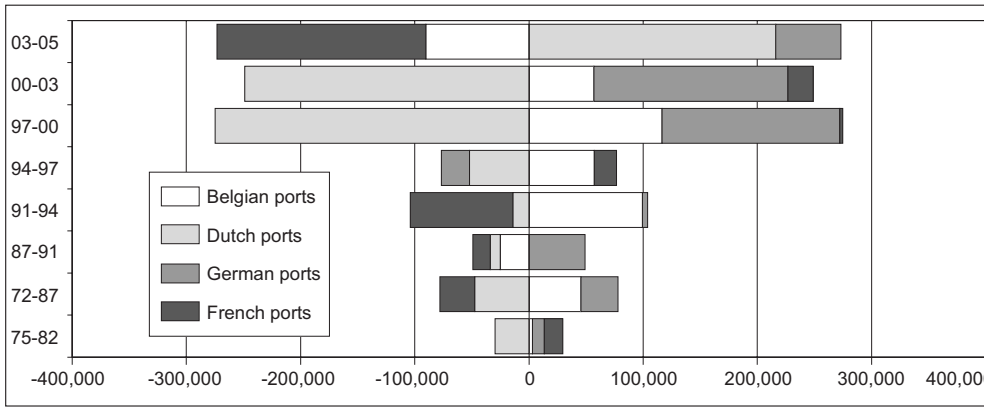
Source: author based on data resp. port authorities

The "big five" in the range will further develop downstream port areas in the future. The port of Rotterdam has developed ambitious infrastructure plans to build a second Maasvlakte on land reclaimed from the sea. A large part of Maasvlakte II would be dedicated to the container business. The first terminal should be open for business by 2013/14. In the meantime, the new *Euromax-terminal* (at the north of the current Maasvlakte) is expected to start operations in early 2008. The Belgian port of Antwerp opened the first phase of a tidal container dock on the left bank of the river Scheldt in 2005. The new *Deurganckdock* consists of 4.85 km of quay wall. When fully operational, the tidal dock will reach an annual capacity of at least 7 mio. TEU. Le Havre opened the first phase of *Port 2000* in the spring of 2006. *Port 2000* should allow Le Havre to triple its container handling capacity in the longer term. Hamburg announced plans to develop the *Container Terminal Steinwerder*, a terminal with a capacity of 3.5 mio. TEU scheduled for completion by 2015. A second phase of *Container Terminal Altenwerder* is planned that would further increase capacity to 2.8 mio. TEU. Bremerhaven continues to extend the *Wilhelm Kaisen Terminal*. The newest plan encompasses the construction of the CT IV terminal (four berths totalling 1,700 m). This will raise the port's annual capacity to 5.6 mio.TEU. These examples make clear that the large load centers in the area have responded in an adequate way to carriers' demand for new large terminal capacity.

In the previous section it was demonstrated that up to now none of the small and medium-sized ports have been able to challenge the large load centers. 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) do not necessarily make the existing large container ports the best locations for setting up hub operations. As such, it is not unlikely the future position of the large load centers can be to some extent threatened by medium-sized coastal ports and new hub terminals. Hence, the container growth potential in the range and potential diseconomies of scale in the existing load centers (e.g. in the form of lack of space for further expansion) have attracted non-hub ports into the container business. The new coastal ports could also partly be an answer to the restricted maritime accessibility and high diversion distance of Antwerp and Hamburg and the ongoing debates on the further deepening of the rivers Scheldt and Elbe respectively.

Zeebrugge, Dunkirk and Amsterdam are already vying for deepsea container flows. At Dunkirk, the *Quai de Flandres* has been extended recently from 470 m to 780 m, and access draught is being increased from 13 m to 14.5 m. Zeebrugge is still one of the few ports in the range still a long way from operating at anything like full capacity. A recent decision of the Zeebrugge port authority *Maatschappij van de Brugse Zeevaartinrichtingen N.V.*

Fig. 2: Average annual net shifts between port groups in range ('000 TEU)



Source: own calculation

(MBZ) opened the way to more direct competition between Antwerp and Zeebrugge. Since the spring of 2006, *APM Terminals* operates a container terminal on the Albert II dock south in Zeebrugge (formerly known as *Flanders Container Terminal*). In recent years, shipping line CMA-CGM has developed Zeebrugge as a major hub in its network. Terminal operator PSA HNN has an option to develop another container handling facility at the northern side of the Albert II dock. The limited cargo generation of the port and less favourable barge connections for serving the German hinterland are some of the weaknesses of Zeebrugge. Low handling charges, good water depth and a good location in relation to the shipping lanes is starting to pay off and Zeebrugge is now observing strong growth which resulted in a high net shift in the period 2003-2006 (see Tab. 2). The Dutch seaport Amsterdam opened its *Ceres Paragon Terminal* in 2001 with its distinctive state-of-the-art handling system based on an indented berth. The terminal with a capacity of some 950,000 TEU opened during a market slump. Current owner *Nippon Yusen Kaisha*'s (NYK) aggressive policy in pursuing clients has resulted in several calls of the *Grand Alliance* since 2005. As a result, Amsterdam was able to increase throughput from 65,844 TEU in 2005 to 302,882 TEU in 2006, but it still needs to be seen whether the rise of Amsterdam is sustainable.

