Relevance of Efficient Hinterland Access for the Inter-Port Competitiveness of European Container Ports

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Abstract Driven by globalization and increasing world trade volumes most European seaports have seen significant growth rates especially in container traffic over the period from 2000 to 2008. With regard to the future growth perspectives, most European container ports have carried out ambitious plans for the extension of container handling capacities. Due to the economic crisis in 2008 and the inherent stagnation of container volumes after the recovery 2010 the terminal landscape can be characterized by overcapacities. Further plans for the provision of additional container facilities such as in Wilhelmshaven (Jade-Weser-Port), Southern UK (London Gateway) and Rotterdam (Maasvlakte II) as well as the upgrade and optimization of existing handling facilities are supposed to intensify the inter-port competition in Northern Europe. Therefore, the hinterland access of the ports will gain importance as competitive element.

1 Introduction

Driven by globalization and increasing world trade volumes most European seaports have seen significant growth rates especially in container traffic over the period from 2000 to 2008. With regard to the future growth perspectives, most European container ports have carried out ambitious plans for the extension of container handling capacities. Due to the economic crisis in 2008 and the inherent stagnation of container volumes after the recovery 2010 the terminal landscape can be characterized by overcapacities. Further plans for the provision of additional container facilities such as in Wilhelmshaven (Jade-Weser-Port), Southern UK (London Gateway) and Rotterdam (Maasvlakte II) as well as the upgrade and optimization of existing handling facilities are supposed to intensify the inter-port

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competition in Northern Europe. Therefore, the hinterland access of the ports will gain importance as competitive element.

The current situation of many ports can be characterized by a high degree of infrastructure utilization with strong impacts on transport quality and competitive situation of the port. As investment plans in almost all major container ports mirror a strong lack of hinter-land orientation, accelerating bottlenecks and hinterland congestion in the context of an enhanced geographical market coverage makes hinterland accessibility increasingly important for the competitiveness of a seaport. Besides guaranteeing basic requirements of a competitive hinterland transport system ports are more and more forced to focus on an optimization of port accessible by fostering modal shifts to transport modes with vacant capacities, by optimizing operational procedures and by displacing downstream container activities to supplementary terminals. Capacity restraints and pending infrastructure upgrades in the main hinterland terminals emphasize the necessity of a synchronized hinterland concept.

The intended derivation of sound recommendations for an increasing inter-port competitiveness through the improvement of hinterland accessibility has to consider a general evaluation of competitive factors in inter-port competition in Europe and experiences in selected ports of the Hamburg-Antwerp range. The subsequent assessment of legislative, organizational and operational framework conditions in Hamburg as one of Europe's leading container ports shall give an idea about the complexity of an efficient hinterland concept facing co-operative aspects between the port, regional authorities, national authorities, national network operators, shipping lines and hinterland carriers.

2 Assessment of Competitive Factors

In addition to a variety of port-related issues, factors focusing on the hinterland perspective of seaports play an increasingly important role for the competitiveness of seaports. In a first definition, the seaport hinterland can be characterized as the upcountry territory limited by the origin or final destination of the goods handled in the port (Biebig et al. 1995, p. 290). A second definition by Lieb (1990) is based on the differentiation between the so called geographic and the economic hinterland. The geographic hinterland is determined by the temporal and spatial distance from any hinterland location to the port whilst transport costs as a function of distance, mode of transport, transit time and the transport volume demarcate the economic hinterland. Another definition by Bird (1971) considers the intensity of inter-port competition. The primary hinterland of a seaport can therefore be defined as region with no inter-port competition and strong focus on local volumes. The secondary hinterland compounds the area with an intense competition of different logistic chains.

Subsuming the previous definitions the hinterland can be described as dynamic figure that is substantially determined by

- load potential and economic development in the main hinterland markets,
- hinterland infrastructure and quality/performance of hinterland transport,
- transport costs.

