

ECONOMIC RESEARCH CENTRE

LAND ACCESS TO SEA PORTS

ROUND
TABLE

113



EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

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ECONOMIC RESEARCH CENTRE

REPORT OF THE
HUNDRED AND THIRTEENTH ROUND TABLE
ON TRANSPORT ECONOMICS

held in Paris on 10th-11th December 1998
On the following topic:

LAND ACCESS TO SEA PORTS

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (ECMT)

The European Conference of Ministers of Transport (ECMT) is an inter-governmental organisation established by a Protocol signed in Brussels on 17 October 1953. It is a forum in which Ministers responsible for transport, and more specifically the inland transport sector, can co-operate on policy. Within this forum, Ministers can openly discuss current problems and agree upon joint approaches aimed at improving the utilisation and at ensuring the rational development of European transport systems of international importance.

At present, the ECMT's role primarily consists of:

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- helping also to build a bridge between the European Union and the rest of the continent at a political level.

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The issues currently being studied – on which policy decisions by Ministers will be required – include the development and implementation of a pan-European transport policy; the integration of Central and Eastern European Countries into the European transport market; specific issues relating to transport by rail, road and waterway; combined transport; transport and the environment; the social costs of transport; trends in international transport and infrastructure needs; transport for people with mobility handicaps; road safety; traffic management; road traffic information and new communications technologies.

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The ECMT's Documentation Service has extensive information available concerning the transport sector. This information is accessible on the ECMT Internet site.

For administrative purposes the ECMT's Secretariat is attached to the Organisation for Economic Co-operation and Development (OECD).

Publié en français sous le titre :

LA DESSERTE TERRESTRE DES PORTS MARITIMES

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SPATIAL AND FUNCTIONAL INTEGRATION OF CONTAINER PORT SYSTEMS AND HINTERLAND NETWORKS IN EUROPE

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Antwerp, April 1998

1. GENERAL CONSIDERATIONS ON LAND ACCESSIBILITY TO SEA PORTS

The globalisation of economic activities and the economic integration process in Europe have strengthened the functional role of sea ports within the emerging global transport system. Land accessibility to sea ports has become one of the major concerns of port authorities and public policymakers in Europe, as it is crucial for a port's competitiveness and for enhancing economic development both in land-locked and coastal regions in Europe. This first section introduces some basic considerations regarding the land access to modern sea ports.

1.1. The functional role of sea ports and the triptych foreland-port-hinterland

In very conventional terms, a port is often defined as a transit area, a gateway through which goods and people move from and to the sea. As such, it is a place of contact between land and maritime space, a knot where ocean and inland transport lines meet and intertwine, an intermodal place of convergence (Weigend, 1958, Hayuth, 1985).

In the course of time, fundamental changing processes have broadened and deepened the functions of sea ports. In the last fifty years, the major European sea ports added new functions to their traditional role of transshipping and storing goods. After the second world war, the industrial function grew rapidly. Some sea ports have grown out to become industrial complexes comprising a large number of related industrial activities, the so-called MIDAs (Maritime Industrial Development Areas), see, e.g., Winkelmanns (1973). In more recent years, the logistical function of sea ports in particular has received much attention. The gateway position of major sea ports offers opportunities for the enhancement of Value-Added Logistics (VAL). VAL integrates the production and distribution chain (AT Kearney & Knight Wendling, 1993). By offering VAL services, ports aim to attract a large portion of the value-added creation within product chains. As such, a modern sea port has evolved from a pure transshipment centre to "a function in a logistics system" (IAPH, 1996). The functional and spatial development of sea ports is depicted in Table 1. A distinction is made between elements related to the external environment, the functional organisation, the spatial organisation and port organisation and strategy. Not all ports pass through all stages. Some remain at one stage; others skip one or more in their development (Van den Berg & Van Klink, 1994 and World Bank, 1992).

In the context of this paper, we prefer to define a sea port as follows:

A sea port is a logistic and industrial node in the global transport system with a strong maritime character and in which a functional and spatial clustering of activities takes place, activities that are directly or indirectly linked to seamless transportation and transformation processes within logistic chains.

The adjective "seamless" stresses that a modern sea port is not to be regarded as a breaking point in various logistic chains, but should be considered as a value-adding transfer point.

Table 1. **Functional and spatial development of a sea port**

	First generation port	Second generation Port	Third generation port	Fourth generation port
External environment				
Period of developments (West-European ports)	Before 1960s	After 1960s	After 1980s	2000
Exogenous developments	Colonisation Steam ships Rise of nations <i>Rise of trade</i>	Petrochemistry Lorry and pipeline Structural prosperity <i>Industrialisation</i>	Multinationals Container Ecological protection <i>Internationalisation</i>	Global economy Information systems Environment <i>Informatisation</i>
Functional organisation				
Port functions	Transshipment (1) Storage (2) Trade (3)	(1) to (3) + Industry (4)	(1) to (4) + Distribution (5)	(1) to (5) + Logistic control
Production characteristics	Cargo flow Simple service Low value-added	Cargo flow Cargo transformation Combined services Improved value-added	Cargo/information flow Cargo distribution Multiple service package High value-added (port oriented)	Cargo/information flow Cargo/information distribution Multiple service package High value-added (network oriented) Chain management
Type of cargo	Break bulk cargo	Break bulk and dry/liquid bulk	Bulk and unitised/ containerised cargo	General cargo/containers information
Spatial organisation				
Spatial expansion of port	Quay and waterfront area	Enlarged port area	Terminals and distribelt towards landside	Network-related functional expansion
Principal locational factors	Presence of market Availability of labour	Access to raw materials Access to sales market Availability of capital	Availability of transshipment facilities Access to sales market Space Flexibility and costs of labour	Availability of transshipment facilities Access to sales market Space Flexibility and costs of labour Available know-how Quality of life
Port organisation and strategy				
Organisation characteristics	Independent activities within port Informal relationship between port and port users	Closer relationship between port and port users Loose relationship between activities in port Causal relationship between port and municipality	United port community Integration of port with trade and transport chain Close relation between port and municipality Enlarged port organisation	Port network community Close relation between port network and public authorities on different levels
Port authority's task	Nautical services (1)	(1) +Development of grounds and infrastructure (2)	(1), (2) + Port marketing (3)	(1) to (3) + Network management
Attitude & strategy	<i>Conservative</i> Port as changing point of transport	<i>Expansionist</i> Transport, industrial and commercial centre	<i>Commercial oriented</i> Integrated transport and logistic centre	<i>Commercial oriented</i> Integrated transport, logistic and information complex and network

Source: Based on World Bank (1992), Van den Berg and Van Klink (1994) and Van Klink (1995).

The proposed definition illustrates that sea ports are part of a bigger system with specific spatial and functional characteristics. The concept “tritych foreland-port-hinterland” accentuates the spatial and functional ties of a sea port with its seaborne leg and land leg (Charlier, 1982). Port, foreland and hinterland are closely bound together in a symbiotic relationship¹. Robinson stressed the need for an integral approach of the triptych by stating that “*the separation of foreland and hinterland*

relationships of a port into two neatly labelled packages represents a false dichotomy. The flow of commodities from foreland to hinterland might better be viewed as a continuum (Robinson, 1970)." The strong interdependency between a port's foreland and hinterland is very apparent when considering the rise of containerisation and intermodality. For instance, it shall be demonstrated that the hinterland transport pattern of containers is largely determined by push effects exerted by the organisation of maritime transport (economies of scale in shipping, mainporting). It is clear that the issue of land access to sea ports must be studied and analysed not as an isolated phenomenon but within the framework of relational patterns. A close relationship exists between land access to sea ports on the one hand and the maritime organisation and foreland on the other.

1.2. The concept of land accessibility to sea ports

Accessibility has generally been defined as the ease with which activities may be reached from a given location using a particular transportation system (Morris *et al.*, 1979). It is a measure for the quality of access of a certain location to a number of other locations. As such, accessibility is closely linked to the issue of mobility. A basic distinction is to be made between "relative accessibility" and "integral accessibility". Relative accessibility describes the relation or degree of connection between any two nodes in a transport system (e.g. a sea port and a central place), whereas integral accessibility describes the relation or degree of interconnection between a given node (a sea port) and all other nodes within a spatial network. The former measure is relevant in assessing land access on a specific origin-destination relation via a transport link or corridor². The latter is more appropriate in view of determining the overall accessibility of a sea port.

Another approach to the issue of land accessibility consists in discriminating between the supply characteristics of the transport system and the actual use and levels of satisfaction. On the one hand, accessibility may be interpreted as the potential or opportunity to travel to selected activities. This "intrinsic accessibility" is a function of the supply/capacity of the infrastructure and transport services. It must be borne in mind that the intrinsic land accessibility to sea ports is no longer only considered in terms of proximity but more and more in terms of lead time and reliability. Alternatively, it may be held that the "proof to access" lies in the use of services, not simply in the presence of opportunities. This behavioural dimension could be described as "revealed accessibility" and reflects the demand side, e.g. the actual traffic flows on specific hinterland corridors. The concept of revealed accessibility is a particularly appropriate criterion for assessing the market's valuation and satisfaction as regards the quality of the land access to a sea port.

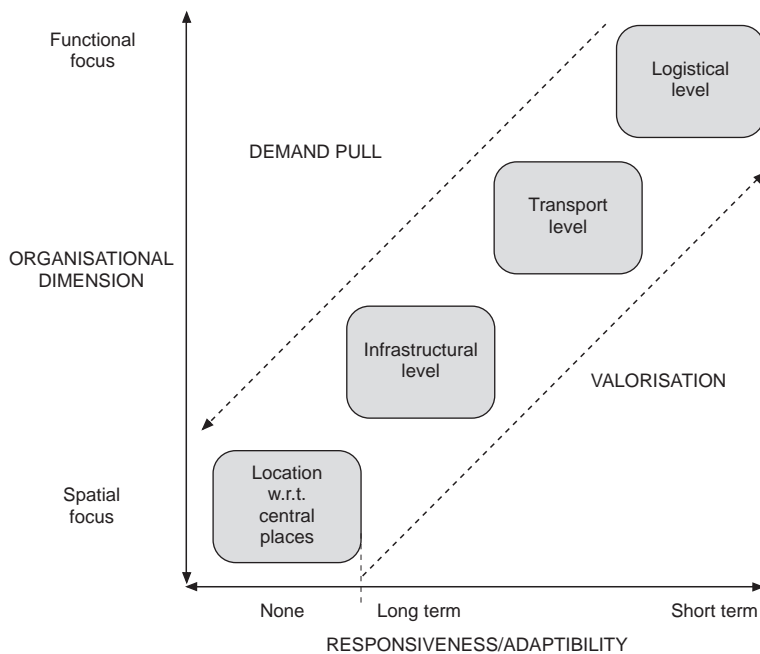
The issue of land accessibility to sea ports differs substantially according to commodity and transport mode. For instance, the gateway function for iron ore and coal of major European ports, such as Antwerp and Rotterdam, only involves one traffic direction (incoming seaborne cargo), a limited number of market players and few nodes, i.e. the port and a limited number of steel plants and/or power plants in the hinterland. For containerised cargo, however, land access involves numerous origins and destinations dispersed over a vast hinterland, a large number of economic players and two traffic directions. From a monomodal perspective, it is very apparent that considerable differences in a port's intrinsic land accessibility can be observed, depending on the transport mode³.

1.3. A multi-level approach to land accessibility

In general, four interrelated layers shape the land access to sea ports, see Figure 1:

- The **LOCATIONAL LAYER** (first level) relates to the geographical location of a gateway *vis-à-vis* the central places in the economic space and forms a basic element for the intrinsic accessibility of a sea port. The relation between geographical location and accessibility is discussed in section 1.6.;
- The **INFRASTRUCTURAL LAYER** (second level) involves the provision and exploitation of basic infrastructure for both links and nodes in the transport system;
- The **TRANSPORT LAYER** (third level) involves the physical aspects linked to transport chains, i.e. exploitation of transport services on links and corridors between the port and other nodes within the transport system and the exploitation of the transshipment function in the nodes of the system;
- The **LOGISTICAL LAYER** (fourth level) involves the organisation of transport chains and the integration of the transport chain in the logistic chain (i.e. chain management).

Figure 1. **A multi-level approach to the issue of land accessibility**



Source: Author.

The upward arrow in Figure 1 shows that each layer valorises the lower layers. The downward arrow represents the demand pull exerted from the higher levels towards more basic layers. In a demand-driven market environment, the infrastructural layer serves the transport layer and logistical layer. The first and second levels demand a more spatial approach, whereas for the upper levels the functional approach prevails. The more basic the layer the lower the responsiveness or adaptability (expressed in time) to changes in the market demand. For instance, the planning and construction of major rail infrastructure (infrastructural level) normally takes many years, not including possible

delays as a result of resistance from pressure groups [e.g. the NIMBY (Not In My BackYard) syndrome] or due to legal complications with financial institutions or building contractors. The political aspect related to the provision of most basic land infrastructure further complicates and lengthens the decisionmaking process. The duration of the planning and implementation of shuttle trains on specific railway corridors (transport level) usually varies between a few months up to one year⁴. At the logistical level, freight forwarders and multimodal transport operators (MTOs) are able to respond almost instantly to variations in the market by modifying the transport chain design, i.e. the routing of the goods through the transport system. The differences in responsiveness on the proposed levels leads to considerable time lags between proposed structural changes on the logistical and transport levels and the necessary infrastructural adaptations needed to meet these changes adequately. This observation partly explains both the existing undercapacity (congestion) and/or overcapacity situations in the European hinterland network and port system.

1.4. Stakeholders

Several stakeholders are involved in the land access to sea ports on each of the three upper layers:

- By means of the infrastructure and transport policy, supranational, national and regional authorities have a large impact on the intrinsic accessibility to sea ports. The infrastructural investments in the links and partly in the nodes of a transport system shape the basic access profile of a sea port. Moreover, the transport service operators have to comply with the regulatory specifications issued by the government: technical specifications for transport means, market access, etc.;
- Shipping companies, road hauliers, inland waterway companies and rail companies have a large impact on the second layer (transport level) as they determine the frequency, reliability and quality of services on specific origin-destination relations;
- By providing physical transshipment and related activities, stevedoring companies and terminal operators, both in sea ports and inland terminals, contribute to the transition and integration of transport modes and networks;
- The higher the efficiency and creativity of freight forwarders, multimodal transport operators (MTOs) and other logistic organisers in designing transport chains between origins and destinations, the higher the revealed accessibility for a given intrinsic accessibility. An optimal transport chain design combines the best quality, reliability and lead time at the lowest possible costs;
- The role of port authorities in enhancing the access in the foreland-hinterland continuum can vary from a reactive facilitator to a proactive accessibility manager (see subsection 2.4.2);
- The trade relations of shippers and their network formations with other firms (e.g. outsourcing) shapes the shippers' demand for accessibility on the logistical and transport levels.

Some current issues will eventually make the identification of well-defined layers and stakeholders in the accessibility debate more difficult in the future:

- The European Union's focus on the creation of a Trans-European transport Network (TEN), deregulation and innovation in the transport sector and technical standardization of transport equipment should result in free and fair competition on all layers and among most of the stakeholders. The impact of these transport policy objectives will be discussed in Section 2.4.;
- Major freight forwarders, shipping lines, transport operators, terminal operators, integrators and other logistic service providers are involved in a competitive battle for the control over

door-to-door transport chains. By a vertical and horizontal integration of activities, a large number of these players increasingly affect both the transport and logistical levels of the accessibility profile of an individual sea port or port system in a direct manner;

- On the infrastructural level, national and supranational public authorities are facing serious budget constraints. Notwithstanding the growing demand for mobility and accessibility, the investments in inland transport infrastructure (new construction, extension, reconstruction and renewal) by EU Member States declined from 1.5 per cent of total GDP in 1975 to around 1 per cent today (Commission of the European Communities, 1993). The lack of public funds for transport infrastructure puts more pressure on alternative financing *via* public-private partnerships, especially in relation to safeguarding or improving the land access to sea ports.

1.5. The costs related to accessibility

From the perspective of a port client, the cost dimension linked to land accessibility is no longer so heavily influenced by the cost of transporting goods between origin and destinations and the port. It becomes more a function of network costs with the ports chosen being those that will tend to minimise the sum of sea, port and inland costs (Gilman, 1997). It could be argued that cost minimisation design takes place at the logistical level (design of total transport or even logistic chain), no longer at the transport level (individual transport link). This observation supports the need for an integral triptych approach to the issue of land access to sea ports.

Chain designers usually only focus on direct logistics costs linked to land accessibility, such as transportation costs, port costs (transshipment and storage), costs linked to value added services in nodes and inventory costs. The scale of operations and the capacity utilisation to a large extent affects the costs incurred by the handling and/or the transportation of cargo. However, some other more indirect and less quantifiable cost factors determine the land accessibility to sea ports: the indirect logistics costs and the costs related to non-cost-optimising human behaviour.

Indirect logistics costs result from the satisfaction level of the customer and the performance of the whole transport chain in terms of reliability, availability and compatibility. They provide an *ex-post* indication of the aggregated technological and organisational quality within the transport chain and the willingness of the various actors involved in the chain to tune operations to the customers' requirements (see also Ojala, 1991). As such, inefficiencies at one of the layers of Figure 1 can have a serious impact on the spatial patterns within the port area and the orientation of port-linked flows across landward and maritime space.

Hidden costs linked to the fact that humans are not behaving in a fully rational way appear in different forms. Firstly, incorrect and incomplete market information on the possible alternative routes available to chain managers and shippers results in "bounded rationality" in the transport chain design, leading to sub-optimal decisions. Shippers sometimes impose bounded rational behaviour on freight forwarders and shipping lines, e.g. in case the shipper asks to call at a specific port or to use a specific land transport mode. Secondly, opportunistic behaviour of economic actors or informal commitments to individuals or companies might lead to non-cost-minimising decisions. Thirdly, some customers might not consider to use other ports or other transport modes because:

- They assume that the mental efforts (*inertia*) and transactions costs linked to transferring activities to other ports or modes do not outweigh the direct and indirect logistics costs connected to the current non-optimal solution;
- Other ports or transport modes are not accessible in a psychological way as a consequence of the disinterest of terminal operators and/or modal operators to serve the client⁵ (e.g. because

of the limited volumes offered or the extra, non-standard efforts needed to comply with the client's specifications), the (deliberate) lack of transparency of the port/modal operations or the specific structure or organisation of the port or transport services (e.g. a monopoly-averse port client normally will not opt for a port dominated by only one terminal operator for a given commodity).

A last cost dimension related to the land accessibility of sea ports concerns the external costs (unsafety and environmental damage) generated by transport activities. Depending upon the traffic region and the capacity of the transport means concerned, road haulage generates 13 to 45 times more external costs per 100 ton-km than inland barges, see Table 2. The market can play its full role only if inputs are adequately priced, including externalities. As long as these external costs are not internalised in an adequate manner, this market imperfection enhances non-optimal port and modal choices from a macroeconomic perspective. In the framework of the sustainable development of land access to sea ports, the efforts of policymakers should be directed towards approaching the perfect market as much as possible, without interfering with it.

**Table 2. External costs generated by goods traffic according to different studies.
Average external cost (environment and unsafety)
generated per 100 tkm and index (inland navigation = 1)**

Study / paper	Country	Inland navigation	Rail transport	Road haulage
Planco (1990)	Germany	0.35 DM <i>Index</i> 1	1.15 DM <i>3</i>	5.01 DM <i>15</i>
Van Ginkel <i>et al.</i> (1995)	The Netherlands	0.07 ECU <i>Index</i> 1	0.3 ECU <i>4</i>	1.0 ECU <i>13</i>
	Belgium	0.09 ECU <i>Index</i> 1	0.15 ECU <i>1.6</i>	2.2 ECU <i>25</i>
	Germany	0.04 ECU <i>Index</i> 1	0.5 ECU <i>12</i>	1.3 ECU <i>32</i>
Roos <i>et al.</i> (1995) (*)	The Netherlands	0.1 Gld <i>Index</i> 1	0.2 - 0.4 Gld <i>2-4</i>	2.5 - 4.5 Gld <i>25-45</i>

(*) The extreme values are dependent upon the capacity of the transport mode.

Whereas some twenty years ago the issue of accessibility was largely focussed on controlling the direct logistic costs related to hinterland transportation, nowadays it can be noticed that the interest in the direct and indirect logistic costs linked to the total logistic/transport chain, the externalities and the issue of customer satisfaction and market transparency (EDI) is growing.

1.6. Some thoughts about proximity, centrality and location (locational level)

As suggested by Figure 1, the geographical location of a sea port constitutes a basic ingredient for a port's competitiveness in terms of land accessibility. A strategic location can imply a location near the main maritime routes (e.g. Singapore, Mediterranean load centre ports such as Marsaxlokk and Gioia Tauro) and/or near production and consumption centres (e.g. Rotterdam, New York, Santos) (World Bank, 1992). The notion of "centrality" refers to a port's aggregate proximity *vis-à-vis* the central places in the hinterland. The relation between centrality and accessibility is somewhat ambiguous. On the one hand, centrality is a necessary condition for attaining a high intrinsic accessibility to a vast hinterland. It becomes a sufficient condition when the favourable geographical location is valorised by means of the provision of efficient infrastructure and transport services. On the other hand, some ports with extensive and efficient hinterland connections tend to be viewed as central ports, notwithstanding the fact that their geographical locations with respect to major hinterland regions might not be so favourable.

The centrality index, as developed by the Bremer Ausschuss für Wirtschaftsforschung (1980), is a function of the distance to and the population of the main economic regions in the hinterland. The assumption is that the further the nodes are apart the less interaction there will be, because time and cost are presumed to increase with distance (the "distance hypothesis"). Moreover, it is assumed that the larger the "size" of a place -- measured in terms of population or economic output for central places and cargo volumes for gateways -- the larger the attraction exerted towards other places ("scale hypothesis"). An application to the Hamburg-Le Havre range shows that Antwerp reaches the highest centrality index, thus indicating the best location *vis-à-vis* the shared hinterland. A comparison with the centrality analyses performed by AGHA-SEA (1996a) and Bureau Bartels (1993) reveals major differences in ranking, resulting from a.o. variations in the measure for distance and the hinterland regions considered. As such, Table 3 illustrates that any definition of the concept "centrality" will always be relative, in that a central location cannot exist other than by reference to a central area or a centrepoint (Ojala, 1997). For western Europe, this centrepoint is basically the one corresponding to the "blue banana" (southern England, the Netherlands, Belgium, Luxembourg, the north-east of France, the Rhine axis, southern Germany and northern Italy), although alternative centrepoints are often put forward.