Flushing and Wilhelmshaven have well-advanced plans of becoming deepsea container ports in the near future. The Dutch seaport Flushing is eager to start large-scale container operations on the *Westerscheldt Container Terminal* with a quay length of about 2 km. Realisation of the terminal remains uncertain due to legal procedures concerning environmental aspects. If the terminal would be realized, the first operations would not start before 2010. *JadeWeserPort* in Wilhelmshaven is due to start operations by 2010. The new facility will finally have a quay length of 1.7 km. By 2016

Tab. 3: Estimated new terminal capacities in the range added between 2005 and 2015

Estimated new capacity between 2005 and 2015 (in mio. TEU) = 33,4
(maximum approach - only new terminals, no expansion/reconversion of existing terminals)

Large load centres	*Mio TEU*	*%*
Rotterdam (Euromax, first phases Maasvlakte 2)	5.5	16
Antwerp (Deurganckdock East & West)	7.0	21
Le Havre (Port 2000, phase I, II and III)	3.0	9
Hamburg (Steinwerder, Burchardkai, Tollerort)	7.5	22
Bremerhaven (CT4)	2.0	6
Subtotal	*25.0*	*75*

All ports	*Mio TEU*	
Belgium	9.0	27
the Netherlands	8.4	25
Germany	12.2	37
France	3,8	11

Small and medium-sized (new) ports	*Mio TEU*	**%**
Flushing – Westerscheldt Container Terminal	2.0	6.0
Amsterdam – Ceres Paragon Termial	0.9	3.0
Dunkirk – Qui de Flandres	0.8	2.0
Zeebrugge (Albert II Dock)	2.0	6.0
Jade/Weserport	2.7	8.0
Subtotal	*8.4*	*25.0*

All ports	*Mio TEU*	*%*
Upstream ports	15.4	46
Downstream ports	18.0	54

Source: based on data resp. port authorities

the terminal should offer a capacity of 2.7 mio. TEU. The new deep-water port will consist of a container terminal (120 ha), an immediately adjacent port-associated logistical, industrial and commercial area (170 ha) and a cargo distribution center. The strong point of *JadeWeserPort* is a draft of 18m independent of tides. *JadeWeserPort* plans to become a main hub for European sea transit traffic - primarily with destinations in Scandinavia and the new eastern European EU countries and Russia (60 % of total throughput). In the coming ten years, it is expected that new terminals in the range will add about 33 mio. TEU of capacity, without taking into account the upgrading of existing terminals in the ports concerned (see Tab. 3). Three quarters of this new capacity will be located in the existing large load centers. Consequently, additional terminal supply in small and medium-sized ports supply is expected to have a moderate impact on port hierarchy. Assuming that the additional capacities would eventually be fully

Tab. 4: Ports of call combinations on the Europe – Far East and Europe – North America trades – figures for February 2006

Europe - Far East - 35 loops

Configuration of port rotation in North Europe						
Benelux	Germany	France	UK	Other	No. of loops	% of total loops
1	1	1			10	28.6
2	1		1		5	14.3
1	1	1	1		5	14.3
2	1	1	1		4	11.4
1	1		1		2	5.7
1	1			2	1	2.9
2	1				1	2.9
1	2		1		1	2,9
1	1	1			1	2.9
2		1	1		1	2.9
1	2				1	2.9
2					1	2.9
2	1	1			1	2.9
2	1				1	2.9

Europe - US/Canada - 26 loops

Configuration of port rotation in North Europe						
Benelux	Germany	France	UK	Other	No. of loops	% of total loops
1	1		1		5	18.5
2	1	1	1		3	11.1
1	1				3	11.1
1			1		3	11.1
2	1		1		2	7.4
1	1	1	1		2	7.4
1	1		1		1	3.7
1	1	1			1	3.7
1			1		1	3.7
1	2	1			1	3.7
1		2	1		1	3.7
1		1	1		1	3.7
1	2	1	1		1	3.7
1	1	2	1		1	3.7

Source: author based on carrier data

utilized, the market share of the small and medium-sized ports could increase from 7.1 % in 2006 to approximately 16 % past 2015. The terminal supply figures further indicate that upstream ports continue to invest heavily in large-scale container facilities: 46 % of additional capacity concerns upstream ports. This observation supports the idea that river ports such as Antwerp and Hamburg strongly believe in their future growth potential, even though some scholars have advocated the inevitable decline of upstream ports (see BAIRD 1996; NOTTEBOOM et al. 1997).