The inter-port competition of European container ports is more and more affected by the infrastructural development and the efficiency of transport service providers. With a growing volume of transit cargo, this aspect becomes more important. From shipper perspective aspects like rapidity of transport, customer orientation, flexibility and reliability can be considered as key success factors for ports in inter-port competition (Gielessen 1998, S. 71). Highly frequented and reliable hinterland connections can thereby only be achieved by bundling hinterland services in few hub-ports. An efficient capacity allocation and utilization through matching volumes in im- and export flows is under economic and ecological view favourable. Especially for the development of marketable intermodal hinterland services, the bundling of cargo volumes enabling large economies of scale is of major importance.

Using the analytical approach of the conjoint analysis the relevance of hinterland-related factors for the inter-port competitiveness of a seaport can be evaluated. Taking the con-joint analysis as a model and technique used to assess the different weights individuals place on the variables presented to them in a given purchase situation, decision makers from terminal operators, shipping companies, logistics providers and regional authorities have been asked for their opinions. The selection of the participants turned out in close co-operation with shipping and transport associations to ensure a representative character of the analysis. Based on the instrument of individually composed profile cards the preferences of the participants with regard to eight port- and hinterland-related competitive factors were assessed.

Table 1 gives an overview showing the relative importance of eight selected competitive factors based on the aggregated utility weights.

The overall assessment of the mentioned factors confirms a dominant role of port infra- and superstructure (17.09 %) and maritime access conditions (15.98 %).

Table 1 Relative importance of selected competitive factors

	$I^{Terminal}$	$I^{Shipping}$	$I^{Logistics}$	$I^{Authorities}$	I^{Total}
Port infra- and superstructure	22.88	15.90	13.87	13.30	17.09
Terminal productivity	8.85	8.97	12.72	21.33	12.60
Intra-port competition	6.85	3.06	4.64	4.82	5.15
Existence of maritime cluster	6.22	10.15	6.75	6.68	7.12
Maritime access conditions	19.17	16.59	13.37	14.03	15.98
Load potential and economic development of hinterland	7.41	13.63	15.38	11.59	11.64
Quality of hinterland services	16.15	16.88	15.02	14.41	15.58
Transport costs	12.47	14.81	18.24	13.85	14.83

Source Own assessment

With percent-ages between 11.64 and 15.58, the hinterland-related factors also stand for a strong impact on the competitive situation of a seaport. Depending on the different participant group, the results show divergent estimations regarding the relative importance of the eight factors. As expected, terminal operators put a strong emphasis on the port infra- and superstructure (22.88 %). Due to their dependence on competitive hinterland connections, the quality of hinterland services stands with 16.15 % above the average. Same as terminal operators also shipping companies are highly interested in a good quality of hinterland services. Reasonably logistic providers show the highest affinity to hinterland-related factors. For them costs for hinterland transport play the most important role in inter-port competition. Surprisingly regional authorities consider terminal productivity as most important factor for the competitiveness of a seaport.

Subsuming the results of questioning it can be stated that the three hinterland-related factors stand for a cumulated relative importance of 42.05 %. The quantified relative importance of the hinterland issues indeed gives no evidence regarding the type and the quality of hinterland access and intermodal transport. The following qualitative approach carries out some general trends in European hinterland transport.

3 General Trends in Hinterland Transport in Hamburg-Antwerp-Range

The assessment of modal shares in hinterland transport for selected ports in the Ham-burg-Antwerp-Range mirrors a special relevance of different modes of transport for the examined ports (Table 2).

All port statistics (except for Bremerhaven) indicate a truck share of more than 50 % leading to more or less the same problems in all ports. Road congestion within the port area as well as on the main hinterland axis, limited terminal capacities to handle trucks especially in peak hours and delays due to administrative obstacles like long customs clearing processes have led to various initiatives for a modal shift to railways and waterways. Additionally the intensification of legal framework conditions for road transport (e.g. German road toll, adjustment of driving and resting times all over Europe) have set further incentives for modal shifts especially on the long haul.