The distance and scale hypotheses are extremely crude in an imperfect geographical space, which seriously undermines the practical use of centrality indices in assessing the land access to sea ports:

- Although the proximity of a port and its scale (e.g. represented by number of sailings) remain important (see Table 4), other port selection criteria like cost and pricing structure, the port's reputation in terms of output performance, reliability, applied technology and security, the quality of customs handling, the presence and efficiency of auxiliary services (e.g. value-added services) and the socioeconomic stability to a great extent determine the gateway position of a modern sea port. So, a customer's valuation and satisfaction of a port's land accessibility may differ substantially from the basic intrinsic accessibility obtained by its scale and location, as a consequence of the value the customer attaches to the attractiveness of the port in terms of these other more qualitative factors⁶;

Table 3. Centrality indices for some ports in the Hamburg-Le Havre port range

	BAW (1980)	Bartels (1993)	AGHA-SEA (1996a)			
Period	1979	1980-90	1995			
Number of ports	13	9	20			
Number of central places in hinterland	22 (> 400 000 inhabitants)	75 (NUTS-II)	188 (> 200 000 inhabitants)			
Location of central places	Germany, France, the Netherlands, Belgium	Germany, France, the Netherlands, Belgium, Luxemburg	A. EU B. EU and eastern Europe			
Measure for "scale" of the central places	Population	Gross Regional Product (GRP)	Population			
Measure for "distance" port-central place	Distance in km (by road/rail)	Travel time	1. Distance in km by truck 2. Travel time by truck			
<i>Centrality indices</i>	(*)	(**)	A.1. (***)	A.2.	B.1.	B.2.
Antwerp	285 (1)	15 (3)	100.0 (1)	100.0 (1)	100.0 (1)	100.0 (1)
Rotterdam	265 (2)	14 (4)	106.6 (3)	106.4 (3)	105.0 (2)	104.6 (2)
Amsterdam	263 (3)	12 (5)	110.1 (5)	110.0 (5)	106.9 (4)	106.6 (4)
Zeebrugge/Bruges	226 (4)	2 (8)	104.3 (2)	105.0 (2)	105.1 (3)	105.4 (3)
Dunkirk	224 (5)	17 (2)	107.1 (4)	107.4 (4)	108.5 (5)	108.2 (5)
Bremen/Bremerhaven	196 (6)	8 (6)	120.3 (7)	118.5 (7)	109.5 (6)	108.3 (6)
Le Havre	158 (7)	7 (7)	112.5 (6)	115.6 (6)	117.1 (8)	118.0 (8)
Hamburg	138 (8)	19 (1)	128.0 (8)	124.8 (8)	113.9 (7)	111.9 (7)

(*) The higher the index, the more centrally-located the port (rank in parentheses).

(**) Dunkirk and Hamburg attain a high score as the weight of the own-port region in the potential is substantial.

(***) A.1. is a measure for the centrality towards the EU hinterland in terms of the aggregate distance in km by truck (index Antwerp=100).

The A.1. centrality values for some southern European ports: Genoa = 112; Algeçiras = 230.6; Bilbao = 142.4; Marseilles = 114.7.

- The relation between distance and transport price sometimes is far from straightforward. In an optimal system, port hinterlands for a specific commodity are separated by lines of equal costs of carrying cargo to and from the port. However, Table 5 illustrates that transport pricing and tariffication can lead to large discrepancies among transport modes where land access to major ports is concerned. In particular, Benelux ports often complain that the container tariffication policy of the national railway companies of neighbouring countries, including the high cross-border interconnect fees, gives rival ports situated in these countries an artificial competitive edge over the Benelux ports. The history of the rail freight tariffication of the Deutsche Bundesbahn (DB) illustrates the somewhat obscure relation between costs, tariffs and distance in rail transportation between ports and major industrial centres⁷. One should also take into account the fact that the transshipment cost (including the intermediate terminal costs) and its share in the total direct costs related to the inland segment of an intermodal transport chain partly determine the competitiveness of an inland transport mode or intermodal transport solution⁸. In theory, intermodalism presents an optimal form of transport over a certain minimum threshold distance (minimum distances are quoted in the range of 450 km to 600 km, but rail operators have set targets for lowering these distances to some 250 km), providing the costs of transshipment remain low;
- Remotely situated ports, like Algeçiras and Gioia Tauro, can serve as important load centres in the framework of hub-and-spoke networks, primarily because their low proximity to inland centres is counterbalanced by a favourable location *vis-à-vis* the maritime routes (limited diversion distance);

- The relation between distance and lead time sometimes is far from straightforward. Hence, the lead time on a given origin-destination relation is a function of:
 - *The travel time on the transport links:* Table 6 depicts the travel time between gateway Rotterdam and some German production/consumption centres. It should be noticed that, from a technological point of view, the average speed of traditional land transport means has hardly increased over the last 30 years⁹. Moreover, due to increasing congestion on infrastructural networks and the still existing problems at border crossings (especially in the rail sector due to non-standardization of technical equipment), the average attainable commercial speed on the links of a transport system tends to be much lower than the intrinsic technical speed of the transport means.
 - *The throughput time at the terminals:* The stagnation of the commercial speed of the capital-intensive transport services, in combination with the rise of continental goods flows in Europe, imposes a high pressure on the speed of terminal operations in the nodes of the network (sea ports and inland ports) and the effectiveness of the logistical organisation of the inland segment of the transport chain. The sea carriers' demand for elevated quay crane productivities -- in order to limit the turnaround time of the capital-intensive and ever larger container vessels¹⁰ -- seriously affects terminal operations and the transfer to the hinterland. Although crane technology and the physical layout of modern container terminals in theory allow a fast transfer from seagoing vessel to inland transport mode, it can be observed that it usually takes several days before the container eventually heads for the hinterland. For less time-sensitive goods flows this might be explained by the fact that customers frequently use a terminal as a temporary storage space. For time-sensitive goods flows, such lengthy delays are not acceptable as they point to inefficiencies in the organisation of the transport chain (indirect logistic costs). Containers often remain several days on a terminal awaiting instructions for further dispatchment. Research into this issue has revealed that the throughput time at the terminal generally remains lower for carrier haulage (the sea carrier arranges the inland transport of the container) than for merchant haulage (the shipper or forwarder manages the inland segment), which might indicate a more effective chain integration by sea carriers.

Table 4. **Comparison of the rankings of some port selection criteria from a shipper's point of view**

Priority	<i>Distribution Worldwide</i> Vol. 78 (1), (1979)	Slack (1985)
1	Transport costs	Number of sailings
2	Proximity of port	Freight rates
3	Number of sailings	Proximity of port
4	Port equipment	Congestion
5	Congestion	Intermodal links

- Notes:*
- Apart from physical port infrastructure and superstructure, port equipment also encompasses information technology such as the availability of EDI (Electronic Data Interchange).
 - The number of sailings is closely related to the cargo-generating effect of a port. Especially in container shipping, the cargo-generating effect is an important port selection criterion.

Source: Slack (1985).

Table 5. Prices of land access for different ports to selected French cities based on actual tariffs for a 20 ft container -- Figures for 1988 (100 is equal to the lowest price proposed on the origin-destination leg)

Origin/ destination	Le Havre		Marseilles		Antwerp		Rotterdam	
	Road	Rail	Road	Rail	Road	Rail	Road	Rail
Paris	100	100	-	-	132	178	179	236
Amiens	100	123	-	-	115	196	170	260
Lille	260	229	-	-	100	274	185	415
Nancy	156	100	220	125	100	106	125	120
Metz	197	132	274	165	100	145	132	190
Strasbourg	193	100	230	128	121	105	148	106
Lyons	269	133	129	100	256	175	305	237
Bordeaux	100	110	110	100	132	140	154	160

Note: The figures do not reflect the actual pattern of traffic. Hence, the actual traffic flows are also influenced by differences in indirect logistic costs, behavioural aspects of the economic agents involved in the transport chain and more qualitative port selection criteria.

Source: Grosdidier de Matons (1991).

Table 6. A comparison of travel times in hours between gateway Rotterdam and some German central locations in the Rhine area

	Road	Rail	Inland waterways (Rhine)	
			Upstream	Downstream
Duisburg	4	16	22	12
Cologne	5	16	39	16
Mainz	7	21	47	26
Frankfurt	7	20	48	27
Mannheim	8	28	64	30
Basel (CH)	12	32	100	48

Note: The travel time for road transport does not include the legal rest times for the driver, nor the prohibition to drive on the German motorways during weekends.

Source: CBRB (1995).

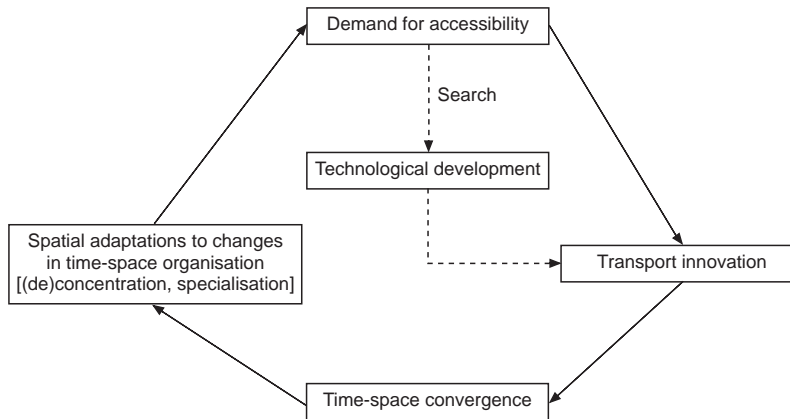
2. LAND ACCESS TO THE EUROPEAN CONTAINER PORT SYSTEM

2.1. Introduction

Both containerisation and intermodality emanated, in the 1950s, from a growing demand for accessibility, measured in terms of time. These concepts revolutionised and redefined modern shipping, port competition and, at a later stage, inland transportation. Containerisation, intermodality and the associated logistics lead to a time-space convergence and have induced spatial and functional adaptations to port systems and hinterland networks. The adaptations, in their turn, reshape the

demand for accessibility, thereby stimulating the search for efficient technological and organisational innovations, see Figure 2.

Figure 2. **A process of spatial reorganisation in response to changes in the demand for accessibility**



Source: Based on Lloyd & Dicken (1972).

The dynamics within this evolutionary pattern make the issue of land access to the European container port system complex and ever changing. This section will subsequently focus on:

- The spatial and functional development of the European container port system and the associated hinterland networks in the past, the present and for the near future;
- The role of different stakeholders in the further integration of the container port system and inland transport networks.

2.2. A theoretical note on container port system and hinterland network development

2.2.1. *The development of a container port system*

The development pattern of a container port system is strongly entwined with the development of its associated hinterland network. In general, the economies of scale linked to containerisation are believed to enhance the concentration of large volumes of containers in a few load centre ports. This concentration tendency is the result of forces in all three segments of the triptych: the ocean voyage, the transit through the port and hinterland transport. The maritime sector involved in the ocean voyage, however, to a great extent seems to dictate the developments in the other two segments. Hence, containerisation allows carriers to realise significant economies of scale in shipping, which results in concentration of the supply side of liner shipping via conferences, vessel sharing agreements and the formation of megaconsortia, but also in a scale enlargement in vessel size. The need to decrease turnaround time for the ever-larger container vessels leads to a concentration of calls on a limited number of load centre ports (with strategic market locations, suitable draft of water and transshipment equipment) acting as turntables in extensive hub-and-spoke networks, especially on long-distance routes where economies of scale are most apparent. In view of receiving load centre status, ports follow the structural changes in the liner shipping industry by constructing massive, highly productive container terminals. Intercontinental shipping and the increasing concentration of

container flows in a limited number of load centre ports generates a disproportionate increase in distribution requirements and, as such, creates the conditions for large-scale intermodal initiatives in the area of sea-rail, sea-inland navigation and sea-sea (feeder). Port equalisation systems, i.e. “*systems of pricing inland movements in the deep sea liner trades, in which ocean carriers will equalise charges for inland transport from points in the hinterland to a range of designated base ports which serves it*” (Gilman, 1997, p. 327), support the mainporting strategy of sea carriers.

The idealised theoretical model on container port system development, as presented by Hayuth (1981), distinguishes five phases, each with different characteristics as regards concentration patterns, port-hinterland relationships and technological innovations. In the infancy stage of containerisation, concentration in the container system is influenced by the willingness of smaller ports with favourable site or location and larger ports to adopt the new changes. As the potential of containerisation has not yet been identified as a means to extend the port’s market area, no major changes in port-hinterland relations take place. Once containerisation and intermodality become fully operational, initial advantages and self-reinforcing processes allow the earlier adopters of the system to benefit the most. The development of a hierarchical arrangement of large-scale load centres and secondary feederport facilities enhances concentration in the container port system.

When containerisation becomes a dominant technique in the general cargo trade, the intermodal transport network expands and container traffic further concentrates on a limited number of larger ports. The concentration on high-volume trunk lines between load centres and major market centres allows deeper hinterland penetration and introduces direct competition among ports located far away from each other (inter-range competition).

In the fifth and final phase, Hayuth introduces the trend towards deconcentration in the container port system as a result of what he calls “the peripheral port challenge” (Hayuth, 1981). As the port system develops, diseconomies of scale in some load centres emerge in the form of a lack of space for expansion and/or limited foreland or hinterland accessibility (longer port turnaround times). These constraints to the growth of the load centres encourage smaller ports to attract carriers from these load centres. In such a highly competitive environment, the danger for creation of structural overcapacity in the container port sector becomes real. The battle for favourable inland penetration results in complex, partially shared hinterland networks.

2.2.2. *Hinterland network development*

INRO-TNO (1993) distinguishes three consecutive types of networks in a transport chain: a collection network, a transportation network and a distribution network. In the collection and distribution network logistics prevail. The transportation network functions as a high-volume pipeline and primarily relies on economies of scale in transportation. Since the flows along the international maritime routes are becoming thicker, the tendency towards hub-and-spoke formations in seaborne transport increases. Consequently, the mainport development leads to an increase in the distances in the inland collection and distribution networks, see also Priemus *et al.* (1995) and Klapwijk (1996).

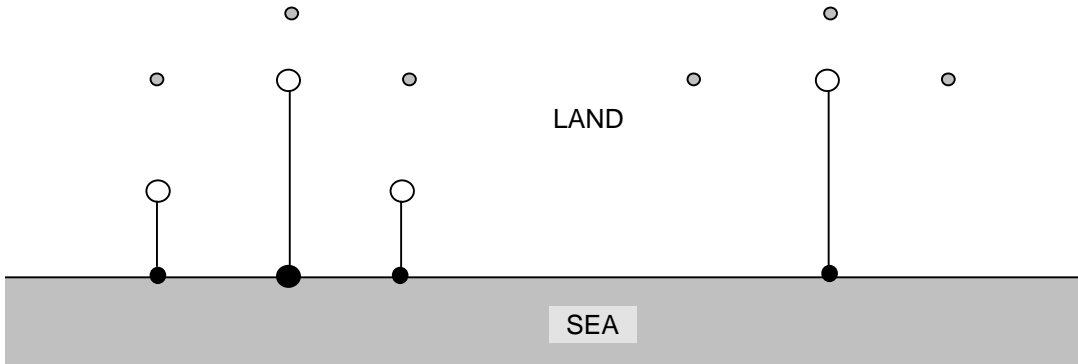
On the land side, the immense pressure on the collection and distribution networks caused by the changes in the port hierarchy eventually leads to the emergence of inland hubs. These inland load centres enable the extension of the transportation network inland far beyond the sea ports, thus relieving some pressure on the collection and distribution networks. The concentration of traffic flows on high volume intermodal trunk routes or corridors between sea ports and large inland hubs is the most apparent result of this spatial and functional development. In this respect, inland hub and corridor formation are indispensable for allowing large-scale concentration in a port system and to avoid fierce congestion in the collection and distribution networks and in the load centres.

The phenomena discussed above can be placed in a theoretical model on the spatial development of an inland network. Figure 3 describes such a theoretical model for the rail sector. In the first phase, the economies of scale in the large container ports enables them to extend their hinterland. The market area of the smaller ports, however, is limited to inland centres in the immediate hinterland. In the second phase, self-reinforcing effects intensify the hinterland penetration level of the load centres and consequently enhance the concentration tendency in the port system. Lines of major penetration emanate from the load centres and it is these ports which can now possibly capture the hinterlands of neighbouring smaller ports. The latter ports find themselves confronted with a vicious circle. The small-scale container transshipment activities prevent the installation of 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 the smaller ports in their round-the-world services (RTW). This results in even lower volumes destined for the distant hinterland. Therefore, smaller ports tend to channel some of their container traffic to the larger ports in order to benefit from their extensive hinterland network. The hub-feeder hierarchy further strengthens the competitive position of the load centre port. However, the large load centre is still not able to compete effectively with smaller ports that are situated closer to a specific distant hinterland (e.g. the sea port on the right hand side of Figure 3). Hence, the shuttle and block trains departing from the load centre port and destined for these distant hinterlands have a low frequency and high lead time because of limited container volumes.

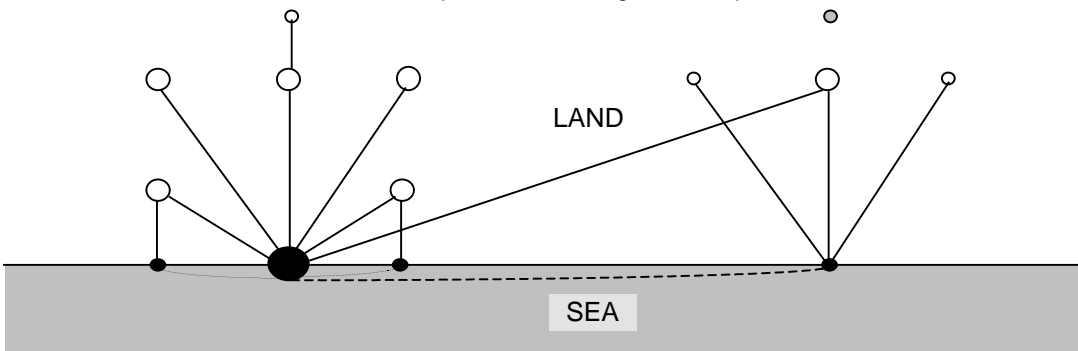
In the third phase, inland hub formation in the distant hinterlands takes place. The spatial structure evolves from a poorly-connected system of inland terminals of equal status to a hub-and-spoke network. The load centre port still serves as a hub for the more immediate hinterland. The concentration of long-distance rail traffic on few high-volume trunk lines offers the mainport some opportunities to effectively compete with more distant container ports. New inland terminals emerge along the corridors. Initially, these terminals benefit on a limited scale from the cargo flows passing through the corridors.

Figure 3. A theoretical model on the development of a port-linked intermodal rail network

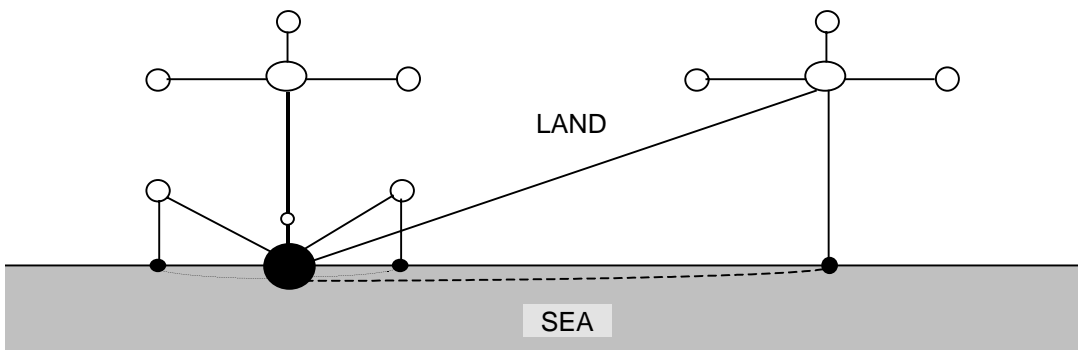
PHASE 1: Limited hinterland capture and unilateral penetration



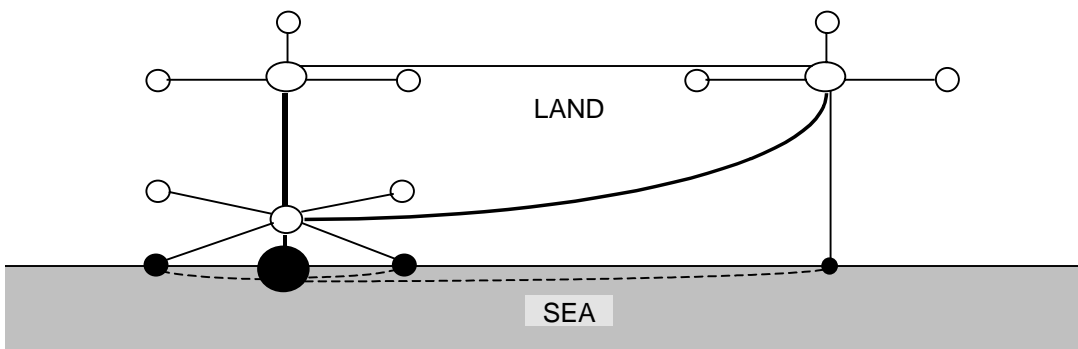
PHASE 2: Centralisation towards load centre ports and extending hinterland penetration



PHASE 3: Inland hub formation in the distant hinterland

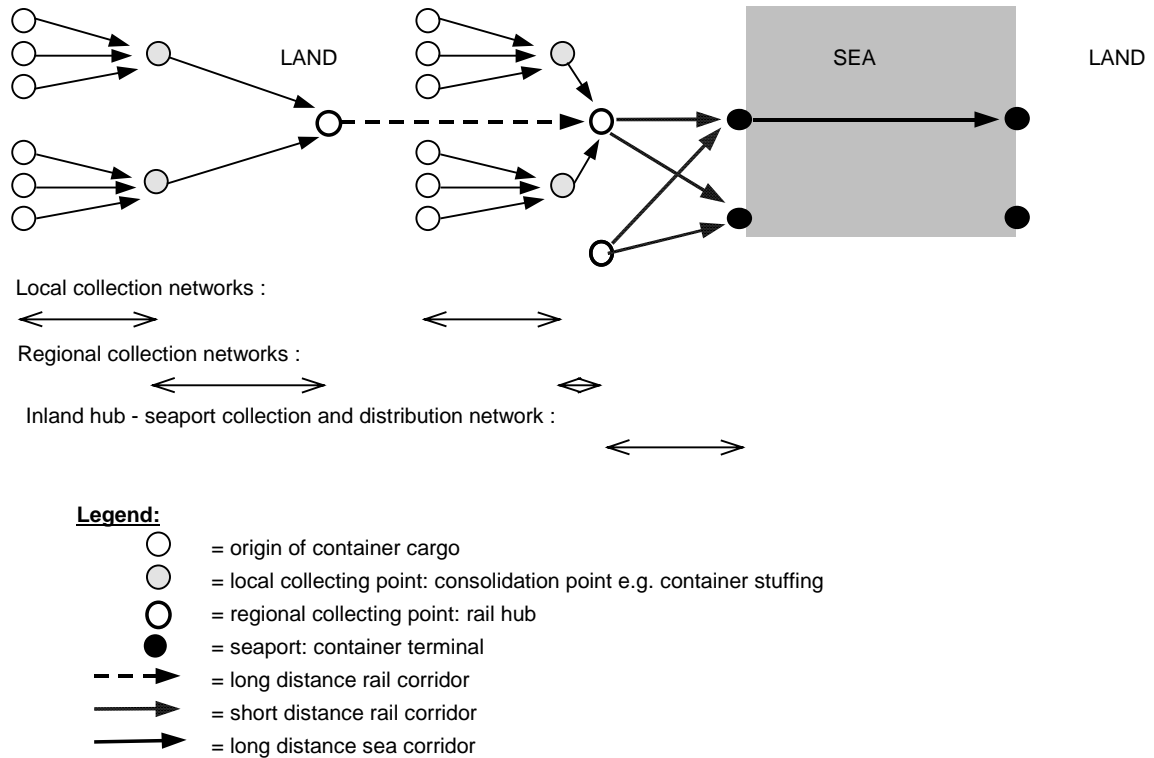


PHASE 4: Inland hub formation in the more immediate hinterland and interconnection between inland hubs



Legend: ● = container port ○ = inland centre/terminal — = inland route

Figure 4. An example of a complex collection network in container transportation



Source: Theo Notteboom.