Based on the above analysis of future terminal supply, it is likely that cargo concentration levels in the Hamburg-Le Havre range will slightly decrease in the years to come stimulated by a number of seaports entering the large-scale container handling market and by a further narrowing of the throughput gap between Rotterdam and the main competitors. However, the supply-oriented analysis does not point to structural shocks in the range's existing port hierarchy.

The demand side: the changing face of port competition

Providing terminal capacity is one issue, filling them is another. There are several organizational and institutional driving forces at the demand side that could lead to spatial and structural changes in the port hierarchy. These forces are related to the changing face of port competition in the region. This section deals with key factors related to the dynamic nature of port competition in the region.

Liner shipping networks: "ship follows cargo" versus "cargo follows ship": In the last two decades increased cargo availability has made shipping lines and strategic alliances among them to reshape their liner shipping networks through the introduction of new types of end-to-end services, round-the-world services and pendulum services, especially on the main east-west trade lanes. As a result, a new breed of load centers has emerged on the east-west shipping lanes for transshipping at the crossing points of trade lanes. Elsewhere, in particular in Northern Europe and North America, load centers remain mainly functioning as gateways between deepsea liner shipping networks and extensive intermodal hinterland networks. Sea-sea transhipment volumes in the Le Havre-Hamburg range do not exceed 40 % of any port's throughput. Only Hamburg has emerged as a major feeder hub for the Baltic States and Scandinavia. Consequently, the competitiveness of the load centers in the Le Havre-Hamburg range is largely determined by the ports' capabilities in dealing with container flows to the immediate and more distant hinterland regions.

The organizational dynamics in liner service networks have a clear spatial impact. Most mainline operators running services to/from the continent stick to line bundling itineraries with calls scheduled in each of the main markets (see Tab. 4). This implies the alleged footloose behavior of shipping lines is limited in space. Carriers do not select one north-European mega-hub but select three to five regional load centers per loop with partly overlapping hinterlands.

The future spatial development of liner schedules to and from the Le Havre-Hamburg range will largely depend on the balance of power between shipping lines and shippers. The higher the bargaining power of shippers vis-à-vis ship-

Tab. 5: Container modal split for load centers in the Le Havre – Hamburg range, excluding sea-sea transhipment (in %)

	Rail			*Road*			*Barge*		
	1998	2001	2003	1998	2001	2003	1998	2001	2003
Rotterdam	14.5	13.0	10.0	51.3	48.7	50.0	34.2	39.0	40.0
Antwerp	7.8	8.8	9.5	64.5	61.3	59.5	27.7	29.9	31.0
Le Havre	14.3	11.4	12.4	84.6	85.3	82.8	1.3	3.1	4.8
Zeebrugge	34.4	41.9	40.2	50.6	48.8	55.1	15.1	9.2	4.7
Dunkirk	9.0	13.5	20.5	90.0	82.5	767	1.0	4.0	2.7
Hamburg	29.7	28.7	28.7	70.1	69.9	69.8	0.2	1.4	1.7
Bremerhaven	33.1	36.0	30.6	65.0	62.0	67.3	1.9	2.0	2.0

Source: based on data resp. port authorities

ping lines the more pressure for direct calls as this will shift the "cargo follows ship"-principle to the "ship follows cargo"-principle. For example, 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. The optimal liner network design is not only function of carrier-specific operational factors, but more and more of shippers' needs (for transit time and other service elements) and of shippers' willingness to pay for a better service.

The rise of Asian trade: Volumes on the trade route between Asia and Europe (the second largest container trade route after the transpacific) increased substantially in recent years. Hence, it should come as no surprise that ports in the Hamburg-Le Havre range, and in particular those ports which have strong links with Asia (in particular Hamburg and Rotterdam), enjoyed healthy growth in the last couple of years. It is expected that worldwide container trades, in particular the export trades originating from Asia, will continue to grow strongly in the years to come. This poses major challenges for load centers with a weaker Asian tradition (cf. Antwerp and Bremerhaven in relation to East Asia). Moreover, the Asian boom could generate the volumes necessary to give new entrants to the container handling market a fair perspective for growth. These new entrants all possess a favorable maritime accessibility, a precondition in view of accommodating the ever larger vessels on the Europe – Far East trade (at present typically varying between 6,000 and 11,000 TEU).