Table 2 Modal share in selected seaports 2011 (intermodal transport in %)

	Road (%)	Rail (%)	Barge (%)
Antwerp	55	10	35
Bremerhaven	31	65	4
Hamburg	61	37	2
Rotterdam	60	9	31

Source Port statistics

Particularly the German ports Hamburg and Bremerhaven stand for a significant railway share considering the total hinterland volume. A superior connection to the European railway network, flourishing intramodal competition, high load potentials hinterland areas with excellent rail access and save transport conditions at moderate product-related costs can be named as key success factors for rail transportation to and from the German seaports (Aberle 2000, p. 508). The competitiveness of intermodal services in comparison to road haulage highly depends on the realization of disintegration on the long run levelling the additional costs of terminal feeding and double container handling (Boes 1999, p. 18). Coming from the non-liberalized market approach a minimum transport distance of 500 km is considered as necessary to reach the mentioned effects of disintegration (Ewers and Fonger 1993). Positive impacts on the operational side mainly resulting from a rising intramodal competition set the framework for productivity increases shortening the minimum transport distance for an efficient railway transport. Current logistics trends support the development of railway transportation through internationalization and cross-border transport on long-distances. The innovative potential of new market entrants arising from an increasing intramodal competition contributes to push back "historical" problems of cross-border railway transportation. Besides different technical standards (six major different electrification and 23 different control-command and signalling systems) inefficiencies of the incumbent national railway operators, the pending liberalization process in various countries and administrative obstacles at border stations still affect the European railway sector. Due to the fast growing container volumes railway transport experiences an increasing number of bottlenecks facing the port adjacent infrastructure as well as the main hinterland corridors and terminals. Long-winded approval procedures and a port-oriented subsidization of intermodal terminals have led to an imbalance between seaports and hinterland terminals.

Same as railway transport inland navigation is suffering from bottlenecks in the main European seaports as well. Port congestion can be considered as of high relevance for barge operators calling Rotterdam and Antwerp. Typical scenarios include unavailability of berths, impossibly small berth windows and containers left behind. Barge operators have also incurred extra costs by having to charter extra barges to fill the gaps caused by the delays. Additional effects like unstable water levels on the Rhine River and the in-creased efficiency of railway transport due to a rising intramodal competition have fostered the development of barge terminals to trimodal logistic centres offering a wide range of rail-related services as well. With the opening of the dedicated freight route Betuwelijn connecting Rotterdam with its German hinterland, the port of Rotterdam has taken another attempt to reach a wider spread of modal share.

The first overview reflecting some more general trends on the hinterland side indicates that almost all ports in the Hamburg-Antwerp range are affected by the impacts of in-creasing requirements from the market side. To understand the full complexity of a holistic hinterland approach the example of the port of Hamburg gives a more detailed analysis of key strategic factors for an efficient hinterland orientation of container ports.

4 Detailed Assessment of Hinterland Transport Conditions in Hamburg

With regard to the total traffic volume (container and bulk), railway transport stands for 30.2 % of all hinterland traffic, rising from 28.8 % in 2007. The container volume trans-ported by rail mounted from 780,000 TEU in 2000 to 1,970,000 TEU in 2012 (+8.0 % p. a.). Due to the way of calculating the modal share (with or without transshipment) this is equal to 22.1 % (based on total volume) or 37.1 % (based on hinterland traffic excluding transshipment). Considering the high proportion of local bound containers being distributed by truck the railway share rises to >60 % of goods to/from hinterland outside Hamburg metropolitan region and 70 % of all long-distance containers (over 150 km). Compared to the development in most competing ports in the range Hamburg's development prospects are divergent. An updated handling forecast from October 2010 predicts a cargo handling volume of 296 million tons in 2025, equal to an annual average growth rate of 6.4 %. Container handling will develop much more strongly than total cargo or bulk cargo in the port of Hamburg. Annual growth in container traffic will average 8.3 % up to 2025, by which time it will total 25.3 million TEU in the most likely base-case scenario. A more detailed assessment of the forecast figures shows that hinterland volumes will partly lose their dynamics—the hinterland share is supposed to decrease from 65 to 50 % under-lining the strong impact of transshipment volumes for the future port development. After the weak results in 2012 (downturn of container volumes by −1.7 %) a growing number of experts believes in a trend change towards a more stable market development without exceeding growth rates and an ongoing shift of market shares from Hamburg to Rotter-dam (Preuss 2013). The ongoing struggle concerning the planned adjustment of the River Elbe navigation channel and the ambitious expansion plans in Rotterdam have in-creased the pressure on Hamburg to defend its position as one of the leading container ports in Europe.