In the fourth phase, some of the new inland terminals in the more immediate hinterland of the load centre port develop into a master-hub. The neighbouring smaller ports are now able to use the extensive hinterland network without relying on the load centre port. The use of the master-hub by small and large ports of the same port cluster strengthens the trend towards a certain degree of deconcentration in the port system. The intermodal rail network becomes fully integrated when all inland master-hubs are interconnected via high-frequency block trains. The increasing number of inland centres in the rail network has large consequences on the complexity and structure of the collection and distribution network. Figure 4 illustrates the possible layout of a complex collection network as it would appear in the fourth stage of the model.

2.3. Empirical perspective on port system and hinterland network development

It is interesting to supplement the above theoretical models with some empirical evidence in a European context. In this respect, the following unanswered questions need further investigation:

- Is the European container port system getting more concentrated or deconcentrated?
- In what manner does the hinterland network adapt to or anticipate port system (de)concentration?

2.3.1. *Assessing structural changes in the European container port system*

The European container port system considered in this contribution consists of 43 ports situated in four European port ranges: the Hamburg-Le Havre range (eleven ports), the Atlantic range (nine), the European Mediterranean range (eighteen) and the UK range (five ports on the east and south coast), see Figure 5. The proposed classification of the European container port system is interesting in view of assessing inter-range port competition emanating from deeper inland penetration of the major European ports. Total container traffic in the four ranges increased from 4.3 million TEU in 1975 to 27.4 million TEU in 1996. Although container traffic in the Mediterranean range grows rapidly, the majority is still handled by the sea ports of the Hamburg-Le Havre range (14.1 million TEU in 1996). Table 7 shows that the four largest container ports of the Hamburg-Le Havre range (i.e. Rotterdam, Antwerp, Hamburg and Bremen) together handled half of the total container throughput in the European port system in 1975, 48 per cent in 1985 and 44 per cent in 1996¹¹. The use of Gini coefficients allows a profound analysis of the level of concentration. If all the ports in a port system are of equal size, the Gini coefficient will equal zero. Alternatively, in case one port accounts for the total volume of containers (full concentration), the Gini coefficient equals unity¹². Based on Figure 6, it can be concluded that:

- The total European port system has witnessed a modest deconcentration tendency since 1989;
- The Hamburg-Le Havre range shows the highest concentration level of all port ranges¹³ ;
- The container flows in the west Mediterranean range are fairly evenly distributed over the different ports. The moderate deconcentration tendency in the 1990s primarily results from the hub battle among the medium-sized ports (e.g. Barcelona, Valencia, Marseilles) and from the emergence of new load centre ports such as Gioia Tauro and Marsaxlokk;
- Since 1987, the traffic decline in smaller container ports of the Atlantic range such as Bordeaux, Pasajes and Cadiz has led to a concentration tendency in the Atlantic range;
- The UK range witnessed a sharp concentration tendency during the late 1980s as a result of the traffic boom in Felixstowe. From 1990 on, the strong growth in Southampton and Thamesport resulted in a more evenly distributed port range.

It is useful to examine the volume of container shifts among ports, port ranges and port categories (small and medium-sized as well as large ports) in order to get a more detailed insight into the concentration dynamics. The “total shift” analysis provides a good tool to measure these container shifts. The total shift reflects the total TEUs an individual port, a port range or a port category has actually lost to or won from competing units. A total shift of zero would mean that the port, port range or port category would have the same growth rate as the total sea port system. Additional relevant information can be obtained by calculating the net volume of containers shifted between individual ports, port ranges or port categories. Periods characterised by high net volume shifts refer to a considerable degree of dynamics and competition within the container port system. Table 8 represents the results of both a range-based and a category-based¹⁴ “total shift” analysis applied to the European container port system for five consecutive periods. $VOLSHFT_{total}$ is the average annual total net volume of TEU shifted between container ports in the system. $VOLSHFT_{inter}$ indicates the average annual net volume of TEU shifted between ports situated in different ranges (respective categories). The higher this figure, the higher inter-range competition in the port system. Finally, $VOLSHFT_{intra}$ represents the average annual net volume of TEU shifted between ports situated in the same range or category. The sum of the total inter-range net volume shifts and the total intra-range net volume shifts equals $VOLSHFT_{total}$. The average annual total shift figures for the port ranges or categories 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 range or category would have grown at the same average growth rate as the total port system.

Figure 5. Overview of ports considered in the concentration analysis



Table 7. Top ten European container ports in 1975, 1985, 1996 and 1997

1975			1985			1996			1997	
Port	Traffic in 1 000 TEU	% in port system	Port	Traffic in 1 000 TEU	% in port system	Port	Traffic in 1 000 TEU	% in port system	Port	Traffic in 1 000 TEU
Rotterdam*	1 079	25.2	Rotterdam*	2 655	21.2	Rotterdam*	4 936	18.0	Rotterdam*	5 340
Bremen*	410	9.6	Antwerp*	1 243	9.9	Hamburg*	3 054	11.1	Hamburg*	3 370
Hamburg*	326	7.6	Hamburg*	1 159	9.2	Antwerp*	2 654	9.7	Antwerp*	2 969
Antwerp*	297	7.0	Bremen*	986	7.9	Felixstowe	2 065	7.5	Felixstowe	2 145
Tilbury	232	5.4	Felixstowe	726	5.8	Bremen*	1 543	5.6	Bremen*	1 700
Le Havre*	231	5.4	Le Havre*	566	4.5	Algeciras	1 307	4.8	Algeciras	1 538
Felixstowe	230	5.4	Marseilles	488	3.9	Le Havre*	1 020	3.7	Gioia Tauro	1 448
Southampton	199	4.7	Leghorn	475	3.8	La Spezia	971	3.5	Le Havre*	1 185
Zeebrugge*	184	4.3	Tilbury	387	3.1	Genoa	826	3.0	Genoa	1 179
Genoa	162	3.8	Barcelona	353	2.8	Southampton	808	3.0	Barcelona	965
Top ten	3 351	78.4		9 037	72.1		19184	70.0		21 839
Port System (43 ports)	4 273	100		12 539	100		27395	100		-

Note: * = Port of the Hamburg-Le Havre range.

Source: Based on statistics provided by respective port authorities.

Figure 6. Evolution of the Gini-coefficients for the European container port ranges

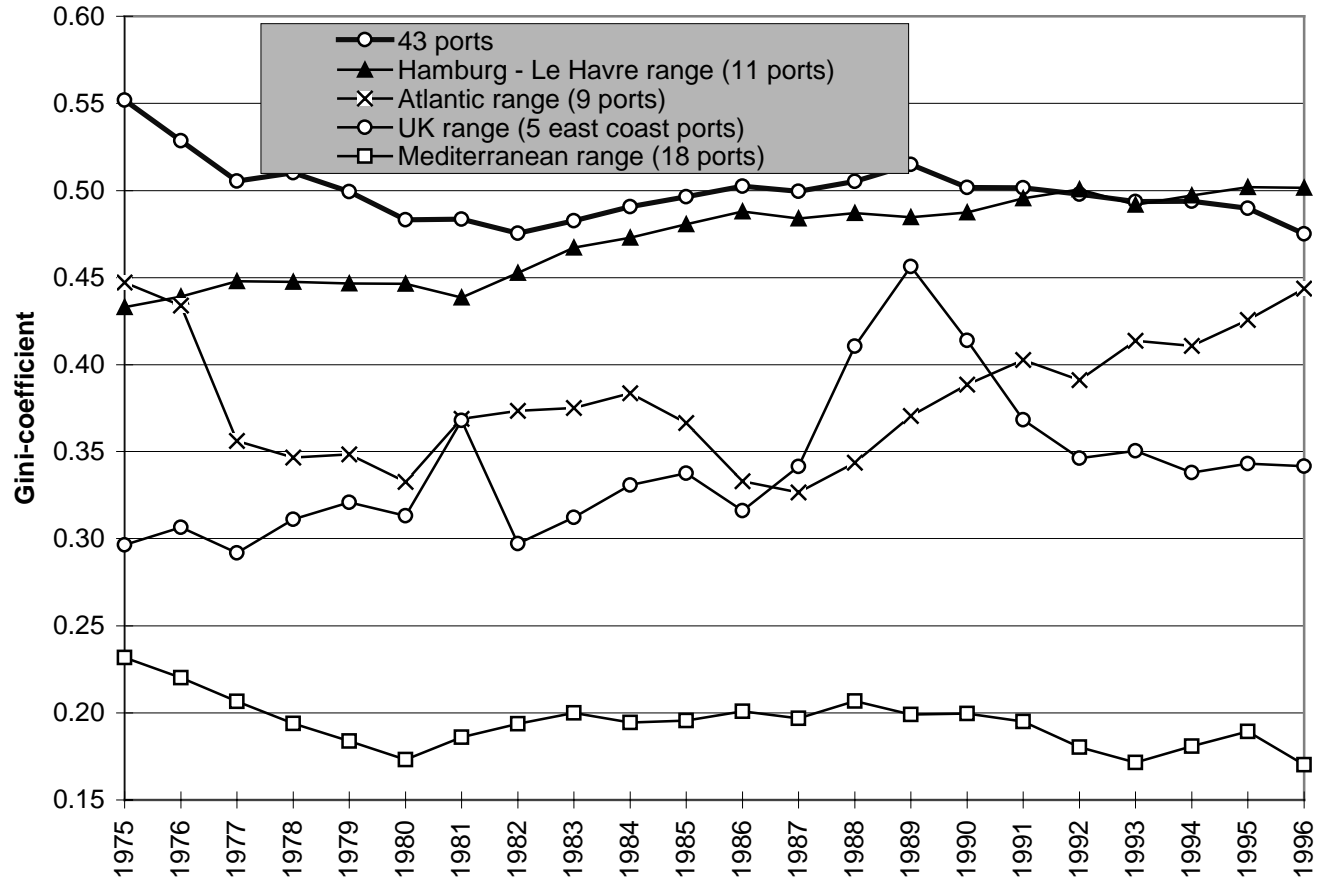


Table 8. **The dynamics within the European container port system**

	1975-82	1982-87	1987-91	1991-94	1994-96
VOLSHFT _{total} per cent of traffic in t ₀	229 447 TEU (5.4 %)	229 760 TEU (2.3 %)	310 532 TEU (2.2 %)	390 898 TEU (2.1 %)	764 042 TEU (3.3 %)
A range-based "total shift" analysis for the European container port system, average annual shifts in TEUs					
VOLSHFT _{inter}	137 415 TEU	43 088 TEU	65 584 TEU	131 742 TEU	611 445 TEU
VOLSHFT _{intra}	92 031 TEU	186 672 TEU	244 948 TEU	259 156 TEU	152 598 TEU
Of which:					
- Hamburg-Le Havre range	52 898 TEU	91 623 TEU	75 958 TEU	88 171 TEU	18 486 TEU
- Atlantic range	5 220 TEU	8 711 TEU	5 250 TEU	19 435 TEU	3 629 TEU
- Mediterranean range	21 982 TEU	56 872 TEU	119 136 TEU	120 024 TEU	69 248 TEU
- UK range (East Coast)	11 931 TEU	29 466 TEU	44 603 TEU	31 525 TEU	61 235 TEU
Average annual total shifts between ranges:					
- Hamburg-Le Havre range	- 73 313 TEU (- 2.8 %)	+ 6 979 TEU (+ 0.1 %)	- 21 348 TEU (- 0.3 %)	- 96 432 TEU (- 0.9 %)	- 559 599 TEU (- 4.4 %)
% of traffic in t ₀					
- Atlantic range	- 10 349 TEU (- 4.7 %)	+ 25 357 TEU (+ 5.6 %)	- 32 768 TEU (- 4.4 %)	- 35 310 TEU (- 4.1 %)	- 51 846 TEU (- 5.4 %)
% of traffic in t ₀					
- Mediterranean range	+ 137 415 TEU (+ 20.7 %)	- 43 088 TEU (- 1.7 %)	+ 65 584 TEU (+ 2.0 %)	+ 104 588 TEU (+ 2.3 %)	+ 596 652 TEU (+ 9.9 %)
% of traffic in t ₀					
- UK range (East Coast)	- 53 753 TEU (- 7.3 %)	+ 10 752 TEU (+ 0.8 %)	- 11 468 TEU (- 0.6 %)	+ 27 154 TEU (+ 1.1 %)	+ 14 793 TEU (+ 0.5 %)
% of traffic in t ₀					
A category-based "total shift" analysis for the European container port system, average annual shifts in TEUs					
VOLSHFT _{inter}	24 967 TEU	92 466 TEU	74 151 TEU	164 333 TEU	449 555 TEU
VOLSHFT _{intra}	204 480 TEU	137 294 TEU	236 380 TEU	226 585 TEU	314 487 TEU
Of which:					
- Small ports (<100 000 TEU)	10 265 TEU	20 438 TEU	21 121 TEU	36 883 TEU	43 001 TEU
- Medium-sized ports (100 000-400 000 TEU)	121 303 TEU	66 732 TEU	155 810 TEU	166 592 TEU	206 259 TEU
- Large ports (> 400 000 TEU)	72 912 TEU	50 124 TEU	59 449 TEU	23 091 TEU	65 227 TEU
Average annual total shifts between categories:					
- Small ports (<100 000 TEU)	+ 24 967 TEU (+ 12.1 %)	- 37 424 TEU (- 5.6 %)	- 59 346 TEU (- 8.2 %)	+ 8 122 TEU (+ 1.1%)	- 40 952 TEU (- 4.4 %)
% of traffic in t ₀					
- Medium-sized ports (100 000-400 000 TEU)	- 15 039 TEU (- 1.0 %)	- 55 041 TEU (- 1.7 %)	- 14 805 TEU (- 0.3 %)	+ 156 211 TEU (+ 2.8 %)	+ 449 555 TEU (+ 6.0 %)
% of traffic in t ₀					
- Large ports (> 400 000 TEU)	- 9 928 TEU (- 0.4 %)	+ 92 466 TEU (+ 1.5 %)	+ 74 151 TEU (+ 0.8 %)	- 164 333 TEU (- 1.4 %)	- 408 603 TEU (- 2.8 %)
% of traffic in t ₀					

Source: Theo Notteboom.

On the basis of Table 8, the following conclusions regarding the concentration patterns can be put forward:

- In recent years, port competition in Europe has increased considerably (see VOLSHFT_{total});
- This evolution was due to a staggering rise of inter-range competition (see VOLSHFT_{inter}). The average annual total shifts in the last period illustrate that the northern ports missed a potential growth of approximately 560 000 TEU per annum (some 4.4 per cent of total range traffic in 1994), primarily to ports situated in the Mediterranean;
- The results of the category-based "total shift" analysis further indicate that the container shifts between the different port categories have risen considerably over time. Up to the early 1980s, the faster growth of smaller ports and the engagement of new ports into the

container business caused deconcentration in the European sea port system. During the 1980s, concentration within the port system took place, as the small and medium-sized ports lost ground to the larger ports. The two final periods of observation introduce a slight deconcentration, for the medium-sized container ports managed to attract additional containers from the larger ports. In general, the position of the large ports in the Hamburg-Le Havre range deteriorated the most; from a positive average annual total shift of 48 000 TEU in the second period, to a negative shift effect of 462 000 TEU in the last. Major winners include the English and Mediterranean medium-sized ports.

Table 9. The disproportionate dominance of the Hamburg-Le Havre range in the European container port sector

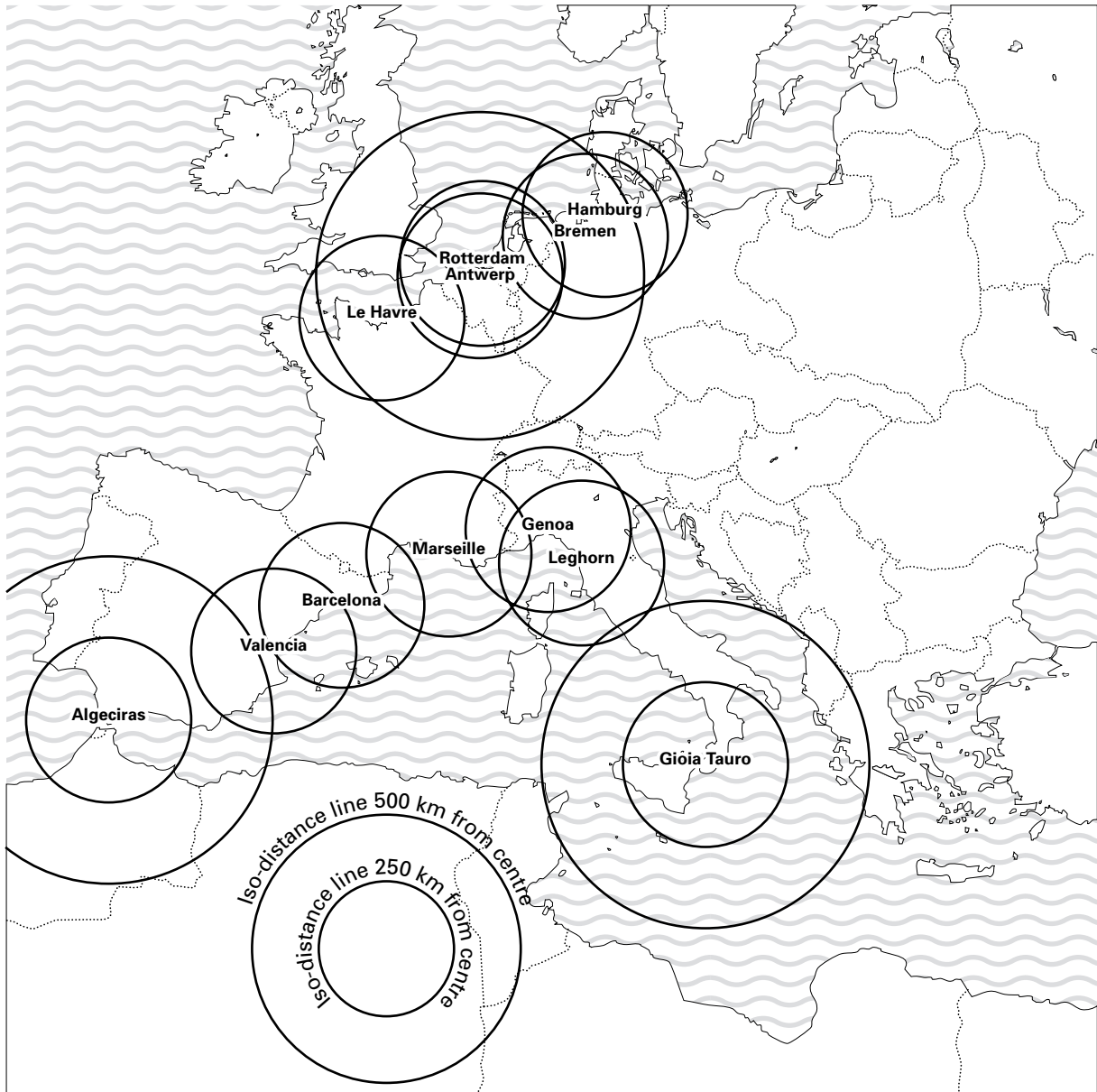
	Surface (1)	Population (2)	GDP (3)	Container traffic (4)	Share surface	Share popn.	Share GDP	Share traffic
Unit	1000 km ²	millions	billion ECU	1000 TEU	%	%	%	%
Year	1996	1996	1993	1996				
TOTAL (a)	1 994	285.5	4 797	21 990	100.0	100.0	100.0	100.0
Iso-distance line 250 kilometres								
<i>Ranges</i>								
Hamburg-Le Havre range	375 410	88.9 55.1	1 723 879	14 096 4 196	18.8 20.6	31.1 19.3	35.9 18.3	64.1 19.1
Valencia-Leghorn range	146	46.4	845	2 654	7.3	16.2	17.6	12.1
<i>Individual ports</i>								
Antwerp	45	7.9	77	571	2.3	2.8	1.6	2.6
Gioia Tauro	66	4.9	38	1 307	3.3	1.7	0.8	5.9
Algeciras								
Iso-distance line 500 kilometres								
<i>Ranges</i>								
Hamburg-Le Havre range	726 1 032	139.7 116.5	2 672 1 886	14 096 4 196	36.4 51.7	48.9 40.8	55.7 39.3	64.1 19.1
Valencia-Leghorn range	473	110.1	2 242	2 654	23.7	38.6	46.7	12.1
<i>Individual ports</i>								
Antwerp	104	213	236	571	5.2	7.5	4.9	2.6
Gioia Tauro	365	395	397	1 307	18.3	13.8	8.3	5.9
Algeciras								

- (a) Total figure for France, the Netherlands, Belgium, Germany, Spain, Portugal, Italy, Austria and Switzerland.
- (1) The area of the above countries covered by the aggregate iso-distance lines of the ports of the range or the individual port (Hamburg-Le Havre range = Antwerp, Ghent, Zeebrugge, Rotterdam, Amsterdam, Flushing, Le Havre, Rouen, Dunkirk, Bremen and Hamburg; Valencia-Leghorn range = Valencia, Tarragona, Barcelona, Sete, Marseilles, Savona, Genoa, La Spezia, Leghorn).
- (2) The population of the above countries living within the perimeter of the aggregate iso-distance lines of the port range or individual port.
- (3) The Gross Domestic Product in market prices of the above countries realised within the perimeter of the aggregate iso-distance lines of the port range or individual port.
- (4) Total seaborne container traffic loaded and discharged in the port range or individual port (expressed in TEU).

Source: Theo Notteboom, based on regional statistics provided by Eurostat and respective port authorities.

Although Mediterranean ports are catching up, the Hamburg-Le Havre range remains the dominant port range in Europe. Even today, this dominance is disproportionate to the economic significance and the consumer market in its immediate hinterland, as revealed by the relative figures in Table 9, based on the iso-distance lines depicted in Figure 7.

Figure 7. **Iso-distance lines applied to some European port ranges and individual ports**



Only recently, major container shipping lines began to include Mediterranean ports directly in their RTW services¹⁵, primarily because of improved terminal productivity, better services and less problems with port labour in southern ports. Locational factors (closeness to main RTW route) seem to be the primary reason for the emergence of new ports and not congestion or the lack of space in the existing ports. Indeed, the hub battle partly shifted activities from remote ports, in terms of the diversion distance from the main RTW route, to nearby ports such as Algeçiras, Marsaxlokk and Gioia Tauro. These latter ports do not possess a European immediate hinterland (certainly not compared to ports such as Antwerp, see Table 9), but are transshipment turntables with feeder services to numerous secondary ports, where the big ships do not call. As such, some 90 to 98 per cent of total container volumes involve direct transshipment to feeder vessels.