Hinterland capture areas and inland networks: Seaports are competing fiercely to extend their hinterlands across frontiers. The ports in the Le Havre – Hamburg range are all strategically located in relation to the area of the EU with the highest concentration of main economic centers, i.e. the so-called "blue banana" reaching from the southern part of the United Kingdom over the Benelux, central and eastern France to northern Italy. Hence, the Le Havre – Hamburg range is characterized by fierce competition for shared hinterlands. Antwerp is a striking example. The port faces tough competition from other ports in the region, even in relation to service areas in the immediate hinterland. Antwerp competes heavily with Rotterdam for local and European hinterland cargo, with Le Havre for French cargo and with Bremen and Hamburg for traffic to/from Germany, the Alpine region, Northern Italy and Central and Eastern Europe. Major hinterland overlap regions characterized by intense port rivalry are the Rhine-axis (the German Ruhr-Area in particular), Northern France, Northern Italy and the East-west corridors from the Benelux ports to the hinterland. Even the regions close to the Antwerp port are not captive.

In the last years, the traditional "blue banana" approaches the shape of a boomerang as a result of extensions to Central and Eastern Europe and significant investments in the Mediterranean (Spain in particular). Northern ports, in particular Hamburg, are benefiting the most from the last round of EU enlargement, whereas new development opportunities might arise for secondary port systems in the Adriatic and the Baltic Sea. An increasing number of ports gain direct hinterland access to the "blue banana" area. On the one hand, this development has broadened container port competition and altered spatial hierarchy, in the sense that the load centers in the Hamburg – Le Havre range are increasingly facing competition from container ports in other European port ranges (Baltic, Adriatic and Mediterranean), primarily for serving hinterland regions in the periphery of the core of the EU. On the other hand, the rise of economic centers in Eastern and Central Europe creates opportunities for the Le Havre – Hamburg range to develop shortsea shipping services and water- and land-based hub-feeder networks to these areas.

The tendency towards intense competition for shared hinterlands is enhanced by the development of intermodal corridors and inland terminals. By developing strong functional links with particular inland terminals a port might intrude in the natural hinterland of competing ports. "Islands" in the distant hinterland are created in which the load center achieves a comparative cost and service advantage vis-à-vis rival seaports (see NOTTEBOOM/RODRIGUE 2005 for more on "island" formation). The spatial impact of "island" formation is profound: the distance to a specific hinterland region as such becomes less dominant in explaining a port's competitive position with respect to serving that specific hinterland region. Instead, corridor formation seems to have a larger impact in explaining ports' positions vis-à-vis shared hinterlands.

The modal split in a number of European load centers is summarized in Tab. 5. The German ports have developed a strong orientation on rail shuttles, whereas Antwerp and Rotterdam heavily rely on barges to reach water-linked hinterland regions. Most ports have achieved a considerable modal shift in hinterland container transport, but rail and inland navigation still have not reached their maximum potential. Trucking remains the most important transport mode in all ports, especially in traffic relations to France and to inland destinations outside the large economic centers of Europe.

Rotterdam and Antwerp each have between 150 and 200 intermodal rail departures per week. Le Havre features more and more direct shuttles via *Naviland Cargo*. 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. nearly 1 mio. TEU in 2003). German container terminal operators are directly involved in intermodal rail transport. The German case is quite unique in the range. The organizational focus on rail implied the spatial development of extensive hinterland corridors, at first instance with a North-South orientation, but the last ten years also with a West-East orientation.

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 1.5 mio. TEU in 2004 leading to higher frequencies and bigger vessels. The growing realization of the potential offered by barge container shipping has led to a wave of investment in new terminals over the past few years, in Northern France, the Netherlands and Belgium. Consequently, the organizational dynamics of the competitive barge industry have led to a spatial widening of the barge option to navigation areas outside the Rhine. In the other large container ports of the Hamburg – Le Havre range, barge container transport as yet plays a modest but increasing role. Among the present and future new entrants to the container handling market in the range, only Flushing and Amsterdam offer excellent barge connectivity. The barging potential of Dunkirk, Zeebrugge and Wilhelmshaven is not at the level of Rotterdam and Antwerp.