The provision of efficient hinterland services especially to Southern Germany and Eastern Europe can still be considered as the core competitive advantage of Hamburg. Following the expectations for an increase of railway share from now 37.1 % (based on hinterland traffic excluding transshipment) to 41 % this might lead to a container volume of 5.7 million TEU in 2025 to be handled by rail. Current predictions foresee that the number of freight trains with source/origin in the port will double from currently 200 freight trains per day to 400 by 2020.

To cope with the expected growth, port planning requires the substantial expansion of rail infrastructure facilities over the period to 2025. The Hamburg Port Railway as a service provider in accordance with railway legislation is responsible for the 386 km of railway tracks within the port area. The current port railway network implies various bottlenecks, which lead to restrictions and operational inefficiencies. Examples like the non-electrified single-track connection between Hamburg-Sued and Hohe Schaar, the single-track gateway for northbound traffic in interchange Veddel, the single-track link between eastern and western port areas via

rail/road dual use bridge "Kattwykbruecke" and the equal level single track access to the national railway network in Hausbruch mirror the necessity of future infrastructure upgrades.

Considering the mentioned bottlenecks both the infrastructure facilities and operations of the port railway need to be optimised. This comprises in particular the expansion of existing railway yards and the construction of new track facilities as well as further operational improvements. The illustration shows the port railway and the planned measures (Fig. 1).

Operational inefficiencies predominantly affect a capable capacity allocation on the port rail network. The current infrastructure utilization of 90 % together with the forecasted increase of rail volumes and train movements accentuate the necessity to investigate managerial and organizational framework conditions in hinterland transport by rail. To en-sure the short- and mid-term continuance of competitive railway transport to/from the port of Hamburg, measures to improve the operational efficiency on the port rail network have to be undertaken. These measures cover aspects like

- the guarantee of non-discriminatory access to the port rail network,
- the contribution on an efficient slot management at the rail terminals to optimize capacity utilization,
- monetary incentives for optimized train utilization and wagon loads through the HPA charging regime,

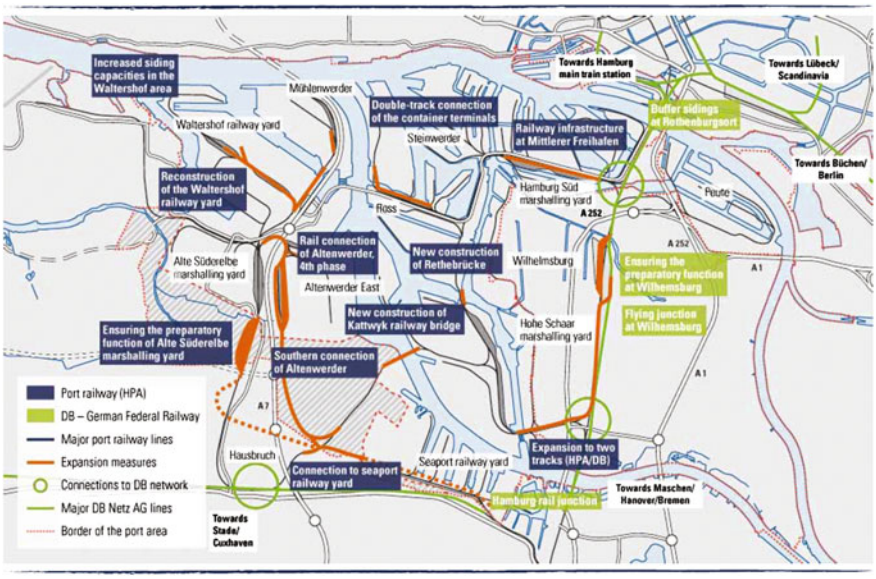

Fig. 1 Railway track network of the port railway and planned measures. *Source* Free and Hanseatic City of Hamburg—State Ministry of Economic Affairs, Transport and Innovation (2012), p. 51

- incentives to reduce dwell-times in container yards by bonus-malus-systems,
- incentives to avoid train formation on port rail network,
- the simplification of customs clearing processes,
- an extension of time-based port operations to avoid peak loads.