In comparison with the Mediterranean port range, ports in the Hamburg-Le Havre range nowadays are more confronted with possible diseconomies of scale (congestion, lack of space) connected to large-scale containerisation. Up to now, these diseconomies of scale did not lead to a radical deconcentration in the port system. Only Zeebrugge aims to become a real alternative for the northern Big Five.

2.3.2. *Assessing structural changes in the European hinterland networks*

Road haulage “in retreat”

In most European container load centre ports, a slow modal shift from road haulage to intermodal initiatives in the area of sea-rail, sea-inland navigation and sea-sea (feeder) can be observed in order to cope with the increasing distribution requirements. Table 10 depicts the evolution of the modal split in the ports of Antwerp and Rotterdam. In Hamburg, around 70 per cent of container cargo travelling more than 150 km enters or leaves the port by rail (HHVW, 1997).

Table 10. **The modal split for container transport in Antwerp and Rotterdam (basis = TEU)**

	Road %	Inland barges %	Rail %
Port of Antwerp			
1995	72.1	22.7	5.2
1996	69.5	24.3	6.2
1997	65.8	27.1	7.1
Port of Rotterdam			
1993	66.0	26.0	8.0
1997	53.0	34.0	13.0

Note: Sea-sea transshipment is not included in this table. In 1997 about 26 per cent of total seaborne container cargo in Rotterdam involved sea-sea transshipment, compared to 22 per cent in 1993. In Antwerp, feeder container flows have increased from 156 000 TEU in 1995 (6.7 per cent of total seaborne container traffic) to 302 000 TEU in 1997 (10.1 per cent).

Source: Port of Rotterdam, February 1998 and AGHA-SEA.

The “modal shift” results look promising, though they remain below the theoretical capabilities of the main alternatives for road transport. The intermodal solutions based on inland navigation and rail transport can be profitably exploited in a number of high-density traffic corridors (i.e. the Rhine axis, some Alpine routes and the Channel Tunnel traffic¹⁶) or in some specific niche markets, but often they are not profitable enough to become a European-wide alternative for road haulage due to technical and

operational inefficiencies. Moreover, the customer's main reasons for choosing the intermodal option instead of pure road transport for long distances are almost exclusively related to lower direct logistics costs, rather than service levels or particular features related to quality (indirect logistic costs).

At first sight, road transport plays a limited role in a port's modal split on the longer distances. For instance, a study of AGHA-SEA (1996b) revealed that about 95 per cent of the container flows by road to and from the port of Antwerp are realised within a limited radius of some 300 km around the port, i.e. Belgium, the Netherlands, the German Ruhr area and northern France. This observation, however, is misleading.

Firstly, figures on a port's modal split do not reveal that, in the framework of an intermodal transport chain, road transport is commonly used for the segment between the inland terminal and the final destination. The more inland waterway or rail traffic is concentrated on only a few corridors between a sea port and inland hubs, the higher the demand for such end-hauls by road. Secondly, a large portion of the container flows by road are destined for European distribution centres (EDCs) or other logistics centres in the immediate hinterland of the sea port. In normal circumstances, the containers arriving in these EDCs are stripped and, after some value-adding manipulations, the cargo is regrouped to reach the final destinations -- even in the more distant hinterland -- by truck in a conventional, non-containerised form. As such, the penetration level (in terms of distance) of road haulage in the hinterland transport of containerised cargo is much higher than suggested by the figures on a port's container modal split.

Rearranging the rail network

A main problem facing ports and transport operators with regard to land accessibility by rail (and also inland navigation) is to provide an adequate answer to the shipper's demand for frequent services (in number of departures per week) and the operators' interest in attaining a high volume per haul in order to gain a reasonable profitability. For instance, in order to guarantee a daily departure with a shuttle train of 50 TEU, 80 per cent capacity utilisation and 50 weeks' service a year, a rail operator needs a critical volume of some 10 000 TEU per annum, which is equivalent to 10 000 to 20 000 moves for a terminal (depending on the ratio 40'/20' containers). From the standpoint of the operators and railway undertakings, the shuttle train is the most economical form of train operation, as there is no need for time-consuming and expensive wagon regrouping operations in marshalling yards. Generally, major European load centres generate enough critical mass to install a number of direct shuttle trains to a limited number of destinations in the immediate hinterland. For the more distant hinterland (more than 500 km), however, the volumes do not always allow direct shuttle trains on a frequent basis, even though rail becomes a more attractive alternative for road haulage in terms of direct logistics costs on the longer distances.

With a view to finding the right trade-off between frequency and volume and to benefit the most from the cost advantage of rail on the longer distances, numerous intermodal railway networks have emerged in recent years, similar to those in phases three and four of the theoretical model developed in subsection 2.2.2. The nodes within these networks are connected by frequent block and shuttle trains with capacities for a single train combination ranging from 30 up to 80 TEU. Some examples are:

- Qualitynet of Intercontainer-Interfrigo (ICF), the most important intermodal actor in rail traffic in Europe, uses Metz-Sablou in north-eastern France as its master-hub, linking up the Rhine-Scheldt delta ports with the rest of western Europe. Shuttle trains arriving from the northern ports are shunted in Metz-Sablou to form new block trains destined for Spain, Portugal, Italy and southern France. ICF argues that, for most of these destinations, even the volumes in the load centre ports of Rotterdam and Antwerp are too low to allow direct shuttle trains on a frequent basis. So, shuttle trains from the main ports, carrying containers

for many destinations, arrive in Metz-Sablon on a regular basis. The wagon groups are exchanged between trains at Metz and are combined to form new, single-destination shuttle trains heading for the distant hinterland of the Rhine-Scheldt delta ports;

- The dry port of Muizen (between Antwerp and Brussels) serves as a master-hub within the North European Network (NEN), a combined container network for short-distance container transport, jointly operated by the French company CNC (*Compagnie Nouvelle de Conteneurs*), Ferry-Boats (a subsidiary of the Belgian railway company NMBS) and Terminal Athus;
- Combi 24 is an extensive intermodal shuttle train network, covering the whole of France *via* inland master-hub Paris and with extensions to Zeebrugge and Antwerp;
- The rail terminal of Schaarbeek near Brussels acts as a master-hub for the combined rail-road services to northern Italy, Spain and southern France, offered through the Cortax network of TRW (Transport Rail-Weg N.V.), another subsidiary of the Belgian national railway company, NMBS.

This kind of hub-and-spoke network enlarges the possibilities and competitiveness of rail shuttles. Hence, the profitability of individual, direct shuttle trains to the distant hinterland of the northern European load centre ports remains insecure, due to the ever-changing volumes of maritime containers in these sea ports. In the mainports, bigger container vessels discharge more containers for more destinations. The problems related to the fluctuating volumes and the numerous final destinations can best be resolved by bundling container flows in centrally-located nodes in the more immediate hinterland, as depicted in phase four of Figure 3. From a sea port perspective, it is much easier to fill a mixed block train containing cargo for various destinations to a nearby inland hub than to run a direct, dedicated block train to a final destination in the distant hinterland. Moreover, the services offered by the master-hubs allow an increase in frequency of scheduled services between the load centres and the distant destinations.

It can be concluded that the intermodal rail network in Europe is slowly evolving from Phase 3 to Phase 4 of the proposed model, albeit that the interconnection between the different inland hubs has not yet been completed. However, some major obstacles to a highly efficient rail market still remain, as will be demonstrated in Section 2.4.

Structural changes in the European inland waterway network

The European inland waterway network covers a fairly limited, though economically important part of Europe. The Rhine Basin, with its tributary rivers, is by far the most important inland waterway in Europe. In 1997, total European container traffic by inland barge amounted to some 2.2 million TEU. This number rises each year by a double-digit growth figure. The sea port of Antwerp handled a total barge traffic of more than 1 million TEU in 1997, compared to 128 700 TEU in 1985. The river-linked container business in Rotterdam reached an estimated 1.4 million TEU in 1997 versus 225 000 TEU in 1985. An impressive 560 000 TEU were shipped by inland barge between Antwerp and Rotterdam in 1996, thus representing a market share of about 35 per cent in the modal split of container transport between both ports. The bulk of the remaining container flows, 0.8 million TEU in 1996, is oriented towards the river ports in the Rhine Basin. The spatial structure of the inland terminal network for container transshipments along the European rivers and canals is presented in Figure 8.

Figure 8. Location of container barge terminals in the European inland waterway network



Barge shuttles link the main ports with the navigation areas on the Rhine and the Danube on a multiporting basis: an inland vessel loads containers at different maritime terminals in a Benelux sea port and then sails to a specific navigation area (e.g. lower Rhine) to load and discharge its cargo at various inland terminals before returning non-stop to the sea port. The scheduled services from the Benelux sea ports to navigation areas outside the Rhine Basin are not organised on a multiporting basis, i.e. both Antwerp and Rotterdam have direct river services to almost each non-Rhenish terminal separately. To avoid unduly increasing competition among the barge operators and so as to provide customers with the best possible service, the operators tend to co-operate in services offered to the various areas in the Rhine Basin. For instance, the lower Rhine area is served by the *Fahrgemeinschaft Niederrhein*, a co-operation between Combined Container Service, Rhinecontainer, Häger & Schmidt and Haniel.

None of the container terminals along the Rhine serves as inland hub for other river ports. Consequently, possible concentration of container traffic in some Rhine basin ports does not result from river-linked hub-and-spoke formation. For instance, Duisburg (96 990 TEU of river transshipment in 1997) and Basel (64 027 TEU) are inland hubs in the barge business, not because of their traffic relations with other Rhine terminals but primarily because of: (1) a high demand for container transshipment in their immediate hinterland; (2) their role as intermodal transfer point in flows originating from the load centre ports and destined for more distant hinterland locations, situated in land-locked regions that have no or limited inland waterway facilities in the vicinity.

In recent years, some major structural changes reshaped the inland terminal network:

- After a period of decentralisation in the Rhine Basin, the large barge operators have started to centralise the river-linked container flows in only a few terminals. For instance, Combined Container Service (CCS) closed down their terminal in Ginsheim at the beginning of the nineties and abandoned the idea of developing a new terminal in Duisburg or Düsseldorf. Instead, operations are now centralised in Emmerich for the lower Rhine and Ludwigshafen and Koblenz for the middle Rhine;
- The number of barge terminals in the Rhine basin, however, is still increasing as new operators try to enter the market (for example, a third terminal in Duisburg which will be operated by ECT). The growing awareness for the potential of inland navigation in recent years also led to the emergence of new intermodal river ports outside the Rhine Basin (see Table 11). Many of these new barge terminals are located close to the load centre ports¹⁷. This evolution proves that container transport by barge can be both cost effective and competitive on relatively short distances, given sufficient container volumes between the transshipment points;
- A substantial number of container barge operators have extended their logistic services to the customers by offering door-to-door transport. The inland terminals function as key nodes in their logistic strategy. For instance, Rhenania Intermodal Transport operates a logistic network built around its five container terminals along the Rhine. As such, a large number of the European river container terminals have become real logistic centres with tri-modal facilities;
- Barge terminals are increasingly valorising the complementarity between inland navigation and rail. For instance, a portion of the container flows between the Rhine-Scheldt delta ports and eastern Europe arrives in Duisburg by inland barge for transshipment to rail shuttles towards the final destinations in the Czech Republic, Poland or Slovakia. The same phenomenon can be observed when studying container flows between the Benelux ports and northern Italy. A further intensification and optimisation of the rail-barge transfer function of inland container terminals can exert a major impact on the competitive position of load centre ports in the European port system, especially as far as the land-locked locations in large parts of south-east and central Europe (e.g. Romania, Slovakia, the Czech Republic and Hungary) are concerned.

Table 11. Some new container terminals outside the Rhine Basin

Navigation area	Barge terminal	Place and country	First year of operation	Traffic 1996 (barges only) TEU
Albert Canal and Meuse	WCT	Meerhout (Belgium)	1996	14 765
	Renory	Liège (Belgium)	1996	4 000
	Born Barge Terminal	Born (the Netherlands)	1991	50 000
Kortrijk-Lille	ACT	Avelgem (Belgium)	1991	14 357
	Lille Conteneur Terminal	Lille (northern France)	1991	13 384
Seine	Gie Paris Terminal	Gennevilliers (France)	1994	9 376

Source: Information obtained from the terminal operators.

2.4. The (further) integration of container port system and hinterland networks

2.4.1. *Introductory remarks*

As indicated earlier, the growth in world seaborne trade and the concentration of container flows in a limited number of load centre ports demands initiatives to better employ the opportunities offered by high-volume transport modes such as rail, inland navigation and feeder shipping. The growing volumes make efficiency improvements and rationalisations in the land accessibility to sea ports not only possible but also necessary. A failure to do so puts a mortgage on the land accessibility to the European sea port system and eventually might negatively affect the economic performance of European central places in an international context.

The provision of efficient inland terminals is clearly a prerequisite for the further integration of the container port system and hinterland networks and the development of intermodal transport. It should be borne in mind, however, that further modal shifts and concentration of intermodal container flows on a limited number of corridors will go ahead with some important side-effects on port-hinterland relations:

- The emergence of master rail hubs and barge terminals in the immediate hinterland of the load centre ports implies a transfer of a part of the collection and distribution function inland away from these ports, thus preventing a further overcrowding of limited sea port areas. Under these circumstances, it is easier for load centre ports to preserve their attractiveness and to fully exploit their potential economies of scale. The corridors towards the inland terminal network, in fact, create the necessary margin for further growth of the seaborne container traffic. These inland terminals acquire an important satellite function with respect to the sea ports, as they help to relieve the sea port areas of potential congestion.
- The economies of scale in transportation have made inland hubs very interesting sites for consolidating a range of ancillary distribution activities. Consequently, a number of inland terminals have become important logistics centres (e.g. Duisburg in the Ruhr area and the region Arnhem-Nijmegen in the Netherlands), thereby enhancing logistical polarisation in Europe (see also ECMT Round Table 104 on *New Trends in Logistics in Europe*). Quite a few of these logistics zones have become direct competitors of diversified sea ports as far as the location of central distribution facilities (e.g. EDCs) and VAL activities is concerned.
- Agglomeration effects in sea ports and inland logistics centres enhance a process of circular growth in traffic volumes which can result in diseconomies of scale (local traffic congestion and pressure on land), thereby offsetting the advantages of centrality and leading to pressure for dispersal. As such, ports and major inland logistics centres might risk to lose the most important factor which eventually leads to the observed agglomeration effects and growth, i.e. their high accessibility within the transport system. Alternatively, the danger exists of simply moving bottlenecks from the load centre ports to the corridors and inland centres. Given this danger, companies could consider relocating their logistics sites from the saturated areas to nearby locations (situation comparable to the “peripheral port challenge” phase in the Hayuth model) or even to locations far from the saturated logistics zone.

Experts generally agree on the fact that a certain level of traffic concentration in a limited number of nodes is required in order to allow a virtuous cycle of modal shifts to high-capacity and environment-friendly transport modes. The above considerations, however, make clear that such a node-focused intermodal strategy, aimed at improving the land accessibility to sea ports in the longer term, might generate spatial relocation patterns (deconcentration). As such, the further integration of container port system and hinterland networks should include more nodes and a more Europe-wide coverage of intermodal services. This section presents some ideas on the input required from

important stakeholders in the accessibility debate (port authorities, sea carriers, railway companies and supranational authorities) in order to optimise the integration of the container port system and the hinterland networks in Europe.

2.4.2. Accessibility management from the perspective of the sea port authority

With the economic growth of their foreland and hinterland, an increasing demand over ports is felt. One of the main management strategies to fulfil the joint demand of the foreland and hinterland is to enhance the intermodal capacity of the port with a heavy reliance on the performance of infrastructure (second level), transport services: shipment and transshipment (third level) and related logistics (fourth level). Port authorities generally are well aware of the fact that they need to enhance the development of a fast, efficient, reliable and sustainable intermodal transport network in which all transport modes (i.e. inland navigation, road haulage, rail transport, shortsea shipping and pipelines) and nodal points (i.e. intermodal inland terminals, feeder ports) are integrated. However, in developing an active accessibility management, the manoeuvrability offered to European port authorities seems to be restricted:

- The infrastructural level is still dominated by public authorities which have to take into account social and political aspects and financial limitations in the decisionmaking process. In general, the direct financial involvement of European port authorities is limited to investments and maintenance of docks, quays, reclaimed land, etc. within the port's perimeter (see ESPO, 1996);
- The transport level is dominated by transport operators, who under normal circumstances do not have to give account to the port authority. The strategy and competitiveness of private stevedoring companies, however, is partly determined by the external conditions created by port authorities;
- The players at the logistical level are only in some cases clearly linked to an individual port (e.g. the extensive forwarding sector in the port of Antwerp). The majority of the logistic service providers, however, operate and control vast networks, supported by powerful information systems that allow total "pipeline" visibility to the customers (Electronic Data Interchange, tracking and tracing, etc.). As sea ports are merely nodes in these networks (though usually important ones), land accessibility to sea ports from a logistical perspective is assessed by these players in the framework of total network accessibility.

In the tradition of the landlord port, it is tempting to presume that port authorities should act as "facilitators" as far as the issue of land accessibility is concerned. However, port authorities of major European gateways, such as Antwerp and Rotterdam, are rethinking their role as facilitator, thereby introducing a transition process from the third generation to the fourth generation port (see Table 1). The concept of "mainport manager" is often put forward in this respect: port authorities should actively participate in the accessibility debate, based on a clear mission statement to enhance the efficiency with which transport flows move in the foreland-hinterland continuum. Initiative, co-operation and consultation constitute the keywords underlying this proactive accessibility management. The most apparent land-leg related characteristics are:

- *A clear vision on accessibility incorporated in the strategic planning process:* The most recent master plans of European load centre ports cope with the accessibility debate in a more multi-dimensional fashion by accentuating the importance of issues such as the "modal shift" to environment-friendly transport modes, the optimisation of the hinterland infrastructure and improved logistics of goods and information flows. A good master plan is developed through consultation of and co-operation with all relevant parties and serves as a basic document for introducing concrete initiatives of the infrastructural, transport and logistical kind;

- *A special interest in the relationship with other logistic nodes in the transport system:*
In a first phase, port authorities are actively enhancing the formation of port networks by engaging in strategic alliances with other (neighbouring) sea ports. Recent initiatives in this field have been taken by northern ports in Flanders (the Flemish port network) and the Netherlands (strategic alliance of Rotterdam with the port of Flushing). In addition, in recent years it has become clear that inland terminals also fulfil a strategic role in a port authority's networking strategy. Port authorities tend to follow the strategy of many sea port terminal operators which already operate own inland terminals (for instance, the stevedoring company ECT operates a rail terminal at Venlo and, in the near future, a barge terminal in Duisburg). Participation in hinterland networks is becoming a crucial item in view of port competition and land accessibility;
- *An active support for the development of information systems:*
Sea ports (as well as logistics centres) are good platforms for initiatives aimed at lowering the bounded rationality of actors. Particular opportunities exist for port authorities to act as catalysts in the development of information systems that play a key role in the improvement of efficiency at the logistical level. For instance, IT systems can substantially contribute to a better transparency in the market or a higher capacity utilisation (e.g. elevating vehicle load factors by pooling consignments with an IT system). The EDI systems, such as SEAGHA in Antwerp, INTIS in Rotterdam and DAKOSY in Hamburg, are examples of a joint initiative of the private port sector and the respective port authorities;
- *An active participation in the planning and implementation of new (intermodal) transport services,* in addition to the port authority's traditional involvement in the preparation of project proposals on new (trans)port infrastructure. A survey on ship operators' image of and satisfaction with European sea port authorities and container terminal operators, carried out by Thomas (1997), revealed that the availability of intermodal transport is one of the major key improvements in European ports sought by respondent lines. Therefore, in recent years, the port authorities of Antwerp and Rotterdam have become heavily involved 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.

It can be concluded that a growing number of European load centres increasingly understand that they have a role to play in intermodal transport systems and logistic chains. Ports extend their activity patterns into the hinterland in order to secure cargo under conditions of high competition. In fact, rising goods flows and market demand forces ports to engage in the promotion of intermodal transport networks (Beth, 1997).

2.4.3. *Sea carriers and door-to-door intermodal transport chains*

Mergers and alliances among sea carriers and the scale enlargement in container vessels have allowed considerable cost savings in shipping operations. Given the fact that inland costs remain significant in the cost structure of major container shipping companies¹⁸, improvements in landside operations are required if the savings at sea are not to be lost on land. Alliances seek to increase the percentage of carrier haulage on the European continent (currently about 30 per cent) and to achieve savings through depot rationalisation and increased container interchange, permitting better balancing of flows and higher utilisation of equipment (less repositioning of empty units).

With the severe pressure on ocean freight rates of recent years (especially on the Europe-Far East trade), the limited shipping revenue of major sea carriers makes it increasingly difficult to sustain the existing port equalisation systems. In the coming years, the expected decline or restructuring in such absorption pricing systems for inland transport could lead to a moderate deconcentration tendency in the European container port system (Gilman, 1997).

In the framework of improving the efficiency in door-to-door transport chains, sea carriers tend to increase their involvement in the enhancement of the land accessibility to sea ports by co-operation on purchase and organisation of hinterland transportation, in particular through:

- *Conference control of inland rates*
In principle, the European Commission opposes shared fixing of intermodal inland rates by conferences such as TACA (Trans-Atlantic Conference Agreement). On the basis of the Carlsberg Report of December 1997, the European Commission decided that the broad block exemption from the usual ban on restrictive agreements given to traditional maritime liner conferences (Council Regulation No. 4056/86 of 1986) cannot be broadened to include inland operations. Notwithstanding the Commission's attitude regarding this matter, the discussion has not ceased and it is generally expected that, in the future, the conference control of inland rates might be retained, albeit not in the present form. Any agreement on this should bring about better services to shippers or make the shipowners involved more competitive. The mere fact that the shipowners are offering door-to-door services, or the fact that the shipowners wish to fix prices to prevent price cutting on the land part of the door-to-door chain, are not in themselves enough to justify exemption;
- *The introduction of hub and spoke systems for rail transport via inland depots*
In 1997, TACA members started experiments with inland depots in Frankfurt/Mainz, Lyons and Munich. The aim is to develop an extensive network of such inland depots which eventually should result in higher efficiency in inland operations and less empty hauls. The fact that shippers and forwarders have no access to these inland depots remains a drawback to this appealing concept;
- *Own shuttle train operations*
A good example of carrier co-operation in the rail sector is European Rail Shuttle (ERS), a joint venture between P&O Nedlloyd, Sea-Land, Maersk and the Dutch national railway company, NS, which operates shuttle trains between Rotterdam and inland terminals in Germany and in Italy¹⁹. Shipping lines encounter major obstacles in their attempt to further develop an intermodal rail network. As the railway sector is only partly liberalised, sea carriers have to buy capacity from the different national railway companies. As such, the quality of service to the customer (indirect logistics costs) is partly determined by the performance of the national railway companies²⁰. Sea carriers often complain about the elevated traction cost and the long preparations and negotiations with the national railway companies needed to install fast, direct rail services.