The configuration of barge and rail networks proofs to be a crucial organizational element for the future spatial hierarchy in the Le Havre – Hamburg range. *First of all*, market players have identified inland logistics as one of the most vital area still left to cut costs. More economical ships and alliance co-operation have lowered ship system costs, but at the same time intermodal costs share an increasing part of the total cost. We can speak of a shift of balance from vessel costs to landside costs, favoring load centers with an upstream location close to the main production and consumption markets. This element partly explains why upstream ports are still in the picture, despite scale increases in vessel size and the associated demand for minimum diversion distances.

Secondly, barge container transport has an influence on competitive relationships within the European container port system. It enables the large Benelux ports in particular to create a patchwork of overlapping areas served by individual inland terminals, within which it is possible to achieve a cost advantage over other European container ports. The huge scale of barge operations in Rotterdam and Antwerp generates advantages not found in smaller container ports. The organizational advantages are apparent in the clustering of barge operators and related companies (e.g. ship repairs and ship chandlers). Other load centers including new ones are seeking to give inland barging a more prominent place in their inland distribution patterns of maritime containers, but the existing port hierarchy vis-à-vis Antwerp and Rotterdam is unlikely to be challenged in this respect.

Thirdly, the hinterland connections of smaller ports and new load centers in a start-up phase remain rather precarious. In the past, lines of major penetration emanating from the large load centers have allowed large ports to capture the hinterlands of neighboring smaller ports. Smaller ports and new terminals find themselves confronted with a vicious circle in the organization of hinterland transportation. The small-scale container volumes do not allow to install frequent block and shuttle trains to the more distant hinterlands. Because of the

inability to serve a substantial hinterland, the major shipping lines do not include these ports in their liner services. The only way for smaller container ports to escape this vicious circle is by seeking connection to the extensive hinterland networks of the large load centers through the installation of shuttle services either (a) to rail platforms in the big container ports or (b) to master rail hubs in the hinterland. The hub-feeder hierarchy in case (a) further strengthens the competitive position of the large load centers. Situation (b) demands the availability of rail hubs in the immediate or more distant hinterland. The use of inland hubs by small and large ports of the same port cluster could strengthen a trend towards a certain degree of deconcentration in the port system. Numerous hub-and-spoke railway networks have indeed emerged in the nineties, thereby allowing higher service frequencies and the inclusion of smaller container ports in the network (e.g. the *Qualitynet* of *Intercontainer-Interfrigo* (ICF) with hub Metz-Sablon in the North-east of France). However, European rail liberalization has partly contributed to the recent decline of many of the hub-and-spoke networks. 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 organizational dimension in the rail industry has a clear spatial impact: it creates a negative affect on cargo volumes on the spoke and might lead to a collapse of the whole hub-and-spoke system. For example, both *ICF's (Intercontainer-Interfrigo) Qualitynet* and *IFB's (Inter Ferry Boats) North European Network* (*NEN*) stopped operations in 2004. The rail operators involved shifted operations to a system of direct shuttle trains out of the main load centers. A further decline of hub-and-spoke rail networks in Europe could seriously affect the future growth potential of smaller and new ports as they would remain confronted with the vicious circle effect.

Port competition and logistics chains: Seaports increasingly have to deal with large port clients who possess a strong bargaining power vis-à-vis terminal operations and inland transport operations. The integration strategies of the market players created an environment in which ports are increasingly competing not as individual places that handle ships but within transport chains or supply chains. In the contemporary logistic-restructured port environment it has become more difficult to identify the port customers who really exert power in the logistic chain or who are driving port selection. Market players are sometimes port user and port service supplier at the same time (e.g. a shipping line operating a dedicated terminal). In some cases, the chain manager is situated at the end of the chain. For instance, supermarket chains like *Carrefour* exert strong power on the supply lines of food products. In these high volume logistics chains, a seaport is seen as a bundling point, a buffer within the scope of inventory management and or a fast transit point. In other logistics chains, commodity traders have a large impact on the routing of cargo. Large forwarding agencies negotiate rates with shipping lines and route the cargo they manage according to a combination of determinants such as price, transit time and reliability. The question who really decides which port to choose, typically depends on factors such as the type of cargo involved, the cargo generating power of the shipper, the characteristics related to specific trade routes and the terms of trade and terms of sale.

The above observations of an organizational nature have a large impact on spatial dynamics and port competition in the range. More than ever, terminals are not an end in itself: Efficient cargo handling facilities contribute to the industrial and logistics development in the port area and the hinterland. As the loyalty of port clients cannot be taken for granted, load centers in the Le Havre - Hamburg range are striving to approach some shippers and carriers who control huge cargo flows and who are in a good position to generate value-added for the port region. Success 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. This observation demands closer co-ordination with logistics actors outside the port perimeter and a more integrated approach to port infrastructure planning and concession policy. In co-operation with other parties involved port authorities can actively stimulate the spatial and logistics development of port areas through the enhancement of flexible labor conditions, smooth customs formalities (in combination with freeport status) and powerful information systems. The changing logistics environment also poses new challenges in the spatial relations between seaports and inland ports. A large number of port

authorities promote an efficient intermodal system in order to secure cargo under conditions of high competition. This includes for example the involvement in the introduction of new shuttle train services to the hinterland, together with the respective national railway companies, rail operators, terminal operators, shipping companies and/or large shippers.