Assessing the framework conditions for truck transportation it is considerable that the port of Hamburg is known for its high share of local cargo. This means that more than one third of the goods arriving in the port of Hamburg have their destination within the Ham-burg metropolitan region (HHM 2012). Comparable to the situation on the rail side, road transport is affected by infrastructural and operational difficulties. Infrastructural bottlenecks can mainly be observed on the port route between Waltershof and eastern port areas as well as on the roads leading in and out of the Suederelbe area, to Finkenwerder and to the motorway A7. Traffic volumes causing congestions arise not only from container transport, but are also generated by port-related businesses and workplaces. The discussion on future infrastructure extensions is mainly driven by the planned motorway new construction of the section of the A 26 between the A 7 and the A 1. With 35.000 crossings per day (thereof 35 % trucks) and an expected growth of 118 % until 2015 (HPA 2010, p. 21) the Koehlbrandbruecke can be one of the main future bottlenecks. As necessary upgrades to improve the situation at the traffic junctions adjacent to Koehlbrandbruecke have yet not been undertaken the real capability of the bridge to handle the forecasted volumes can hardly be assessed. Even if traffic flow optimizations may lead to a sufficient capacity, questions regarding the future constructional resistance of the bridge foster plans for an additional Koehlbrand crossing.

Besides infrastructural projects terminal operators are heading for an optimization of terminal related activities to reduce truck-gate congestion. First experiments with extended gate opening hours (24/7) have been started with poor results. Main problems are the opening hours of inland distribution centres and downstream logistic providers who have not adapted to the extended opening hours of the terminals with the consequence of remaining peaks especially in the late afternoons. Other means like vehicle booking systems to smooth out the flow of truck arrivals throughout the day can contribute to an optimized hinterland transport on the road side.

With a 2 % share of total hinterland traffic inland navigation only plays a minor role in (container) hinterland transport (HHM 2012). Main reasons for this purpose can be seen in operational difficulties in navigating the waterway. Besides ice in winter and low water in summer constant dredging is necessary. Several parts of the river also still need to be cleared to open up the possibility for an efficient container transport by barge. The Elbe-Seitenkanal as major link to the German inland waterway network is highly affected by capacity restraints from the ship-lift in Scharnebeck. In addition to transport-related problems the terminal operational side can be considered as another obstacle for the development of significant barge volumes. The necessity to use cost intensive gantry cranes for the loading and

unloading of barges leads to imbalances regarding the handling costs with major advantages for road or rail.

Growing transport volumes with origin in the port of Hamburg do not only affect transport capacities, they also cause problems arising from capacity restraints in the main hinterland terminals. Precise extension plans and terminal investments in the seaport contrast with difficult conditions for the terminal development along the main hinterland corridors. Unverified prospects regarding general hinterland strategies and future transport volumes of the big ocean carriers, the demand for investment capital together with difficult framework conditions for terminal subsidization (due to main focus on the subsidization seaport rail terminals) as well as long-winded approval procedures in the context of tightened environmental laws delay a need-driven capacity extension.

5 Conclusions and Recommendations

The preceding analysis has substantiated a considerable importance of a strong hinterland orientation for the competitive situation of a seaport. The evaluation of hinterland operations indicates that almost all ports in the Hamburg-Antwerp range are affected by bottlenecks in hinterland transportation. One of the key conclusions arising from the described complexity of hinterland processes is to understand container transport as one chain comprising quayside, terminals, port railways, hinterland railways and hinterland terminals. In the short- and mid-term perspective, the optimized utilization of existent infrastructure and transport systems is vital to face the upcoming challenges of the dynamic market development. Incentives to foster modal shifts by using all disposable capacities in barge- and railway-transportation can be considered as one of the main objectives to tap potentials on the carrier side. Additionally, prospectives arising from a liberalized railway sector should be considered. For a sustainable infrastructure allocation short-term measures optimizing the organizational framework for the infrastructure use as well as the establishment of incentives for traffic flow maximization have to be undertaken. Significant efficiency increases for all parties involved, can also be achieved by an advanced IT periphery. The possibility for a sophisticated container disposition along the total transport chain will lead to extensive improvements for terminal operators, carrier and infrastructure operators. As infrastructure upgrades usually require an advanced planning, bottlenecks need to be identified early; planning processes have to be initialized.