Liner shipping firms expect government regulation (liberalisation) to support their efforts to create efficient hinterland transport networks. However, the private interests of large shipping companies will not lead to the creation of pan-European intermodal networks that could be competitive with road transport (Stone and Verbeke, 1997). Hence, sea carriers show opportunistic behaviour and bounded rationality as they focus too much on the microeconomic direct logistics costs related to the intermodal option on a specific origin-destination relation. The controversy regarding the inland transport price fixing adopted by shipping companies as an extension of the conference system, which prevails on the maritime leg of intercontinental transport, demonstrates that the European Commission underwrites the opinion that shipping 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 one or two firms.

In contrast to railway transport, only few container shipping lines are directly involved in inland navigation. Most container barge services are maintained by private inland operators. Since many shipping companies seek to establish control over door-to-door services, the direct involvement of

some deep-sea carriers in the operation of both inland navigation services and inland terminals will most probably increase in the future, which might stimulate centralisation in the inland terminal network (Charlier and Ridolfi, 1994, Notteboom, 1997 and Project Bureau Incomaas, 1996).

2.4.4. *Dynamics in the rail sector needed to improve land accessibility*

Until 1993, cross-border rail traffic of maritime containers in Europe was the exclusive right of Intercontainer. The Intercontainer branch of ICF²¹ managed to increase its traffic from 1.2 million TEU in 1992 to 1.35 million TEU in 1996 (684 000 TEU of maritime containers and 665 000 TEU of continental containers). Although the maritime sector still accounts for the majority of Intercontainer traffic, the pure continental flows are growing faster under the impulse of the booming swapbody business (Charlier and Ridolfi, 1994 and ICF, 1996). In the past, ICF has always concentrated its strategy on the intermodal container flows within the “blue banana”. In the last couple of years, however, due to the revival of the Mediterranean ports and the opening-up of eastern Europe, ICF extended its geographical scope by creating, for example, new rail links from the Italian container ports to their hinterland in Switzerland, Austria and Hungary. An important portion of Intercontainer flows between the railway systems within the blue banana are confronted with a traffic decline (see Table 12) as ICF experiences major competition, due to the moderate liberalisation in the EU rail sector which has allowed some new entrants to buy capacity from the national railway companies and sell it to their customers (see, *inter alia*, Ministerie van Verkeer en Waterstaat, 1997):

- Sea carrier combinations like ERS (see supra);
- Combination of national railway companies and non-European operators. A good example is NDX, a joint venture between the German Deutsche Bahn (50 per cent), the Dutch NS Cargo (25 per cent) and the American railway company, CSX (25 per cent) (the owner of the sea carrier, Sea-Land);
- Some new licensed rail operators, such as Short Lines and ACTS in the Netherlands, which have entered the market on the basis of EU Directives 95/18 and 95/19 and which deal with the rendering of exploitation licences to new entrants, the assignment of rail capacity and the user fee for rail infrastructure;
- Former members of ICF who decided to start their own operations independently of ICF, for instance, Transfracht in Germany and CNC in France, which are both subsidiaries of the respective national railway companies (DB and SNCF);
- UIRR members (*Union Internationale des sociétés de transport combiné Rail-Route*) who slowly start to engage in land transportation of maritime containers as a supplement to their core business, i.e. the transport of continental loading units such as swapbodies, trailers and containers.

New entrants, like NDX, focus their strategy on high-volume corridors between load centre ports and logistics centres within the blue banana and, as such, benefit from the logistics polarisation in Europe (Stone and Verbeke, 1997).

Although the market evolution has led to increased competition among operators and a higher degree of choice available to customers, the competitiveness of rail transport has not significantly improved, mainly because the national railway companies remain the dominant actors, both on the infrastructural and transport levels. As long as no complete open access to the operation of rail services exists, there is no obvious driver for change in the intermodal rail industry other than the national railway companies, which are in fact not acting as intermodal operators directly but through their subsidiaries and participations (e.g. the DB participates in ICF, NDX and Transfracht).

Table 12. **Spatial distribution of the Intercontainer traffic between the railway systems of the Benelux, France, Germany, Spain, Italy and Austria;**
Figures for 1996 (in TEU) and growth compared to 1992 (in per cent)

Railway system of origin	Railway system of destination								Total (2)	(1)(2) in % 1992	(1)(2) in % 1996
	DB	FS	NMBS	NS	ÖBB	RENFE	SNCF	Sub-total (1)			
DB	57 675 +98%	18 460 -60%	9 976 -18%	3 663 -73%	36 364 -6%	39 615 +361%	1 918 -78%	167 671 +7%	276 139 +21%	69%	61%
FS	17 123 -67%	6 -	52 419 +7%	15 632 -29%	8 759 -51%	5 058 x 12	29 040 +4%	128 037 -24%	204 091 -10%	74%	63%
NMBS	12 640 -14%	53 443 - 5%	0 -	29 605 +28%	17 273 +328%	7 790 +52%	19 506 -30%	140 257 +7%	179 573 +16%	85%	78%
NS	5 588 -69%	13 678 -40%	28 675 +52%	2 -	26 128 +760%	1 878 +41%	13 227 +2%	89 176 +16%	112 987 +15%	79%	79%
ÖBB	49 635 +101%	20 732 -4%	1 337 -51%	2 292 -57%	7 -	21 -	3 999 +718%	78 023 +41%	96 915 +23%	71%	81%
RENFE	41 087 +373%	4 766 x 30!	5 403 +226%	1 820 +21%	26 -	65 -	2 560 -60%	55 727 +203%	62 785 +178%	81%	89%
SNCF	1 511 -78%	21 214 -1%	13 770 -46%	8 692 -36%	4 002 +607%	1 513 -52%	2 323 -40%	53 025 -29%	60 268 -30%	88%	88%
Sub-total (3)	185 259 +20%	132 299 -22%	111 580 +1%	61 706 -22%	92 559 +44%	55 940 +198%	72 573 -18%	711 916 +4%	992 776 +11 %	76%	72%
Total (4)	301 714 +24%	204 078 -11%	148 832 +13%	80 459 -17%	107 748 +30%	63 728 +147%	79 422 -18%	985981 +9%	1349296 +13%	76%	73%
(3)/(4) 1992	63%	74%	83%	82%	78%	73%	91%	75%	75%		
(3)/(4) 1996	61%	65%	75%	77%	86%	88%	91%	72%	74%		

Notes:

DB Deutsche Bundesbahn AG(Germany)
 FS Ferrovie dello Stato (Italy)
 NMBS Nationale Maatschappij der Belgische Spoorwegen..... (Belgium)
 NS Nederlandse Spoorwegen..... (The Netherlands)
 ÖBB Österreichische Bundesbahnen (Austria)
 RENFE Red Nacional de los Ferrocarriles Españoles.....(Spain)
 SNCF Société Nationale des Chemins de fer Français(France)

- (1) Total Intercontainer traffic between the considered railway system and the railway systems of DB, FS, NMBS, NS, ÖBB, RENFE and SNCF;
- (2) Total Intercontainer traffic between the considered railway system and all railway systems involved in Intercontainer flows;
- (3) Total Intercontainer traffic between the railway systems of DB, FS, NMBS, NS, ÖBB, RENFE and SNCF and the considered railway system;
- (4) Total Intercontainer traffic between all railway systems involved in Intercontainer flows and the considered railway system.

Source: Calculations based on Annual Reports 1992 and 1996 of ICF.

The national railway companies in Europe too often argue that significant modal shifts can only be instigated by direct regulation, such as the Swiss transit restrictions, or by changes in the pricing mechanism, for example, by the internalisation of external costs. However, if no effort is made to improve the endogenous capabilities of the railway sector, any exogenous measure will partly miss its target or prevent intermodal rail transport from becoming a more widespread alternative for road haulage in the land access to sea ports.

National railway companies too often lack commitment and a commercial attitude. Major complaints relate 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 (e.g. users expect more cost-effective solutions for the pre-haul and end-haul) and the fact that, in most cases, no service guarantees are given. Beside these deficiencies in the market responsiveness, intermodal rail operations are not very accessible in a psychological way, due to a combination of (1) national monopolies on the level of rail infrastructure and traction and (2) a complex structure of subsidiaries and operational units of the national railway companies involved in the commercialisation and exploitation of intermodal rail services. The former psychological barrier requires measures to allow a new generation of rail operators (with the dynamic capabilities to compete with road haulage) to enter the market and a reassessment of the involvement of rail companies in both the infrastructural and transport level (see subsection 2.4.5). The latter psychological barrier requires higher transparency via, for example, the creation of “one-stop shops”.

2.4.5. *The role of EU transport policy in enhancing land accessibility*

General policy outlines

The basic principles of the EU transport policy which can have a major impact on land accessibility to sea ports can be summarised as follows:

- The integration of national transport networks into a trans-European transport network (TEN) through technical interoperability of the different systems;
- The creation of a free market for transport, allowing free and fair competition among transport modes and operators, and based on the harmonization of national transport regulations;
- Internalisation of the external costs related to transport in order to equalise the competitive conditions among transport modes;
- The development of information technologies to improve efficiency and transparency.

An important part of the EU transport policy outlines deals with the intention to increase the market share of the environment-friendly transport modes and intermodalism. This section focuses in particular on three key issues: (1) The TEN programme, (2) Liberalisation and (3) The Green Paper on ports.

The TEN programme

In subsection 2.4.2, it was intimated that the competitive position of a sea port on the infrastructural supply side is largely determined by the effectiveness with which it is able to benefit from public-private interdependencies on a regional, national and supranational level as far as the decisionmaking on and the financing of infrastructural port projects and (cross-border) hinterland networks is concerned. In this respect, the TEN policy deserves some attention. The trans-European transport network will develop progressively to 2010 by integrating national land, sea and air transport

infrastructure networks throughout Europe. Via a set of guidelines covering the objectives envisaged with respect to TENs, several “projects of common interest” were identified in the area of physical infrastructure for axes (roads, railways, waterways, pipelines) and nodes, as well as non-material elements like traffic management systems. The planning of the infrastructure remains the responsibility of the individual Member States. The European Union, however, provides advice, co-ordination and political support in order to facilitate the integration of the existing networks. In some cases, financial support is given, particularly through feasibility studies, loan guarantees or interest rate subsidies as well as financial support through the Cohesion Fund and the Regional Fund for Member States, which qualify for such support (Commission of the European Communities, 1994). Two main issues deserve more attention: (1) the impact of TEN on the competitive relations in the European port system; and (2) the inclusion of logistics centres, inland terminals and sea ports in the TEN programme.

Ad 1 The actual creation of a trans-European network can have a major impact on the European port system. The danger exists that the EU policy will distort inter-port competition not in a direct way but indirectly. Some of the much-quoted effects which are presumed to result from the EU TEN policy are:

- A more balanced traffic distribution between north and south, as many efforts are directed towards the upgrading of the infrastructure and organisation of southern European ports. However, the role of the Cohesion Fund and the European Regional Development Fund (ERDF) must not be overrated in this respect. In most cases, their financial support is granted to southern European port projects that either relate to the improvement of pure intra-range traffic flows or that have a positive impact on the European port system as a whole (Verbeke, 1997);
- The Community's focus on the use of environment-friendly transport modes forces ports to consolidate their position in inland waterway transport, rail freighting, intermodal transport and short sea shipping. Sea ports with historically strong port-specific advantages for environment-friendly transport modes as such gain a competitive advantage *vis-à-vis* rival ports.

Ad 2 At first sight, the objective to increase the land accessibility to the European port system necessitates the integration of ports and intermodal inland terminals into a pan-European distribution system. The Member States identified key links in the trans-European transport network, but they have not been successful in designating key nodes (i.e. sea ports, intermodal logistics centres and inland terminals).

A working report of the European Commission on sea ports and trans-European networks [SEC(93)2129] stressed the interdependency between ports and their hinterland infrastructure and identified an initial set of possible “port and port-related projects of common interest”. The selection of “ports of common interest” was out of the question as it would interfere with the normal and successful market-related evolution of ports. The port and port-related projects of common interest all relate to one or more of the following categories aimed at improving the efficiency of traffic flows through ports: (1) infrastructural improvements in maritime access, (2) port infrastructure, (3) inland transport infrastructure inside the port area and (4) hinterland access arrangements.

As far as inland logistics centres are concerned, national governments have developed separate policies regarding the integration of inland terminals and logistics centres into the emerging trans-European transport network. Since 1990, the Italian Government supports the development of “Interporti”. The French Government introduced a new strategy for intermodal transport in 1994, including the creation of *plate-formes logistiques* and, since 1992, the German Government gives

financial support for *Güterverkehrszentren*. Similar to the issue of sea ports, it is generally argued that the EU should provide funds for inland centres, but at the same time it should have little or no say in decisions affecting the location or type of services provided.

The Commission has been looking into the possibility of establishing certain quality criteria on which to base a possible terminal policy. However, the diversity in the aims and demand for ancillary developments at the local level would make a European quality standard extremely problematic. Moreover, the development of logistics centres in almost all cases goes back to local and regional initiatives and not to intermodal transport operators. The contribution of logistics centres to the development of intermodal transport in Europe must not be overrated, as illustrated by various case studies in Höltgen (1995). Therefore, the EU policy should narrow its focus to specific intermodal inland terminals and their contribution to the improvement of the land accessibility to sea ports, and not on logistics centres as a whole.

Liberalisation

The TEN programme, the efforts to internalise the external costs and the actions to lower the “friction costs” in the framework of the PACT programme (Pilot Action on Combined Transport) may improve the working conditions for intermodality. In the short run, however, these measures do not provide the necessary incentives for the actors to allow more competition in the inland waterway and the rail sector. For the future, a far-reaching technical harmonization and liberalisation in intermodal transportation is needed to enhance the development and optimisation of efficient corridors and to stimulate the integration of the European port system with its hinterland networks.

In the inland waterway sector, a few regulatory deficiencies in some Member States, such as cargo sharing agreements and the prohibition to sail on Sundays, prevent inland barge operators from fully employing their competencies. Fortunately, the European Commission decided that all price fixing and cargo-sharing agreements (the so-called *tour-de-rôle* systems), which are currently operational in certain segments of the EU waterway market, will have to be abolished by the year 2000.

The issue of the limited open access in the rail sector has, to some extent, already been put forward in Subsection 2.4.4. Directives 91/440, 95/18 and 95/19 constitute the basis for further liberalisation, but their implementation is hindered by the shelter-based strategies of a number of national railway companies²². Moreover, it must be borne in mind that the high entry costs of the railway sector remain an important inhibiting factor, even if complete open access were to be established.

The Transeuropean Rail Freight Freeways (TRFF) are an interim step to full liberalisation. The rail freight freeways would not have been needed in the first place, if the Member States of the European Union had implemented the legislation on the liberalisation of the European railway sector (e.g. Directive 91/440) properly and in time. Although the aim of freeways is to guarantee free access to specific fast rail corridors for all licensed rail operators, some Member States like France prefer the freightway concept (i.e. enhancement of the technical and commercial co-operation between existing national railway companies on specific corridors). The major North-South freeways are:

- Bremen/Hamburg-Nuremburg-Munich-Innsbruck-Brenner-Verona-Brindisi;
- Rotterdam-Ruhr-Basel-Milan-Domodossola/Chiasso-Genoa-Gioia Tauro;
- Rotterdam/Bremen/Hamburg-Nuremburg-Passau-Vienna;

The major North-South freightway is:

- Muizen-Bettembourg-Sibelin/Venissieux-Torino-Genoa-La Spezia-Gioia Tauro, with a branch towards Barcelona and Valencia in Spain.

The national railway companies act as capacity managers for the rail freeway infrastructure via the so-called “one-stop shops”. In practice, the dominance of the national railway companies is very apparent and some major imbalances can be observed in the tarification of the use of the infrastructure (e.g. on the Dutch railway network just 1 ECU per km, compared to some 5 ECU in Germany) which might distort inter-port competition in Europe.

Some thoughts on the Green Paper on Sea Ports and Maritime Infrastructure

At the time of writing, the discussion on the Green Paper on Sea Ports and Maritime Infrastructure (Commission of the European Communities, 1997b) is still ongoing and the Barcelona Convention still to come. The Green Paper touches on important issues affecting land access to the European sea port system:

- The subsidisation of sea port terminal development, intermodal services and inland terminal operations and the application of the cost recovery principle to port and inland infrastructure;
- The incorporation of ports in the Trans-European transport Network (TEN) via infrastructure provision, standardization of loading units, integration of telematics, etc.;
- The issue of market access to port services.

A number of stakeholders have expressed their concerns in relation to the further actions proposed by the Green Paper. InterMed, a European interest group for the southern European load centre ports, fears that the Green Paper will further underline the economic imbalance between northern European and Mediterranean ports (*Journal de la Marine Marchande*, February 27, 1998). FEPOR, the Federation of European Private Port Operators, welcomes the Green Paper, but demands a more differentiated approach and clarification as regards the liberalisation of the port services market, the establishment of state aid guidelines for sea ports and the application of the cost recovery principle (FEPOR, 1998).

Policies for ports must avoid being a straightjacket for a sector which is rapidly changing and whose characteristics vary greatly between Member States. The focus of the European Union on the socioeconomic profitability of port projects must not lead to projects for which the purely microeconomic profitability leaves much to be desired.

3. CONCLUDING REMARKS

Land access to sea ports involves a complex and dynamic process of interactions between stakeholders on different functional layers. The future accessibility to the European container port system will primarily be influenced by the technological and organisational evolutions in the triptych foreland-port-hinterland and the outcomes of some current (trans)port policy issues. It must be borne in mind that, for each container carrier, there are large internal economies of scale for consolidating their operations at a load centre within a particular region, but there are substantial external diseconomies of scale from overcrowding limited port land areas. Within this framework, the spatial and functional integration of the load centres with the hinterland network proves to be essential.

The author has primarily dealt with intermodal solutions as a means to safeguard the accessibility to the European sea port system. However, the intermodal option leaves us with some pertinent questions. In particular, it strikes us that the current intermodal developments are characterised by major paradoxes. Firstly, intermodal transport relies heavily on the concentration of large container volumes in a sea port system in order to gain market share through the development of major traffic corridors or land *axes* to sea ports. But, at the same time, it is hoped that the expansion of intermodal transport will increase accessibility to the more peripheral regions in Europe. Secondly, inland hub formation proves to be of major importance to ports and to the enhancement of intermodal initiatives. However, the observed agglomeration effects in inland hubs tend to increase the demand for road transport which, in an extreme form, might simply imply a transfer of bottlenecks in the transport network from sea ports to inland nodes.

It is primarily up to the sea port authorities to be very alert and to adopt a proactive attitude towards the issue of hinterland accessibility. The outcome will largely be determined by: (1) the effectiveness with which the respective port authorities and port companies succeed in developing strong functional ties with the nodes and modes in the hinterland network; (2) the effectiveness with which sea ports try to attract and retain some of the “footloose” megacarriers in the container shipping sector that are active in the organisation of door-to-door transport chains; and (3) the effectiveness with which the load centres are able to benefit from public-private interdependencies on a regional, national and supranational level as far as decisionmaking on and financing of infrastructural port projects and (cross-border) hinterland networks is concerned. These elements also determine the outcome of inter-range competition in Europe.

NOTES

1. In general terms, the concept “hinterland” refers to the land areas adjacent to the sea port area with which the port is connected by the traditional land transport modes such as rail, road or inland waterways. Alternatively, the concept “foreland” refers to land areas which lie on the seaward side of a port, beyond maritime space, and with which the port is connected by ocean carriers (see also Weigend, 1958, Barke, 1986, Blumenhagen, 1981). However, the issue of (hinter)land accessibility to sea ports demands a more integrated approach to the terms “foreland” and “hinterland”. Several aspects support this statement. Firstly, the hinterland of a port also includes a maritime dimension (Charlier, 1988). For instance, containers feedered from Benelux load centre ports to feeder ports in the UK are to be regarded as hinterland flows. Consequently, the so-called foreland and hinterland regions of a sea port can often be treated as one. Secondly, it is extremely dangerous to have a static concept of port hinterlands as being god-given and everlasting. As the inland transport system is still improving, the concept of a “captive hinterland”, in which the port has a geographic advantage, is gradually disappearing. For instance, in container transport, the Benelux load centre ports compete for more or less the same “shared hinterland”. Thirdly, it is hardly possible to demarcate *the* hinterland of a port as it varies considerably according to commodity, transport mode and traffic direction. This complexity of hinterland structures, to a great extent, renders meaningless the traditional hinterland boundaries in spatial and dynamic terms.
2. Rodrigue (1996, pp. 571 and 573) defines corridors as “*a convergence of transactions and spatial accumulation in a buffer space between articulation points - hub centres of multimodal transportation networks. [...] A transportation corridor is a set of modal corridors between hub centres where maritime, fluvial, land and air transportation systems converge.*”
3. For instance, the integration of the port of Zeebrugge in the European road and railway network is sufficient. However, Zeebrugge has a competitive disadvantage in intrinsic accessibility over other Benelux sea ports in terms of inland navigation, as the port lacks a favourable high-gauge connection to the northern-European inland waterway network.
4. The length of the planning period is related to the commercial risks associated with the installation of a new shuttle train. For instance, the planning period for the *Cigogne* shuttle, operated by Interferry between the port of Antwerp and the region around Strasbourg in France, only took some five months. The commitment of the company, Transport Verbeken, to provide a considerable basic volume for the shuttle limited the commercial risks for the operator and consequently resulted in a fast implementation. Similarly, the “Limburg shuttle” between Antwerp and Born in the Netherlands could benefit from a basic container volume offered by the container line, MSC (50 per cent of total capacity). If, however, no shipper or transport company guarantees a large basic volume, the future operator will have to perform in-depth research into the market opportunities for the proposed shuttle service, which makes the planning and implementation of the shuttle more time-consuming and hazardous.