To reflect changes in port-hinterland dynamics as a result of logistics dynamics, NOTTEBOOM/RODRIGUE (2005) introduced a regionalization phase in port and port system development. Regionalization expands the hinterland reach of the port through a number of strategies linking it more closely to inland freight distribution centers. The phase of regionalization brings the perspective of port development to a higher geographical scale, i.e. beyond the port perimeter. The port regionalization phase is characterized by a strong functional interdependency and even joint development of a specific load center and (selected) multimodal logistics platforms in its hinterland, ultimately leading to the formation of a "regional load center network". The port system consequently adapts to the imperatives of distribution systems.

All ports in the Le Havre – Hamburg range have to some extent embraced the idea of port regionalization. However, some ports like Antwerp for a long time stayed at the sideline when it came to inland terminal developments and the creation of logistics zones along hinterland corridors, while other ports such as Rotterdam were more active in this field. In practice, mainly private market players are involved in setting up these types of cooperative networks. Port authorities are often quite 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 has been 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 centers 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 center networks are most likely to be developed around large load centers, whereas smaller ports either become part of these large regional load center networks or remain isolated in a spatial and organizational sense.

The 'terminalization' of port competition: In the last ten years, the container handling industry in the Le Havre - Hamburg range has been characterized by massive consolidation, vertical integration and the formation of terminal networks operated by international stevedoring groups (NOTTEBOOM 2002; MUSSO et al., 2001). *DP World* (since 2006 owner of *P&O Ports*), *Hutchison Port Holding*, *PSA*, *APM Terminals* and *Eurogate* dominate container operations in the range (Tab. 6). Except for *Eurogate*, all of these companies have established a truly global presence (*Drewry Shipping Consultants* 2003). In light of vertical integration strategies, shipping lines have entered the container handling market via the development of dedicated terminals at major load centers. Many of these liner terminals offer stevedoring services to third carriers as well thereby creating some hybrid form in between pure dedicated facilities and independently operated multi-user facilities. MUSSO et al. (2001), BRENNAN (2002) and CARIOU (2003) provide a more in-depth analysis on the issue of dedicated terminals.

The organizational consolidation in the container handling industry has a large impact on the spatial dynamics in the range.

First of all, competition is shifting form port authorities to private terminal operators who are trying to establish terminal networks. SLACK (2005) rightly referred to the "terminalization" of port competition in this respect. The spatial implications are far reaching. Instead of port competition between clearly-defined port areas with spatial boundaries (nodes), competitive forces are shifted to groups of spatially-dispersed but functionally-integrated terminals in different ports (networks).

Tab. 6: Global terminal operators' presence and shipping lines presence in the Le Havre – Hamburg range

Terminal operator	*Terminals*	*Status*
Hutchison Port Holding	ECT (100%) – Rotterdam (>80% of TEU volume Rotterdam)	In operation
	Partial ownership of ECT since end of 1990s, full ownership since 2001.	
	Euromax Terminal – Rotterdam	Construction (end of 2007)
	Terminals at Maasvlakte II	Planning phase
DP World (incl.P&O Ports)	P&O Ports – Antwerp	In operation since 2000
	Major shareholder in Antwerp Gateway (east side Deurganckdock Antwerp)	In operation since end of 2005
	Port Synergy (joint venture with CMA-CGM) - Le Havre	In operation
PSA	PSA HNN (100%)	
	Partial ownership of Hesse NoordNatie since 2001, full ownership since 2003.	
	Terminals in Antwerp (85% of Antwerp's container volume)	In operation
	65% shareholding in Container Handling Zeebrugge (CHZ)	In operation
	50% shareholding in MSC Home Terminal – Antwerp	In operation since 2003
	Northern side Albert II dock - Zeebrugge	Planning phase
	Westerscheldt Container Terminal – Flushing	Planning phase
	Holland Terminals (barge terminal) - Rotterdam	In operation
APM Terminals	APM Terminals - Rotterdam (100%)	In operation since 2000
	Terminal at Maasvlakte II – Rotterdam (no granting yet)	Planning phase
	North Sea Terminal Bremerhaven (50%)	In operation
	APM Terminals - Zeebrugge	In operation since 2006
	APM Terminals – Dunkirk	In operation since 2005
Eurogate	Wilhelm Kaisen Terminal - Bremerhaven (100%)	In operation
	North Sea Terminal Bremerhaven (50%)	In operation
	Several terminals in Hamburg	In operation/planning phase
	JadeWeserPort – Wilhelmshaven	Planning phase
HHLA	Main terminal operator in Hamburg	In operation
	Container Terminal Altenwerder – Hamburg (74.9%)	In operation
	Container Terminal Steinwerder - Hamburg	Planning phase
NYK	Ceres Paragon Terminal – Amsterdam	In operation
MSC	MSC Home Terminal - Antwerp (joint venture with PSA)	In operation since 2003
	Le Havre (joint venture with Terminaux de Normandie)	Under development
Hapag-Lloyd	CT Altenwerder – Hamburg (minority stake of 25.1%)	In operation since 2002
CMA-CGM	Port Synergy (joint venture with P&O Ports) - Le Havre	In operation
	35% shareholding in CHZ - Zeebrugge (since July 2005)	In operation
	Minority shareholding in Antwerp Gateway – Antwerp	In operation since 2005
Cosco Pacific P&O Nedlloyd	Minority shareholdings in Antwerp Gateway - Antwerp	In operation since 2005