In the long term, rail infrastructure in the ports needs to be upgraded to create future capacities for the handling of the forecasted container volumes. The synchronization of port-rail related infrastructure projects and infrastructure and terminal capacity extensions on the main hinterland corridors can be considered as another important issue. Further-more rail hinterland concepts have to be carried out reflecting the different requirements of high-speed traffic and cargo transportation. Agreements on common technical standards have to be promoted,

supporting the strength of railway transportation on the long run. The example of the Betuweroute, where the port of Rotterdam has taken a leading role in the development of additional hinterland infrastructure, demonstrates that a stronger engagement of seaports in the promotion and provision of port-related hinterland infrastructure becomes more and more important.

The further endorsement of inland navigation as mode of transport with environmental advantages and still remaining transport capacities has to be accompanied by future up-grades of canals and locks to reduce economic disadvantages of barge transportation in comparison to road and rail. From the dimension of transport policy, political efforts for equal framework conditions on the transport market have to be undertaken; incentives for modal shifts have to be supported.

Facing the situation in the hinterland terminals the materialization of information from ocean carriers and hinterland operators on future transport strategy, expected volumes and favourable relations are of high relevance for a sustainable capacity planning. Furthermore, an improved and transparent exchange of load specific data between shippers and terminals is important to increase operational performance along the whole transport chain. Thereby an increased schedule reliability of rail transport can contribute to avoid operational inefficiencies due to accounted buffer times and volumes within the container disposition. Requirements for the granting of subsidies need to be revised with respect to stronger hinterland orientation of terminal investments. As subsidization is limited to the promotion of handling activities, additional measures for the funding of container storage areas should be undertaken. Additionally, incentives for private investments in hinterland infrastructure should be fostered by simplifying the legislative framework conditions.

References

Aberle G (2000) Transportwirtschaft – Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 3. Auflage, München

Beddow M (2007) Squeezing blood out of a stone. Containerisation Int 7(07):62–63

Biebig P, Althof W, Wagener N (1995) Seeverkehrswirtschaft, 2. Auflage, München

Bird J (1971) Seaports and seaport terminals, London

Boes M (1999) Wenig Anlass zum Optimismus in: Deutsche Verkehrs-Zeitung, 53. Jahrgang, 17 Apr 1999, S. 17–18 (Sonderbeilage multimodaler Transport)

Gieleßen H-G (1997) Die Rolle der Hinterlandverbindungen für den Seehafenwettbewerb, in: Deutsche Verkehrswissenschaftliche Gesellschaft (DVWG) e.V., 6. Kieler Seminar zu aktuellen Fragen der See- und Küstenschifffahrt, Probleme im Seeverkehr, Schriftenreihe der DVWG, Band 207, S. 69–84, Berlin

Lieb TC (1990) Wettbewerbliche Perspektiven von Weltcontainerhäfen unter veränderten see- und landseitigen Rahmenbedingungen

Free and Hanseatic City of Hamburg—State Ministry of Economic Affairs, Transport and Innovation (2012) Hamburg is staying on course—the port development plan to 2025

HHLA (2012) Hamburger Hafen und Logistik AG, Homepage. http://www.hhla.de

HHM (2012) Hafen Hamburg Marketing, Homepage Port of Hamburg. http://www.hafen-hamburg.de

HPA (2007) Hamburg Port Authority, Homepage. http://www.hamburg-port-authority.de

HPA (2010) Hamburg Port Authority, Masterplan Straßenverkehr Hafen Hamburg
OSC (2006) The European and Mediterranean containerport markets to 2015
Preuss O (2013) Hafen unter Druck – Einen neuen Boom des Containerumschlags werden die maritimen Unternehmen sobald nicht erleben, in WELT am SONNTAG, 14 Mar 2013
Stenvert R, Penfold A (2006) Container port strategy—emerging issues, Publication of OSC
Visser J, Konings R, Pielage B-J, Wiegmans B (2006) A new hinterland transport concept for the port of Rotterdam: organisational and/or technological challenges?