5. It can be argued that subtle price and/or customer discrimination certainly exists in the strategy planning of major actors in the transport chain. This will eventually discourage possible clients to use a specific port or transport mode.
6. For instance, dock labour problems for a long time impeded Le Havre and Genoa from competing effectively with Benelux ports on immediate hinterland regions.
7. For a long time, the rail freight rates for container transport from German ports to German destinations (national tarification) were considerably more attractive compared to rail transport from Benelux ports (international tarification) to these destinations. Up to 1984, the *ausnahmetarif* AT 493, applicable on national container rail traffic in the direction of the German ports, gave the German ports a tariff advantage over the Benelux ports (the latter were subjected to the Intercontainer International Container Tariff No. 9145). In 1984, Transfracht, the container subsidiary of DB, installed the “InGrid” system (inland grid) for the tarification of national container traffic with German ports, thereby injuring the Benelux ports even more. In 1988, the DB was forced to install the MCN InGrid system (Maritime Container Network), which in fact meant a broadening of the InGrid tariff to include Benelux ports. The aim of the MCN InGrid system to attain a more well-balanced tarification, however, was almost immediately undermined by the introduction of the KLV (*Kombinierter Ladungsverkehr*) traffic in Germany which enabled DB to lower national tariffs considerably. After several negotiating rounds with the DB in the period 1988-91, the Benelux ports succeeded in obtaining a limited access to the KLV network and major adaptations to the MCN InGrid system. After a formal complaint by the Dutch Government to the European Commission (DGIV), the DB replaced the MCN tariff by the TCM system (Transfracht Combi-Maritime) in 1992. Although some distortions still exist, TCM led to a more well-balanced tarification system (Foulon, 1993 and Konings, 1992).
8. The transshipment costs for a container vary considerably according to transport mode. If the cost per crane move for a seagoing vessel equals 100, terminal operators in Benelux ports charge, on average, 70 for the transshipment to an inland barge and 45 for putting a container on a truck (relative figures provided by private terminal operators). In intermodal rail-road transport, the actual transfer of units between rail wagons and trucks represents only a small proportion of the total cost of the intermodal transport chain (about 5 to 10 per cent). The total transshipment costs, including road pre-haul and end-haul to and from the (inland) terminals, typically represent about 30 per cent of total costs in cross-border intermodal container traffic and even in excess of 50 per cent for national traffic (Höltgen, 1995).
9. The introduction of the speed delimiter ensures that the speed of trucks never exceeds 90 or 100 km/h, depending upon the EU Member country. Goods trains seldom operate at speeds in excess of 40 to 50 km/h. The low maximum speeds imposed on the majority of Europe’s inland waterways and the passing of locks prevents even the most modern barges from attaining a reasonably high average sailing speed.
10. Some new contracts on the handling of super post-panamax container vessels (above 5 000 TEU) stipulate that the terminal operator should attain 150 moves an hour, which in practice implies four cranes per seagoing vessel and 35 to 40 moves per crane per hour!
11. Rotterdam, Hamburg, Bremen, Antwerp, Le Havre, Algeciras, Genoa, Gioia Tauro and Felixstowe can be considered as the largest load centres in continental Europe, whereas La Spezia, Southampton, Barcelona, Valencia and Zeebrugge rather belong to the sub-top or medium-sized load centres. Some of these load-centre ports, which existed long before the container revolution, invested early in the latest technologies, thus supporting the premise of “the importance of being first” (e.g. Rotterdam, Hamburg and Antwerp). Other,

formerly non-existent or very small ports, gained eminent status as load centres as a result of heavy financial port investments, assuring higher technical productivity, in combination with a favourable geographical location (e.g. Zeebrugge, Algeciras, Marsaxlokk and Gioia Tauro).

12. Mathematically, the Gini coefficient is calculated as:

$$G_j = 0.5 \sum_{i=1}^n |X_i - Y_i| \text{ and } 0 < G_j < 1$$

with: G_j = the Gini coefficient for container port system (or port range) j ,
 X_i = the cumulative percentage of the number of ports up to the i -th container port,
 Y_i = the cumulative percentage of the market shares of all ports up to the i -th container port,
 n = number of ports in port system (port range) j .

13. Noteworthy is the fact that the growing level of concentration in the Hamburg-Le Havre range is not the result of the increasing supremacy of Rotterdam. The market share of Rotterdam in the total European continental container port system dropped from 25.2 per cent in 1975 to 18 per cent in 1996, whilst two other large ports, Antwerp and Hamburg, increased their market share with 2.7 per cent and 3.5 per cent respectively (see Table 7). As such, the megaport idea is not confirmed.
14. A distinction is made between small ports (average container traffic for the period 1975-96 of less than 100 000 TEU), medium-sized ports (between 100 000 and 400 000 TEU) and large container ports (at least 400 000 TEU). The latter category is dominated by the Hamburg-Le Havre range (five ports), whereas most medium-sized ports are to be found in the Mediterranean range (twelve ports) and the UK range (four ports).
15. This ultimately led to additional loops focussed on the trade between the Mediterranean and non-European regions. For instance, in 1996, Maersk and Sea-Land introduced the "Suez Express" on the southern Europe-Far East trade routes, with Gioia Tauro and Algeciras acting as major ports of call.
16. At present, intermodal transport accounts for some 10 per cent of trans-Alpine traffic between Italy and France and some 20 per cent between Germany and Italy. On some tracks, such as the Cologne-Milan corridor, the figure is as high as 40 per cent. Beside the mentioned international corridors, important domestic intermodal flows exist in Germany and France (Commission of the European Communities, 1997a).
17. For instance, the distance between Meerhout and Antwerp is limited to some 45 kilometres. The Dutch inland terminals of Den Bosch, Oss, Nijmegen and Moerdijk are all situated within a 100-kilometre range of the port of Rotterdam.
18. Inland costs for the Canadian company CP Ships (mother company of shipping companies like Canada Maritime, CAST, Contship Container Lines and Lykes Lines) account for 42 per cent of its overall costs or even 50 per cent if the repositioning of containers is included. For P&O Nedlloyd, inland transportation accounts for a much larger component of cost, around 70 per cent, than running the vessels [see *Cargo Today*, 3(1), February 1997, pp. 5-9].
19. In the longer term, P&O Nedlloyd strives to copy their UK system of independent shuttle trains to the European mainland. P&O Nedlloyd already operates its own rail shuttles in the UK (altogether, a traffic figure of some 185 000 containers in 1996). Private companies

are allowed to operate own rolling stock and locomotives on the British railway network. The Railtrack organisation guarantees free access to the network. The concept behind the P&O shuttle system was developed in the 1960s in co-operation with Freightliner and encompasses a network of shuttle trains between the major UK load centres and inland hubs in London, Liverpool, Leeds, Manchester and two terminals in Scotland. P&O Nedlloyd shares its trains with Maersk and occasionally other cargo is allowed.

20. More conventional rail operators also face this problem of dependency. For instance, the poor financial results of the Belgian UIRR member, TRW (road-rail transport), were partly induced by the poor service quality of the French and Italian railways (SNCF and FS, respectively), which made it practically impossible for TRW to comply with customers' requirements in terms of reliability and quality. Other victims were the French company Novatrans and the Italian CEMAT, also members of UIRR (De Lloyd, February 3, 1998).
21. ICF represents the interests of some 24 national European railroad companies and purchases, as a wholesaler, the international traffic of its members and arranges the delivery to purchasers, of whom container shipping lines comprise an important segment. All domestic traffic within the borders of the member countries remains the responsibility of the respective national railroads. ICF does not possess or operate own terminals. ICF rents or owns an impressive rolling stock for intermodal container transport. In 1996, the rolling stock comprised 6 487 container flat cars, with a combined capacity of 19 458 TEU. Some 57 per cent of total ICF transport is realised with the rolling stock of ICF (ICF, 1996).
22. The principal provisions of Directive 91/440, on access to rail infrastructure and the separation between infrastructure and transport activities, still have not been met adequately by all national railway companies. Railed in the Netherlands and RFN (*Réseau Ferré National*) in France are separate entities as regards infrastructure management, but a strong interaction with the respective national railway companies remains.

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LAND ACCESS TO PORTS: NEW METHODS OF OPERATION AND ORGANISATION FOR CONTAINER TRANSPORT

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Arcueil, June 1998

INTRODUCTION

For years, inland and maritime access to ports were regarded as two separate issues, because the two systems were organised differently and subject to different regulations. For some time, even the European Union did not address policy on ports or access to ports: differences in country approaches were compounded by the perceived divide between maritime and inland transport.

This state of affairs was incompatible with the development of container transport, which forced a change in approach and policy. Containers are, in fact, an integral part of a door-to-door transport chain. The land link interfaces directly with the maritime link in an end-to-end transport system in which the use of the same “unit load” by different modes has simplified port-side transfer operations.

When the cost of maritime transport fell substantially, reducing the costs of the land leg -- often accounting for over half the total cost of transport -- became the economic imperative. Containerisation imposed its logistic constraints on the land leg, not least because this type of transport expanded rapidly with the globalisation of trade.

Admittedly, there is nothing new in this overall global approach to transport costs: the costs of transporting raw materials by land was the reason that the steel and chemical industries relocated to port areas.

However, these were quite specific logistics operations, organised along in-house lines, involving bulk cargoes as opposed to dedicated carriers.

With the advent of containerisation, the phenomenon became more widespread, closely linked to the globalisation of trade in recent years and to the fall in maritime transport costs, which meant that it could work out less expensive to transport goods a distance of 5 000 to 10 000 km by sea than 500 km by road.

With the globalisation of trade and higher volume flows, new and more efficient operating concepts that could radically change the modal split in port access have been developed. This has opened up very promising opportunities for intermodal transport as a whole, although it is not yet easy to tell what the long-term developments will be, as we are still in the “transition” phase.

1. GLOBALISATION AND HIGHER VOLUME FLOWS IN EUROPE

The international market is buoyant in both the world economy and within Europe. At the same time, international maritime transport chains are rapidly becoming more efficient, speeding up the globalisation of trade and substantially reducing economic “distances”. As inland transport has resisted the general trend towards lower intercontinental transport costs, it is now perceived as a key factor in the success of a port. In Europe, ports are competing fiercely to extend their hinterlands across frontiers into a market totalling approximately 40 million TEU.

Table 1. **Container rates by country (thousand TEU)**

	1980	1985	1990	1994
UK	2 041	2 847	3 867	4 878
Netherlands	2 056	2 769	3 761	4 480
Germany	1 493	2 152	3 233	4 248
Belgium	915	1 471	1 901	2 805
Spain	660	1 508	1 956	2 596
Italy	1 220	1 508	1 803	2 561
France	1 556	1 477	1 573	1 523
Total Europe	10 890	15 697	21 007	27 034

	1980	1985	1990	1994
North Sea	6 716 (62%)	9 445 (60%)	13 362 (69%)	18 923 (60%)
Atlantic	1 419 (13%)	2 227 (14%)	2 172 (11%)	3 283 (10%)
Mediterranean (west)	2 179 (20%)	3 433 (22%)	4 737 (21%)	8 026 (25%)
Baltic	482 (4.5%)	672 (4.3%)	842 (4.1%)	1 460 (4.6%)

Source: *Green Paper on sea ports and maritime infrastructure*, 1998.

1.1. Inland container traffic mirrors trade globalisation

For more than twenty years now, the growth in international traffic has exceeded that of domestic traffic and container traffic has grown faster than international traffic as a whole. The globalisation dynamic, with its concepts of specialisation and localisation, has become a crucial factor in economic growth, bringing with it increased flows of high value-added products between companies and within companies that have production facilities in different regions.

This phenomenon spread with containerisation, as the carriage of unit loads became common practice in international logistics operations. Now, containers are widely used, particularly for East-West traffic and even more so for flows between Europe and Asia, which are almost without

exception by container for general cargo. Past container traffic trends show an increase of 5 per cent per year and often up to 7 per cent for flows to Asia. Only the recent crisis in Asia has shaken confidence in a trend that looked set to continue for many years to come.

Container traffic in Europe totalled 11 million TEU in 1980, 21 million in 1991 and around 32 million in 1994, of which 27 million in the European Union. In 1997, a very high growth year, container traffic was up by more than 10 per cent in many ports. Even if the trend were to slow to a growth rate of 5 per cent per year over the next twenty years, flows would still be 2.5 times higher: 80 million TEU in 2015. A case in point is the port of Rotterdam -- whose market share of around 42 per cent of the “northern range ports” has remained fairly steady for a number of years -- which handled 5.5 million TEU in 1997 and expects to handle over 11 million TEU in 2010 (5 per cent per year). This is a substantial volume of traffic, close to 1 billion tonnes in 2015, at an average load of 10 tonnes per TEU.

Obviously, not all of this traffic on European inland transport networks is container traffic. Double counting can be a problem. Figures based on port statistics will count a container forwarded by “feeder” to another European port (for transshipment) twice. Transfer traffic of this type can account for one-third of traffic in large ports. Likewise, some of the containers discharged in a port will be “stripped” there: even if the goods are then forwarded by inland transport they will be counted in with continental transport statistics. In a large port like Hamburg, this traffic can account for one-third of the boxes loaded or discharged (but not transferred). The pre- and post-shipment carriage of containers accounted for only one-third of medium and long-haul traffic, or 100 million tonnes, in 1994 and perhaps twice that much, counting regional and local HGV traffic, but not movements within the port area itself. These figures are only rough approximations aimed at highlighting the extent of the problem which, moreover, is centred on major port areas and a few corridors.

These figures are nevertheless consistent with IQ estimates of “containerisable” capacity, based on figures for maritime trade with the rest of the world: some 200 million tonnes, bearing in mind that, for maritime transport, containerisable capacity is close to currently containerised capacity.

Compared with these figures, shipments by Intercontainer, 1.4 million shipments in 1996, seem relatively modest. It should be pointed out that Intercontainer no longer has a monopoly on container rail services and that new operators have been steadily providing more services over the last few years. NS Cargo is already handling 450 000 TEU, more than double INTERCONTAINER’s total on the Dutch network. Nedlloyd, P&O, Sea-Land and NS carried 130 000 TEU by rail in 1997.

Inland waterway transport carried over 1 million TEU, mainly due to services to Antwerp and Rotterdam, which still leaves road transport carrying the bulk of traffic, even over medium and long distances. This is a point which we will come back to.

The growth in trade between the countries of Europe does not boost this type of traffic directly since freight there is largely carried by inland mode or by ferry between the UK and the continent and between Scandinavia and the rest of Europe. However, as frontiers have opened up, the emergence of Europe-wide logistics operations has boosted it indirectly, by extending container distribution and management circuits, encouraging the growth of “feeder”, i.e. short-haul container transport for the purposes of consolidating (or distributing) containers via the larger intercontinental ports.

At present, it is difficult to tell how sea freight container transport will develop in trade within Europe. This said, the following trends are quite clear:

- With enlargement, Europe is reclaiming its sea coasts for its own internal trade;
- With the growth in intra-European maritime trade, different forms of intermodal transport are developing in ports: Ro-Ro traffic, unaccompanied semi-trailer traffic by boat, swap-body traffic.

However, sea freight containers are used only for long-haul maritime trade and in Europe they do not really compete with other types of purpose-built European intermodal unit load (swap-bodies, semi-trailers).

The enlargement of Europe to neighbouring regions of the Mediterranean, the Baltic and the Black Sea is probably more likely to increase container traffic in ports, although the advantage of having a new, standard swap-body -- somewhere between a land container and a sea freight container -- is a matter for debate. A case in point is the future of access to the Mediterranean, where Ro-Ro transport is still expensive but is quite well suited to fairly basic logistics structures and where international sea freight container transport would not necessarily be the best option, and should not impose its economic and commercial rationale on Mediterranean traffic.

The same is probably true for the North Sea and the Baltic Sea, while in the Black Sea more conventional forms of general cargo transport are still justifiable for lower value-added products.

Growth in container traffic resulting from port activities can also be noted in hinterlands, although from the statistics it is not easy to establish a direct link between inland container traffic and the number of containers entering and leaving ports by sea. There are few statistics in this area and where any are available they are generally not standard and have to be identified either by origin-destination or at least by distance covered.

The modal split in inland container access to ports is another aspect of this phenomenon and, in addition to a whole range of considerations related to the economic performance of the different modes, actually reflects the way in which the entire chain is organised as well as the commercial strategies of shipowners and shippers. Any specific data available can therefore only be analysed as they relate to a specific case. It is not enough just to ask whether a container will be transported by road in preference to rail or waterway; other questions that should be asked are: whether -- for reasons other than inland transport performance -- a container will be stuffed (or stripped) in the port area and whether the shipowner prefers direct contact with the shipper or to specialise in the maritime leg alone. The situation differs from one port to another. Antwerp is known as a port which does a lot of stuffing and stripping and consequently port haulage is counted with inland traffic, which is mostly by road. In Hamburg, forwarding agents have traditionally run the port market whereas, in Rotterdam, owners wanting to be in "carrier haulage" will be in direct contact with shippers. It is not easy to obtain accurate figures for all of the above areas, although the trend does actually appear to be towards the penetration of container transport inland, capitalising on the steadily improving performance of inland modes, which enables more direct control of the entire door-to-door logistics chain.

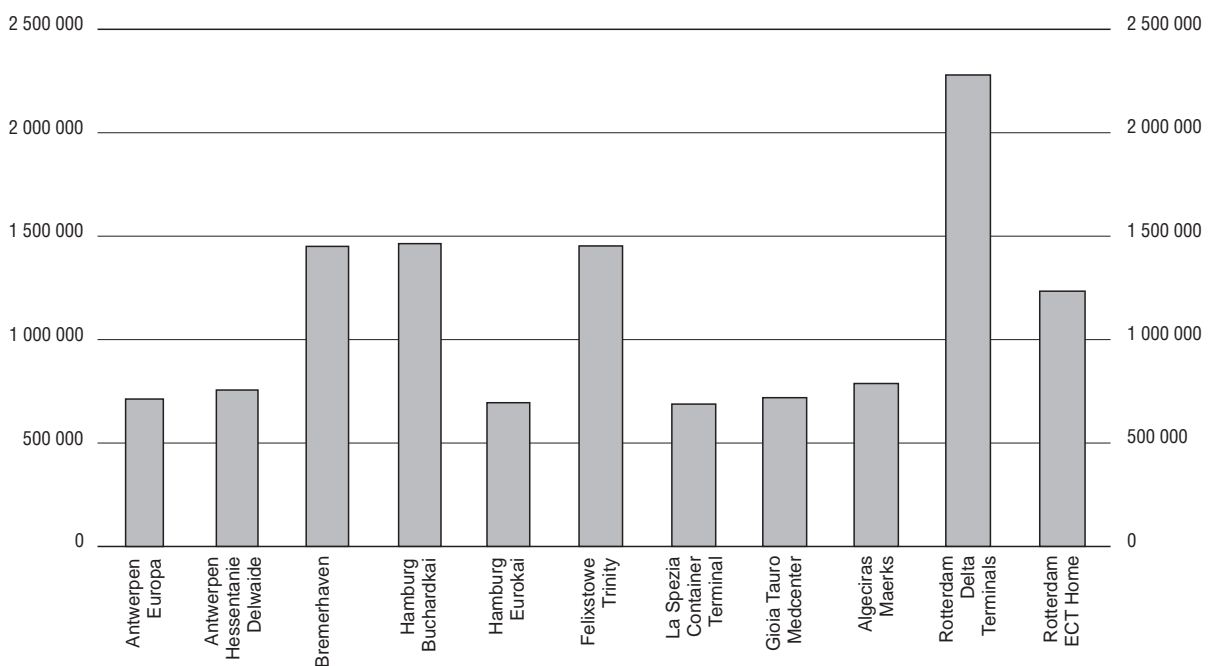
1.2. Flow concentration and higher-volume flows

1.2.1. *The economics of higher-volume flows*

Flow concentration was initially a feature of the maritime industry as it sought to speed up the turnaround times of large-capacity vessels. The result was fewer port calls, higher concentrations of traffic in ports and a substantial reduction in the price of maritime transport. The German Ministry of Transport's price index for containerised liner shipping fell by 10 per cent from 1994 to 1996. This led to the appearance of "hub" ports in the North Sea, attracting the largest deep-sea vessels.

For some time, the question has been whether shipping lines would now have only one port of call in northern Europe, but the answer is not so straightforward, given the frequencies that shippers require and potential cargo turnover. However, there are still no fewer than four or five major ports in northern Europe (Rotterdam, Hamburg, Antwerp, Bremen, Felixstowe) that have seen their traffic grow very quickly in the past ten years as a result of higher-volume traffic flows, which has set them apart from other ports purporting to offer an intercontinental service.

Figure 1. **Large terminals**



One direct result of this has been longer inland hauls, a corollary of which has been even stronger pressure on the price of the inland haulage leg.

The race for steadily bigger ships is not over yet: after ships with a capacity of 5 000 containers and over, we are now heading towards 6 000 and even 10 000 containers, with reductions in maritime freight transport costs of up to 40 per cent. From Singapore to Europe, \$400 per container could become the standard rate.

For many shipments, inland haulage costs are far higher than maritime freight costs. In an industry where competition is keen, the “battle” between shipowners will now be fought on land.

Of course, it is difficult to give an idea of the costs of the different links, as they vary with destinations and terms of contract. However, assuming that maritime freight costs -- after reductions of up to 50 per cent in some cases over the past ten years -- are about \$1 000 per container (and probably lower if the destination is a major Asiatic port such as Singapore), inland haulage costs would amount to roughly the same amount. The costs of the inland haulage leg for different mode combinations (rail, road and waterway) were estimated in a recent study conducted by the Netherlands Ministry of Transport, Public Works and Water Management for the OECD (*International Study on Intermodal Transport*, March 1998). The breakdown was as follows: 60 per cent for rail, 10 per cent for port terminal transfer, 5 per cent for inland terminal transfer and 25 per cent for the terminal haul by road.

Where there is an efficient inland waterway system, the share of the main mode would be lower, by around 40 per cent, while inland terminal transshipment and road terminal haul costs would be proportionately higher (10 and 35 per cent respectively, leaving 15 per cent for transshipment at the port terminal). In this case, inland transport from quayside to end-destination is generally cheaper, by an estimated 20 per cent or so for certain links, although it takes longer.

Interestingly, compared with intermodal inland swap-body transport, the advantage of inland transport of sea freight containers is that it avoids pre- and post-carriage shipment at one end, the port end. As this can account for almost 20 per cent of the total cost of the inland transport chain, relatively speaking, inland haulage of sea freight containers is more competitive than door-to-door road haulage. Factors relating to organisation, terminal layout, information transmission and traffic volume should also be taken into account in an analysis which will be the better for being more detailed.

Higher flow volumes thus seem to have made a reduction in inland transport costs -- in port terminals as well as by rail and waterway -- possible.

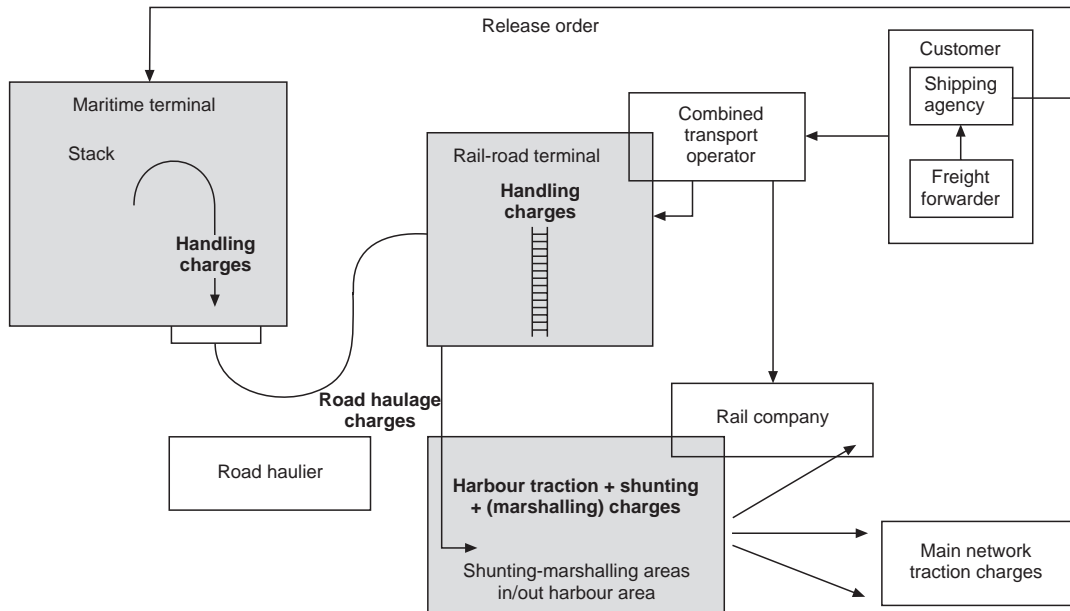
In ports, costs were cut by the introduction of more powerful, faster and more efficient transshipment gear. New technologies and, in all likelihood, the future automation of operations will produce even better results.