Source: based on terminal operator data and specialized press

Secondly, 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. Carriers have the choice between a call at a coastal port with onward inland services to the large load center, or a direct call in the large load center. The extensive terminal

networks are often considered as an effective means to counterbalance the power of carrier combinations in liner shipping, to realize economies of scale and to optimize the terminal function within logistics networks. At the same time, however, the industry structure has become sufficiently concentrated to raise questions about whether market forces are sufficient to prevent the abuse of market power.

Thirdly, the influx of overseas capital in seaports together with the consolidation in the cargo handling business have created circumstances in which some stevedoring companies have acquired a very strategic position in a port's future. A large number of European ports are now confronted with one or two terminal operators within the port area. The key position of such terminal operators inevitably attracts a lot of attention of the local port community, as they want to secure that economic rents of these terminal operations stay local. There is also a spatial implication in the sense that inter-terminal linkages within a port area have become a crucial issue to the dominant terminal operator in that specific port.

Port competition and the community: Securing terminal capacity and land infrastructure within a reasonable timeframe has become a major competitive factor in the Le Havre – Hamburg range. The time needed to develop port and inland infrastructure has increased considerably in the last decades because of painstaking legal procedures and the broad involvement of stakeholders in the planning process. It took the port of Antwerp ten years between the first plans and the first operations at the new Deurganckdock. A first broad discussion on Maasvlakte II in Rotterdam took place in the mid nineties, while the first terminal is expected to become operational only in 2013/14.

The economic value of a port development project now tends to be taken as given, so the argument concentrates on the environmental criteria (e.g. dredging and dredge disposal, loss of wetlands, emissions into the air, water pollution, congestion, loss of open space, light and noise externalities, potential conflicts with commercial fishing and recreational uses of area waters). Port authorities and port companies must demonstrate a high level of environmental performance in order to ensure community support. However, environmental aspects also play an increasing role in attracting trading partners and potential investors. A port with a strong environmental record and a high level of community support is likely to be favored. This observation can potentially have an impact on the future port hierarchy in the Le Havre – Hamburg range. In the last decade, ports in the Le Havre – Hamburg range have had to go through "learning by doing"-experiences in developing stakeholders relations management and in dealing the best they can with EU and national environmental regulations and spatial planning restrictions.

The discussed institutional factors in port development have spatial implications for the port hierarchy. Larger load centers have a richer experience in dealing with these issues. Newcomers in the container market or smaller ports might have less experience, which might show to cause serious delays or even a halt to any large terminal development. The ongoing (long) debate on the *Westerscheldt Container Terminal* in Flushing serves as an example. As such, large load centers have a good starting position to further consolidate their position in the spatial hierarchy within the Le Havre - Hamburg range.

Conclusions

Ports are confronted with ever changing organizational and institutional factors in economic and logistics systems. The global market place, with powerful and relatively footloose players, extensive business networks and complex logistics systems, have a dramatic impact on the raison d'être of seaports. The tendency towards logistics integration in the port and maritime industry and the impact of changes in logistics on the functional role of ports in value chains are well documented in literature. Robinson (2002) placed the role of seaports within a new paradigm of ports as elements in value-driven chain systems, while Martin/Thomas (2001) addressed structural changes in the container terminal community.

Despite these dramatic changes in the organizational and institutional environment of ports in the Le Havre - Hamburg range, port hierarchy in the last 30 years remained rather unchanged and no structural shifts in the spatial characteristics could be observed. The five large load centers keep on dominating the market in spatial terms, with upstream ports slightly improving their market share and French

ports losing some market share. The share of small and medium-sized ports remains small. The supply-based analysis demonstrated cargo concentration levels in the Hamburg - Le Havre range might slightly decrease in the years to come because of a number of seaports entering the large-scale container handling market and because of a further narrowing of the throughput gap between Rotterdam and the main competitors. But no structural shifts in the range's existing port hierarchy are expected.

The demand factors discussed in this paper indicate container port competition in the Le Havre – Hamburg range will remain highly complex and dynamic. Port rivalry will most likely become more intense, and even the core object of port competition will further shifts towards the accommodation of logistics chains for which terminals are merely a node. The large load centers in the range are designing appropriate strategies to respond to these new challenges and in more than one case this includes a trend towards port regionalization incorporating inland terminals and corridors. Smaller container ports will face a difficult time in challenging the established large load centers. New entrants in the container handling market typically meet the requirements for maritime accessibility and terminal layout, and might be well positioned for accommodating a part of the sea-sea transshipment flows, particularly in relation to the Asian trade. However, they will have to tackle major issues including the vicious cycle in hinterland networks, their general lack of experience in stakeholder-related procedures linked to large terminal projects and their lower cargo-generating and cargo-binding potential (typically as a result of a lack of associated forwarders' and agents' networks).

Due to the above organizational and institutional factors, it is unlikely that the spatial hierarchy in the Le Havre – Hamburg range will structurally alter in the foreseeable future. Inter-port networking could reach new heights in the years to come in the framework of the port regionalization phase, but this is not expected to result in a far reaching revision of the existing port hierarchy.

Note

1 Container capacity is measured in *twenty-foot equivalent units* (TEU). A twenty-foot equivalent unit is a measure of containerized cargo capacity equal to one standard container 6.10 m (length), 2.44 m (width) and 2.59 m (height), or approximately 38.5 m^2.

References

BAIRD, A.J. (1996): Containerisation and the decline of the upstream urban port in Europe. In: Maritime Policy and Management, (23), 145-156.

BARKE, M. (1986): Transport and trade. Edinburgh.

BIRD, J. (1971): Seaports and seaport terminals. London.

BRENNAN, J.R. (2002): Brave new world. In: Containerisation International, December, 39-41.

CARIOU, P. (2003): Dedicated terminals in container ports: a cost-benefit analysis, Research seminar: maritime transport, globalisation, regional integration and territorial development. Le Havre.

Drewry Shipping Consultants (2003): Annual review of global container terminal operators. London

HAYUTH, Y. (1981): Containerisation and the load center concept. In: Economic Geography, (57), 160-176.

HAYUTH, Y./FLEMING, D.F. (1994): Concepts of strategic commercial location: the case of container ports. In: Maritime Policy and Management, (21), 187-193

MARTIN, J./THOMAS, B.J., (2001): The container terminal community. In: Maritime Policy and Management, 28, 279-292.

MUSSO, E./FERRARI, C./BENACCHIO, M. (2001): Co-operation in maritime and port industry and its effects on market structure. Seoul. (Paper presented at WCTR Conference, Seoul).

NOTTEBOOM, T. (2002): Consolidation and contestability in the European container handling industry. In: Maritime Policy and Management, (29), 257-269.

NOTTEBOOM, T. (2005): The peripheral port challenge in container port systems. In: Leggate, H./McConville, J./Morvillo, A. (Eds.): International maritime transport: perspectives. London, 173-188.

NOTTEBOOM, T./KONINGS, R. (2004): Network dynamics in container transport by barge. In: Belgeo, 5, 461-477.

NOTTEBOOM, T./RODRIGUE, J.-P. (2005): Port regionalization: towards a new phase in port development. In: Maritime Policy and Management, (32), 297-313.

NOTTEBOOM, T./COECK, C./VERBEKE, A./WINKELMANS, W. (1997): Containerisation and the competitive potential of upstream urban ports in Europe. In: Maritime Policy and Management, (24), 285-289.

ROBINSON, R. (2002): Ports as elements in value-driven chain systems: The new paradigm. In: Maritime Policy and Management, (29), 241-255.

SLACK, B. (2005): The terminalisation of ports: An academic question?. Hong Kong. (Paper presented at *International Workshop on New Generation Port Cities and Global Supply Chains*, The University of Hong Kong, Hong Kong, Dec. 12-14 2005).