The features of maritime terminals able to accommodate large tonnage mother ships were discussed within the framework of the IQ project. Containers are taken from the terminal by HGVs in accordance with strict established procedures to avoid traffic congestion in small and extremely busy areas. They are increasingly removed off-terminal by rail as well.

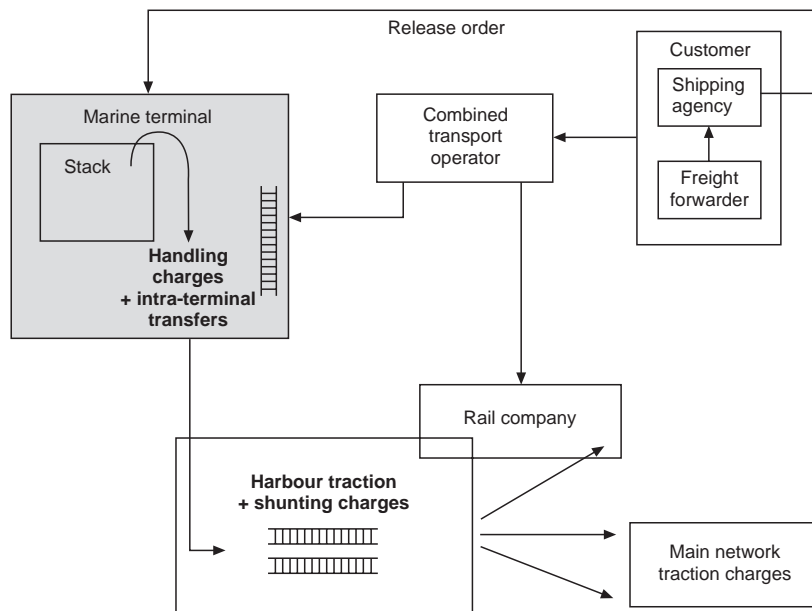
Rail terminals are located either in the port terminal itself or close to it, depending on whether the main aim is to limit shunting operations or, conversely, to limit container handling operations on the port terminal. Operations between the rail terminal and the port terminal can be automated and a great deal of research is being carried out on this subject.

Figure 2.

Scheme of cost elements in harbour when bloc-trains are composed at a harbour rail-road terminal with necessary road haulage from the container terminal



Scheme of cost elements in harbour when full bloc-trains-shuttle trains are composed on maritime terminal



For pointers as to the facilities required by the most efficient terminals, we have only to look at the largest ports like Rotterdam, Hamburg and Antwerp. Handling about 1 million containers per year, they have a quayside frontage of between 1 and 2 km and 8 to 10 operating gantries, with a quay depth of no more than 400 metres. Similar quays are under development in Hamburg, Bremen, Antwerp, Felixstowe and Rotterdam, where one capable of handling several million TEU is under construction. Others are under development in the Mediterranean, particularly Italy. This said, even more automation and faster equipment are a distinct possibility. Automation and new handling gear could reduce space requirements for the same, if not better, performance.

The advantage of the IQ project has also been to highlight the real importance of rail transport organisation within the confines of the port itself. The wide range of hinterland destinations does not always allow frequent enough running of full trainloads from or close to a single terminal. It is important to have a means of forming full trainloads from all of a port's terminals, since rail terminal operations can be as expensive as transit through the maritime terminal itself. Indeed, the quality of access to the main network from the maritime terminal is a key element in the cost and satisfactory operation of the entire inland chain.

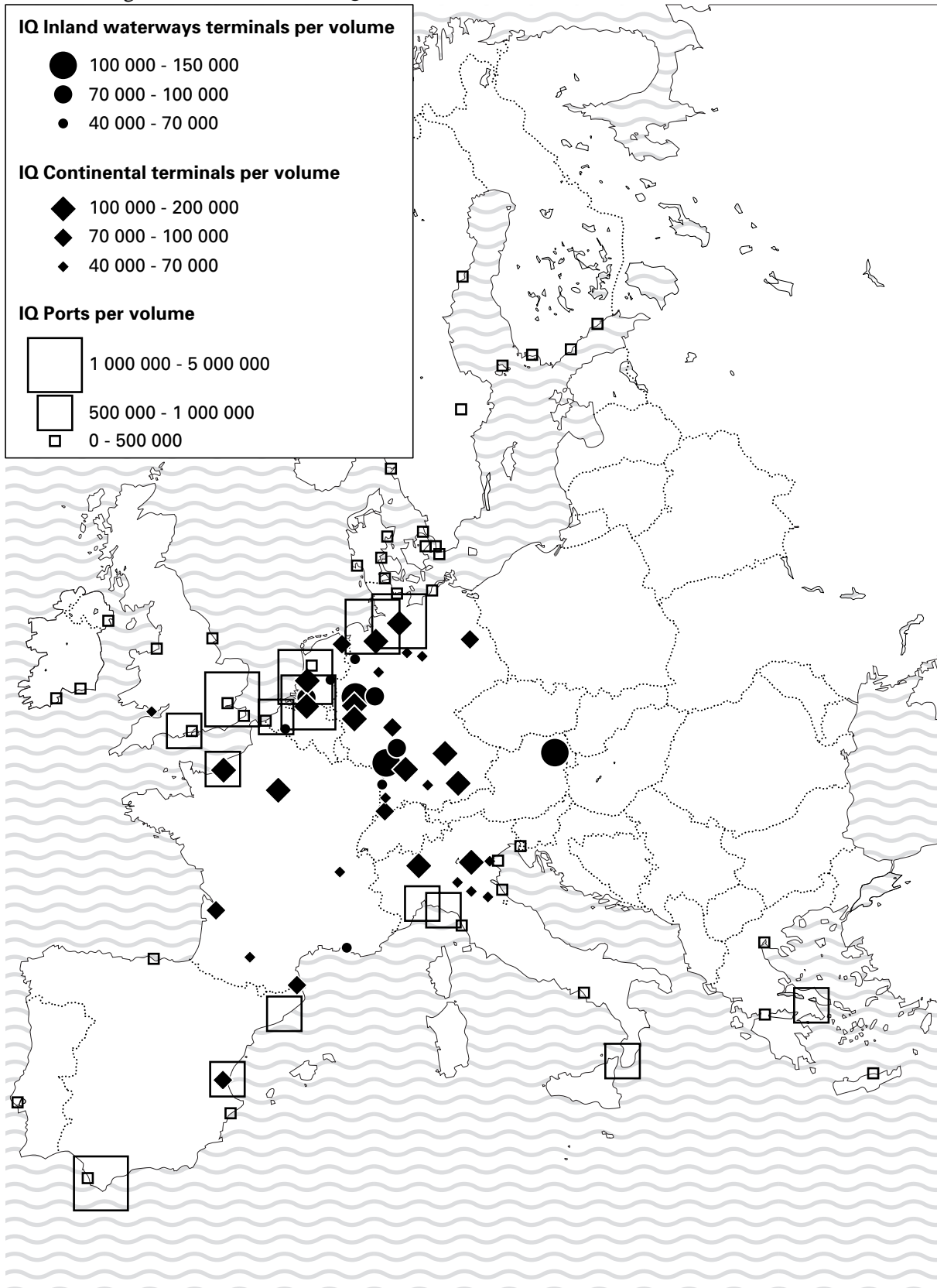
The economics of higher-volume flows comes into play at another level, that of rail haulage itself, with a number of consequences for service quality: reduced haulage costs, ease of train formation operations, more frequent running, easier wagon management, etc. The aim is to be able to run a full trainload (block train) or shuttle train in a fixed formation at regular times on reserved paths. The first such services were to major ports (and some transalpine services), and many more are now operating from Antwerp, Rotterdam, Hamburg, Felixstowe, and indeed Bremen, Le Havre and Mediterranean ports like Marseilles, Genoa, Barcelona, Valencia, La Spezia and Gioia-Tauro.

The same principles -- frequent, good-quality services along a real "corridor", sometimes over long distances inland -- have also been adapted to inland waterway transport, particularly along the Rhine.

On the maritime transport side, the concentration of ports of call led to the development of maritime terminal haul services for ports, i.e. "feeder". The Baltic and Atlantic ports have been linked for some time now to the major northern ports by sea routes, as they had already been abandoned by large vessels. In some cases, including short sea shipping, "feeders" are facing competition from inland modes, and increasingly so from rail. There are inland and maritime transport alternatives from/to the northern range ports, particularly between Germany, Italy, Spain and the main English ports. Since the opening of the Channel Tunnel, rail transport is now an alternative between major English ports and other ports in the northern European range, although its potential still seems rather limited. Direct transshipment between "mother" ship and feeder ship at the same maritime terminal and the low cost of feeders, explain why the only serious competition is if the rail leg is shorter or the difference in forwarding costs is quickly recouped by a more direct rail route to the final destination.

In the Mediterranean, maritime hubs (concentration of traffic at one port) developed to suit the situation there. They are almost exclusively served by sea and play only a transit role, which does not have any great impact on local activity: Malta, Gioia-Tauro and Algeciras are examples of ports involved almost exclusively in transshipment operations. They are linked by sea routes to other major ports such as Genoa, Marseilles and Barcelona, which are also on major traffic flows. There are other examples in the eastern Mediterranean, at Suez, where feeder traffic operates over longer hauls.

Figure 3. Extraction of IQ database: Ports - Inland terminals > 40 000 ITU



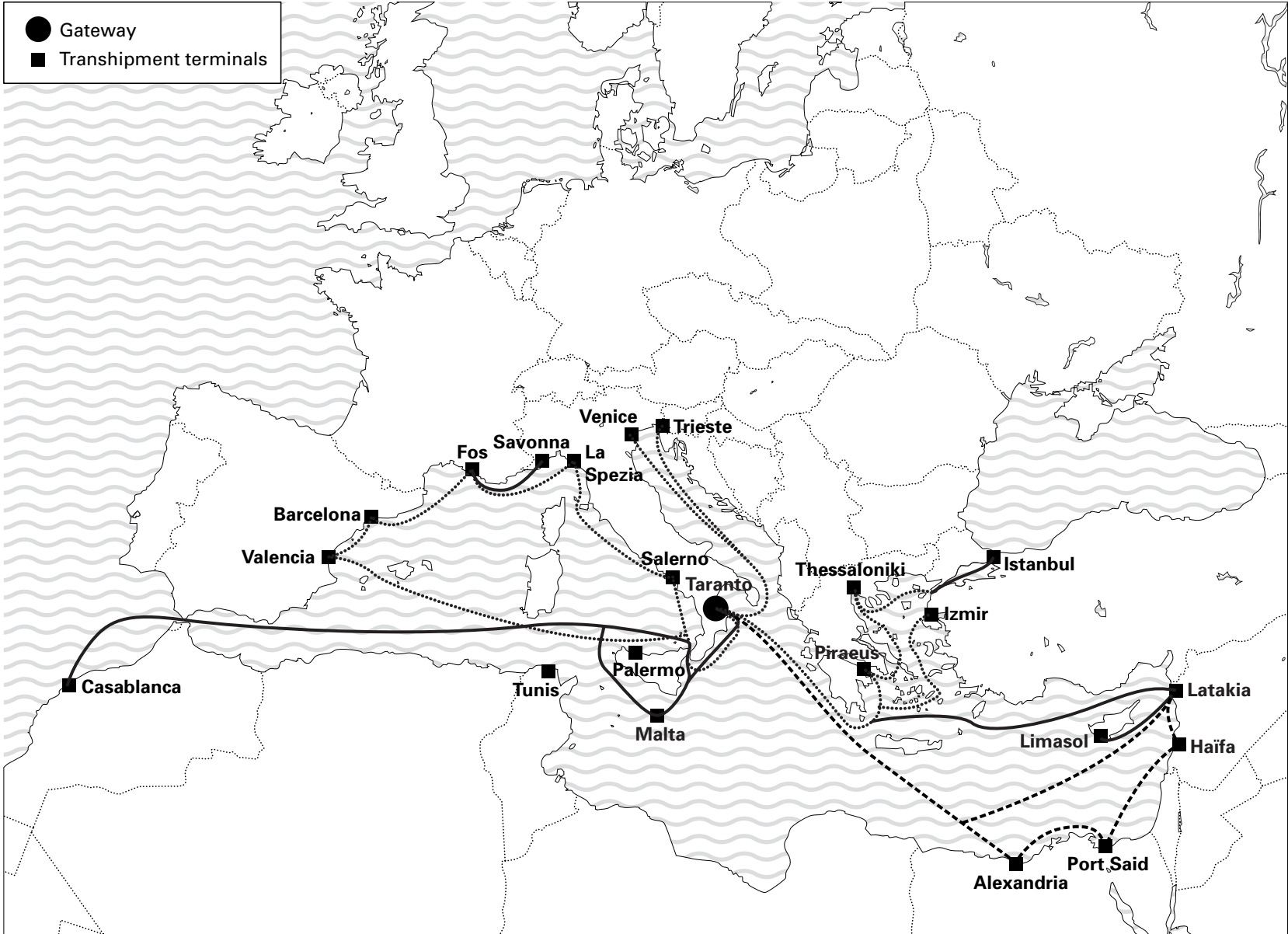


Figure 4. The feeding connections of Contship

The adaptation of road services to higher-volume flows is somewhat less straightforward than it seems and does not bring any advantages of scale. Rather, it increases constraints in terms of timetables and procedures to avoid congestion on terminal access roads, without any clear gain to road hauliers from flow consolidation. Road still does better over shorter distances, which should not be ignored in large ports, whose role is becoming more important as major international distribution centres begin to cluster in and around port areas (distri-parks or European Distribution Centres, EDC).

1.2.2. *Why distribution centres cluster around ports*

Distribution centres gain from savings on maritime transport: rather than the expansion of the European inland market, the world trade context was the determining factor in their location.

In a world context, freight distribution logistics are more important than the organisation of port services. Distribution centres are sited in the vicinity of a major port, where world and European flows meet, and generally cater for Europe. Sea freight containers are stuffed or stripped and their contents are shipped (or consolidated) via distribution centres. Many manufacturing companies and major international distribution groups now have several European DistributionCentres: 200 such centres have set up in the Antwerp area recently.

This affects port services in two ways: more traffic, both maritime and continental, enters and leaves the area or region via the centre, often by road. The distribution centre and portside terminal develop in close proximity to each other in a huge logistics area that attracts a whole range of ancillary services.

For many years, the fear was that containerisation would make ports largely redundant, except as mere forwarding points.

This proved not to be the case, as major container ports realised when they encouraged the establishment of EDCs. From 1995 to 1996, of 25 new distribution centres in nine European countries, 16 chose to locate in the Netherlands, i.e. not far from Rotterdam. The majority of these centres are US initiatives: 17 out of 25, including 10 in the Netherlands.

Developing intermodal access to distribution centres is now more of an inland transport than a maritime transport issue. There are those who have already realised this and are analysing swap-body access requirements to rail transshipment terminals for sea freight containers. It is difficult to assess exactly what impact this will have in quantitative terms, just as it is difficult to put a figure on the tonnage stuffed and stripped in ports as part of load consolidation and distribution operations.

In a port such as Hamburg, one-third of sea freight container traffic remains in the port area, one-third has a pick-up or final destination point in the surrounding region and one-third is long-distance traffic. The statistics on the number of European Distribution Centres confirms that this is a fast growing phenomenon, linked to globalisation, that involves a substantial volume of trade.

Consequently, there are two development concerns for the major ports. The first is good traffic planning in the port and surrounding area -- so that they will be able to retain ancillary businesses or attract large distribution centres. Their second major concern is the quality of their longer-haul inland transport services, which will enable them to build up their maritime business in the face of competition from other ports.

1.3. Impact on ports competing for the internal European market

For years now, ports in northern Europe and the Mediterranean have been competing with each other, although admittedly not to the same extent in both areas.

In fact, northern Europe has the world's highest concentration of ports, within a very short distance of one another, counting those between Dunkirk and Rotterdam or Le Havre and Hamburg and including the major English ports.

Competition is certainly less intense in the Mediterranean, although it can be a factor in smaller areas: between Trieste, Koper and Rijeka for services from the Adriatic to Slovenia, Austria, Hungary, between Gioia-Tauro and Marsaxlokk (Malta) for the role of maritime hub in the central Mediterranean, between Valencia and Barcelona for services to Madrid and, to a certain extent, between Marseilles, Genoa and Barcelona on what is conventionally known as the "Latin seaboard".

The competition-based approach has long since replaced the hinterland approach (especially the idea of a "natural hinterland") which now only makes sense according to purely economic criteria: the only thing that "deters" traffic is a barrier to competition, and "geographical" distance is not always a determining factor.

This said, terms of competition are still difficult to analyse.

For years, the European Commission neglected maritime and port issues, tackling only the question of preferential terms for service provision to a particular national port rather than a foreign port, which had previously been clearly specified (e.g. preferential dockage rates for Hamburg as opposed to Rotterdam). The same was true for the billing of "alongside ship" operations, which were either itemised under a specific port operation or lumped together with the overall maritime transport costs. However, distortions are not always so clear or obvious. When the Commission and operators met, the commercial arguments for integrating the transport chain led to "differentiated" billing for inland transport by shipowners and it was not easy for the Commission to counter what clearly amounted to differences in treatment just at inland service level: what was behind this was, in fact, "carrier's" haulage or the provision of an integrated service directly by owners to shippers.

Having made inroads into the continental market, shipowners began to set up inland terminals, which were by then becoming genuine container management facilities, closer to industry, whereas before container repositioning had been a portside activity. The development of "forward" centres, such as Gennevilliers for Le Havre, Lyons for Marseilles, Duisburg for the Europe Container Terminus (ECT), was part of this trend, which was criticised by forwarding agents who saw their intermediary role between carrier and industry made more difficult and who condemned unfair rates.

Overall, it is still difficult to assess whether a specific commercial measure will have any real impact on services to ports or their hinterlands, as the organisational context has changed so radically in the past few years.

Whatever the case, from now on, ports will have no "protected" hinterland in the European area, although this, of course, does not mean that the market is now distortion-free.

Distortions can also arise from external factors relating to infrastructure charges for road (toll or toll-free) and rail. If charging principles continue to vary from one country to another, on the grounds of the “territoriality” principle, we can probably expect the first complaints about barriers to competition to come from cases relating to access to ports. Such distortions cannot remain “structural” for too long with competition being as sensitive an issue as it is. Economic principles do not always point to an unequivocal solution: should we “charge” to reflect the scarcity of slots on an already congested route, or should we aim to cover costs? The answer may be different for access to ports.

Lastly, distortions can also arise from investment finance methods, particularly finance for port development and access infrastructure works, unless a simple principle of covering total costs through user charging can be adopted and introduced widely, although it would still be difficult to implement. Even if it were implemented, some Mediterranean ports have already stated that the basis of the principle would still have to be defined, as they consider that public investment delays currently put them at a disadvantage compared with northern ports.

Traditionally, port bodies have taken a wide variety of legal forms: they have development and operating objectives, and involve public and private partners operating in industrial and urban areas. These are the arguments often advanced by those who consider that regional and port development are closely linked, stressing the interdependence of local institutions and the authorities responsible for port planning and development.

Ports and inland terminals have always been areas where public and private sectors meet, even where there is very fierce competition, between enterprises in the same port as well as between different ports, whether or not they are directly or indirectly protected by a local, regional or national body.

When reviewing objectives and partners, the different organisational and pricing rules should now be made clear so that there can be a return to a cost rationale instead of the price rationale that grew out of historical practices which sometimes developed a legal basis of their own.

Be that as it may, the Commission is now addressing this issue, although not without problems. General guidelines have been issued. Whereas a few years ago it had not been possible to produce a trans-European port plan, ports have recently been included in a trans-European intermodal plan that integrates different modal networks and ports as well as inland terminals. As regards the economic principles of charging and development, all the elements have now been integrated into one approach. This at least provides consistency, if not a basis for a solution.

Having outlined these principles, the fact remains that an economic dynamic is growing, stimulated by competition and almost certainly by growth in traffic and demand: in a market growing steadily by over 5 per cent, adjustments will almost certainly be easier if a minimum of joint approaches and concentration are maintained.

Currently, major ports handling over 1 million unit loads all have major plans to accommodate the next phase of growth in maritime traffic and the arrival of a new generation of container ships. With the completion of motorway networks and the adaptation of rail services, their hinterlands cover most of Europe from North to South and East to West, although the major ports in the North are in a stronger position than other northern ports, and the northern ports are in a stronger position than those in southern Europe: the Betuwe line, the Iron Rhine, the development of the Paris by-pass line, are

some examples of major railway projects serving ports. On paper, planned increases in port terminal capacity are sufficient to accommodate such growth. However, corrections taken for future port growth and related inland traffic growth are not always clearly stated, either because plans are not yet sufficiently co-ordinated or because potential productivity gains resulting from good network performance have not yet been fully assessed. Organisational change is the major unknown factor in a context where infrastructure project appraisal is still the practice.

In the North, the biggest question is probably the influence of Le Havre and, in England, the strengthening of Felixstowe's lead position. In the Mediterranean, ports are farther apart. However, in the past few years, the Mediterranean ports have not been losing out to northern ports. Their share had been quite low in the 1980s, at around 20 to 22 per cent, increasing to 25 per cent in 1996. The rapid growth of ports such as Voltri near Genoa, Gioia-Tauro, La Spezia and Barcelona goes some way to explaining this. However, for a full explanation we must look to the wider context, including: the reorganisation of shipping movements on a world-wide scale; the emergence of hubs in the Mediterranean concurrently with improvements in the quality of port services and inland carriage as well as the role of inland terminals and the organisation of a more efficient rail service in Italy, without any major railway investment.

2. A PROMISING OUTLOOK FOR INLAND INTERMODAL TRANSPORT

Maritime transport is intrinsically an intermodal form of transport in that it combines a maritime link with a land-based link.

However, maritime container transport has more to offer than a simple combination of links and raises the interesting question as to the impact it will have in the future on the development and organisation of the inland intermodal system in Europe. For a wide variety of technical, economic and environmental reasons, intermodal systems have become a priority for transport policy, although they are not as yet widely used due to the competitiveness of road. At present, intermodal transport accounts for merely 3 to 4 per cent of intra-European trade flows.

However, for certain specific links, such as Alpine crossings and traffic across the English Channel or The Sound (Øresund), intermodal transport is gaining ground and is starting to change modes of organisation and behaviour. The same is true of the inland container transport market, where the rail and inland waterway modes would seem to be well-placed to make gains despite the fact that their share of the modal split still remains low compared with that of road.

Given the scale of anticipated traffic volumes, the number (albeit small) of ports on the various seaboard concerned and the increase in the distances over which goods are shipped in continental Europe, from North to South and now from West to East, inland container transport will probably prove to be one of the most significant factors in the success of the overall intermodal transport sector in Europe, regardless of the problems that may have to be overcome.

The relevant traffic volumes for the horizon year 2015, calculated on the basis of average rates of growth in economic activity, are given in Figure 5 below. The elasticity of container transport with regard to economic activity is generally of the order of 1.5 to 2. In addition to this general factor for world trade, there are also some specifically European factors which will reinforce trends: growth in

intra-European traffic capable of being carried by container; growth in feeder services; increase in the size of the area that can be serviced by the port. Hamburg offers a good example of the latter in that, with the opening up of markets to the East and by virtue of its position in traffic flows to Asia, the port of Hamburg has grown rapidly over the past eight years, both as a feeder port to the Baltic sea and as a port offering access to central Europe through direct train services to Poland and other central European countries. Forecasts indicate that by as early as 2010 the volume of freight handled by Hamburg should amount to nearly 90 million TEUs for Europe as a whole, with pre- and post-carriage legs gradually increasing, either directly through the provision of door-to-door services or indirectly through growth in shipments involving transit through a distribution centre.

This scope for future development suggests that intermodal transport will follow the same course as growth in international port traffic, which imposes its own demand system and therefore introduces its own actors (forwarding agents, dock managers, transit operators) into the inland transport system by virtue of the fact that operations relating to such traffic are less sensitive to national divides.

2.1. Means by which rail and inland waterways can increase their share of the modal split

Although road is the dominant mode for access to ports, most countries expect to see a reversal in the current trend and are making plans accordingly.

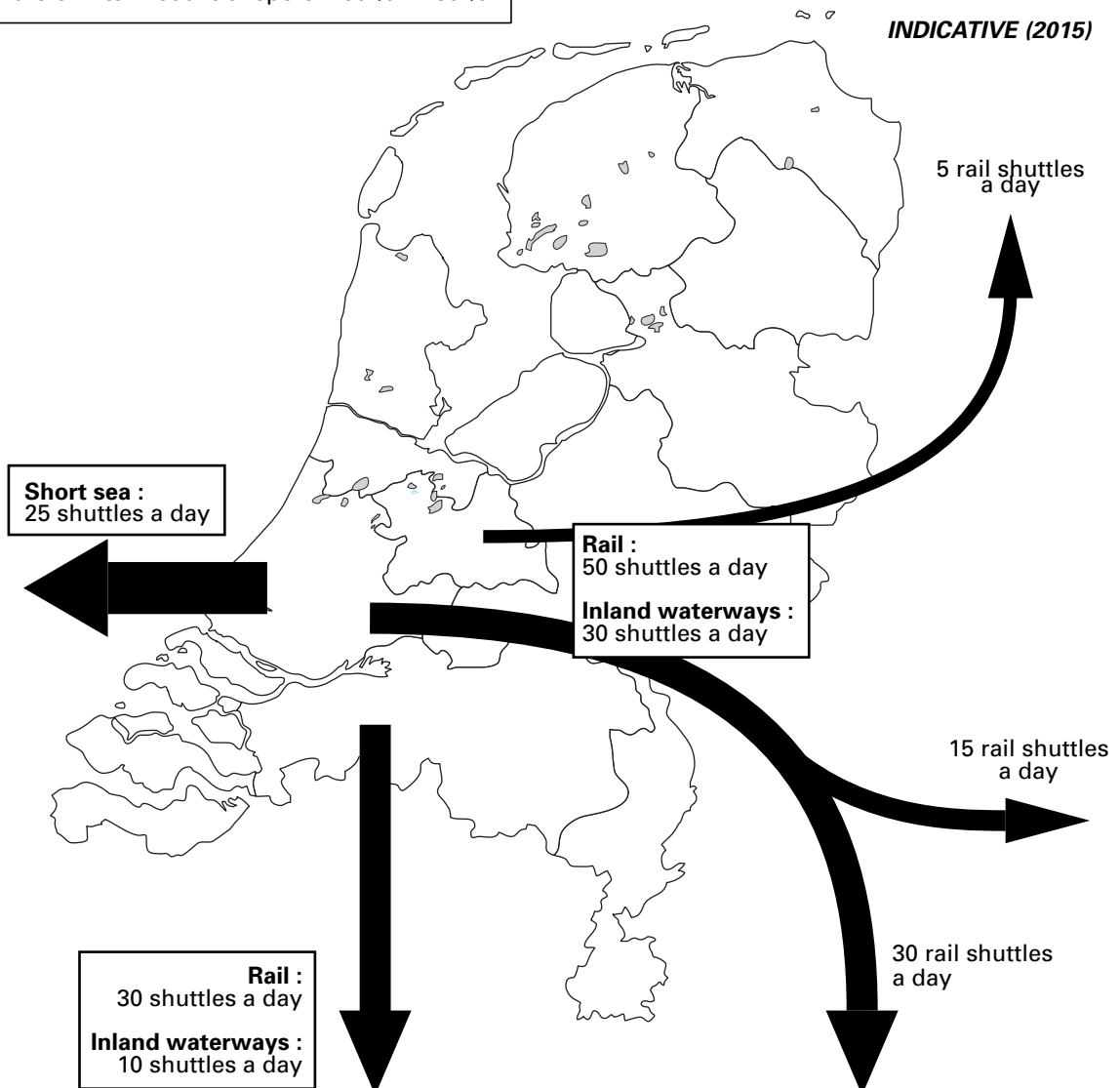
One of the best examples of this is the port of Rotterdam. Prior to 1990, rail accounted for a very small share of the modal split, of the order of 5-10 per cent. Many containers were transported by road to the Antwerp area for transshipment onto rail. At the same time, however, prospective studies up to the year 2010, carried out by the port authorities and the Dutch Government, produced a completely different vision of the future. Road looks set to become a minor mode for shipments to and from ports, at least over long distances, whereas rail should increase its market share to 25 per cent and inland waterways should account for almost a third of the traffic for total port shipments of 100 million tonnes, or around 10 million TEUs.

Recent years have already witnessed a change in trends. Rail traffic to and from the port in 1998 is up by almost 20 per cent on 1997 levels and the share of the modal split would seem to have risen to 18 per cent, with 450 000 TEUs for shipments in and out of major terminals with good rail links. Twenty-two international shuttles and three domestic shuttles have been brought into service, for a total of 250 trains a week for short, medium- and long-distance shipments to Benelux countries, Germany, as well as Italy and Poland. The new Delta terminal has a direct link to the rail network. In this respect, it is worth noting the impact made on the organisation of port access services by an association of shipping companies working in conjunction with Dutch Railways (ERS), which provides 42 shuttles a week with a capacity of 160 000 TEUs a year and annual shipments of 130 000 TEUs in 1997. The main destinations are Germany and Italy.

The use of inland waterways for port access services is another area on which efforts have focused and, as in the case of rail, the emphasis has been placed on improving transshipment links in terms of both terminal operations and movements inside ports -- two prerequisites for placing intermodal transport on a solid footing. In 1996, some 600 000 TEUs were shipped on the Rhine to and from Rotterdam.

Figure 5. Forecast container traffic and map of inland transport services for the port of Rotterdam by the year 2015

[m tonne]	1993	2015
Potential freight		
> km transport	40	100
Realisation		
• rail	2.6	25
• incl. waterways	5.7	25
• short sea	4.3	13
• total	12.6	63
• share of intermodal transport	30 %	60 %



Source : Ministry of Transport, Public Works and Water Management of Netherlands, Directorate General of Transport

Consideration is also being given to intermodal operations for both rail and inland waterway modes over short distances and not just for services to “advance” points for transshipment to road, as in the case of Venlo in the Netherlands for road services to Germany from Rotterdam. Rail could also be used for the follow-on leg for shipments after transshipment and in some cases could even be used to provide door-to-door services.

Once short-distance shipments have themselves become a form of end-to-end transport, which are highly targeted services in logistical terms, then it is clear that operating modes have become more sophisticated. However, in many cases, these short-distance shipments are part of a broader approach to port operations in which services are supplied to several ports, as is already the case for Rotterdam and Antwerp. Thus the 400 000 TEUs transported by inland waterway between Antwerp and Rotterdam constitute an alternative to a maritime feeder service. There are also short-distance rail shuttles between these two ports, which allow services to Europe to be organised over longer distances from a rail centre located inland near to the port areas. Intercontainer has put in place another type of system in Metz, a location further inland in terms of the “northern range”, in which trains from the principal Benelux ports are assembled into full trainloads to destinations in southern and south-eastern Europe. The volume of traffic and the destination will determine how close to the port trains will be assembled.

The port of Antwerp enjoyed better access by rail than Rotterdam even though containers were not always loaded onto rail wagons directly from the terminal, which always makes it particularly difficult to compare modal splits. Rail is estimated to account for 20 per cent of the modal split but substantially less if the share is calculated on the basis of direct pick-ups from the terminal, in which case the figure would be of the order of 10 per cent. Whatever the case may be, rail access to the port of Antwerp has also been comprehensively reorganised in that trains are now assembled in the vicinity of the ports with shuttles, a technique that appears to work well in major ports, being assembled either in the vicinity of the terminal or further inland, depending upon the volume of traffic and the number of destinations: Belgian railways have been directly involved in these developments. At present, the trend in Antwerp also indicates a sharp increase in the share of the modal split accounted for by rail and inland waterway.

In the case of Hamburg, rail links were already widely used for long-distance shipments, with rail accounting for over 60 per cent of the modal split in Hamburg, although the figure falls to 30 per cent if medium-distance shipments are included. Rail services were organised at two different levels: a network inside the port, under the control of the port authority, and a network outside the port managed by DB.

This proved to be highly costly and when work began on developing new terminal facilities both the rail network and services inside the port were reorganised. Two major terminal operators, Eurokai and HHLA, are directly involved in the provision of rail services, notably by assembling full trainloads for shipments both to foreign countries and to destinations within Germany.

Two major French ports, Le Havre and Marseilles, are also endeavouring to promote inland waterway and rail links. Since neither port has an operator of the requisite size, the port authorities are often the ones promoting such new operations, seeking support locations inland or even, as in the case of Le Havre, taking the initiative to propose means of bypassing Paris, in discussions with the SNCF (French railways). The outcome of these efforts looks promising, even though the volumes concerned will not be as high as those mentioned above with regard to other major ports.

The race to provide access services to ports would therefore seem to be under way and all the actors, who to varying degrees are developing strategies to readjust the modal split, have now been mobilised. New technical configurations are starting to emerge in port areas in response to development work currently in progress in maritime terminals. The actors involved in these developments have sufficient resources and experience to make their strategies credible. The largest areas of uncertainty concern the provision of access infrastructure, although the diversity of new operating modes bears witness to the performance gains that can be achieved with existing infrastructure.

2.2. Corridors, nodes and dedicated freight networks: A new approach to the design of intermodal networks

The increase in the volume of traffic flows and the use of full trainload or shuttle trains has lent weight to the idea of “corridors” for traffic flows within Europe. Following the creation of the first intermodal network in Europe, primarily designed to meet the transport requirements of continental Europe and to cover the entire European area, freight “freeways” are a recent development whose main objective is to provide access to major European ports; this did not happen by chance but was a planned response to the changing pattern of demand and was designed to provide sufficient capacity while at the same time transforming the way in which the rail network was managed. In the case of the inland waterways, the routes for corridors were imposed rather more directly by geographical considerations, the most obvious example being the Rhine corridor.

However, the concept of corridors can swiftly become restrictive.

Firstly, before designating a corridor, preliminary studies must be made of the way in which the inland terminals, the points where goods are collected and distributed inland, are operated. Terminals must be flexible in terms of location, handling capacity and the supply of ancillary services. The way in which a terminal is organised will generally depend upon whether the flows handled are primarily of continental or maritime origin, since this will determine how well they perform; small terminals are intrinsically the most versatile. The ancillary services required for maritime containers are more varied than those required for land-based shipments using swap-bodies (warehouses, container management, repairs, administrative formalities, etc.). A wider variety of information needs to be provided (in liaison with customs and port authorities) and different methods are used to handle and store goods (container stacking and advantages of supplying from stocks).

The introduction of shuttle services to and from an inland terminal can also generate savings by allowing several trains to be routed to the same quay on the same day, and by simplifying, as in the case of maritime terminals, marshalling operations.

These distinctions mean that differing levels of specialisation, depending upon the country concerned, may be observed between maritime and continental intermodal transport terminals. In Italy, the difference between the two types of terminal is quite marked. The Quadrante Europa terminal handles practically nothing but swap-bodies, leaving maritime container traffic to be handled by the neighbouring terminal in Padua. Many terminal operators feel that the variety of loading units can lower the performance levels of terminals, although it might perhaps be possible to consider building installations with different types of railheads better suited to one or the other type of traffic; here again, the precise breakdown of traffic will be a determining factor.

In addition, the routes of individual corridors cannot be planned without reference to those of other corridors.

Other than in a few well-known cases in which the point of origin or destination alone are sufficient to warrant the introduction of a shuttle train of full trainload, running at sufficiently frequent intervals, the rule nonetheless remains that flows need to be grouped together in order to improve the performance of operating modes by rail or inland waterway.

The IQ project analysis focused on two types of full trainload operating modes, while shuttle trains and block trains can themselves consist of two part-trains (Y shuttle and Y block train).

Once the benefits of this type of operating system had been demonstrated, several methods of consolidating trains were identified from existing practices: consolidation at the terminal itself where justified by traffic levels, but above all:

- Consolidation at a gateway terminal, with rail-road and rail-rail transshipment to widen the catchment area for collection and distribution. The terminals sited close to the Alps in Italy are good examples of gateways;
- Consolidation through the hub-and-spoke system along radial axes, in order to widen the area served; this well-known technique is applied in the rail sector.

These rail operating modes and consolidation techniques are the nodal points that provide a basis for the new operating systems currently being linked vertically or horizontally in order to cover the entire European area.

Port access services, as well as crossings across the Alps or the English Channel, are the main structural components of a rail system of this nature.

The layout of the inland waterway network is undoubtedly more straightforward; the savings achieved on line transport, or even handling inside the port area, can very rapidly make inland waterways competitive for transport to regions close to the main watercourses providing access to the interior of the continent.

However, it is also possible to design more sophisticated systems comprising rail-inland water transshipment facilities in order to extend the area of influence of the Rhine from East to West or from North to South, or even to provide the necessary links between drainage basins which, for geographical reasons, cannot easily be connected.

Figure 6. The main flows of Intercontainer: Rail operating systems used

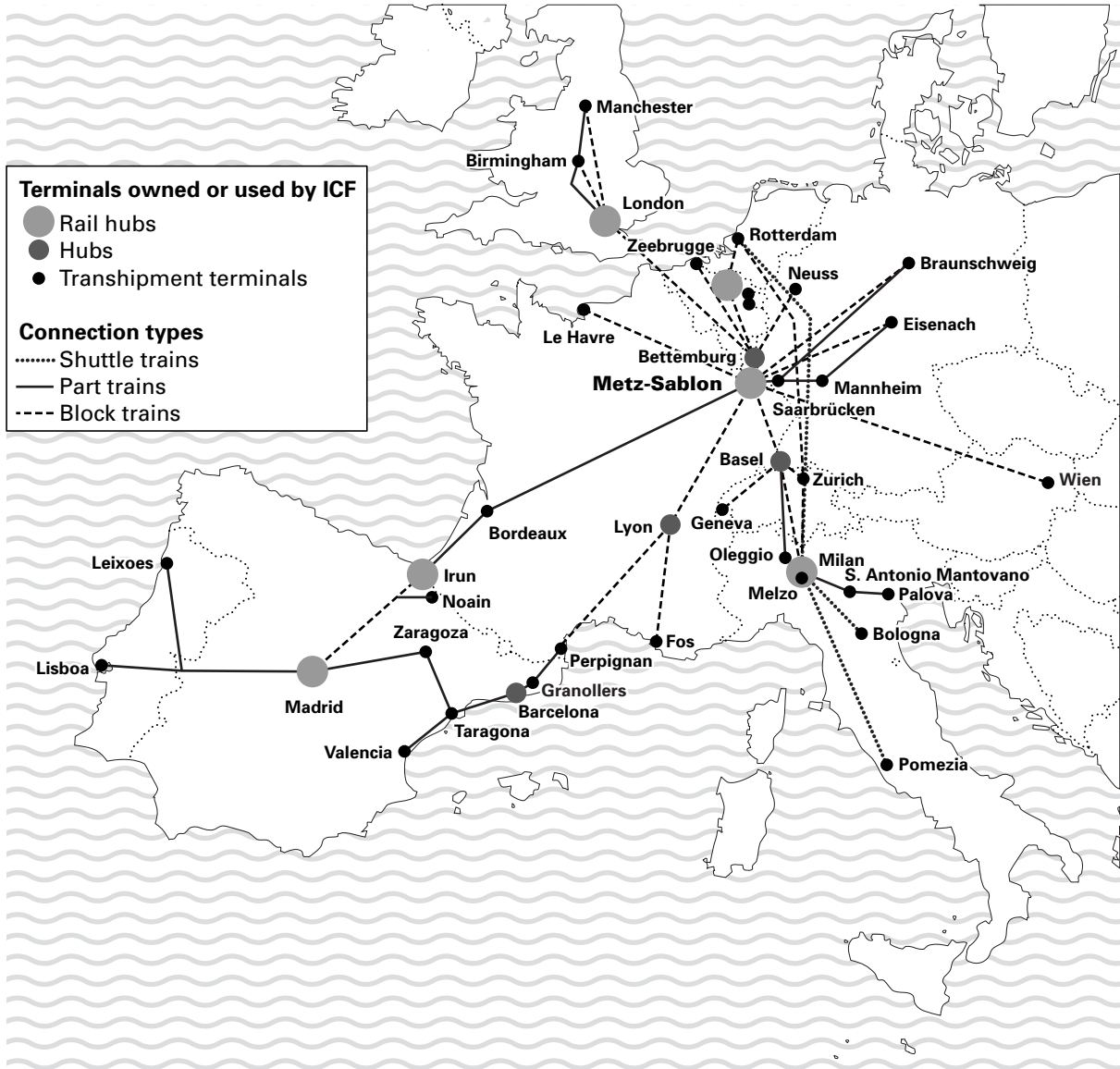
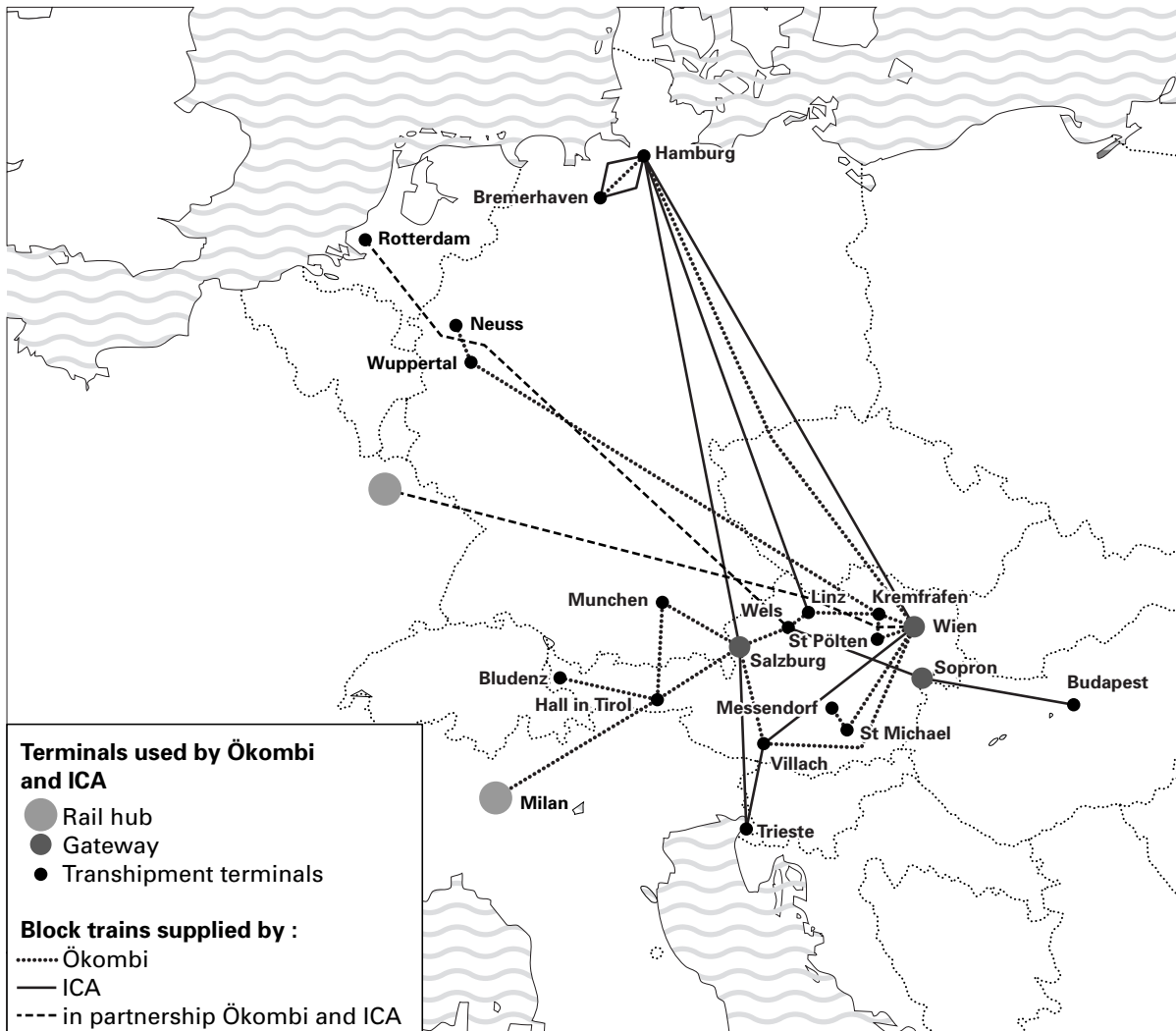


Figure 7. **The main flows of Ökombi and ICA: A rail operating system based on a bi-concept: block train-gateway)**



With the introduction of new operating systems on rail links and the creation of a network based on nodes that serve as effective centres for the organisation of the system, a new form of intermodal network that lends itself strongly to use for container traffic is starting to emerge and the intermodal terminal network has now been incorporated into trans-European network planning.

The final distinctive elements of the system will be the management of rail traffic movements by segment, the priority given to freight and the marketing of services. Another major objective will be to determine the available capacity of individual segments and to optimise their use or, in other words, how they can best be used to achieve the requisite level of quality of service.

The last point to be mentioned is the specialisation of networks, an issue that emerged in discussions on the Betuwe Line and the benefits that could be gained from establishing a specialised freight network in Germany (Netz 21). Specialisation might lead to further technical improvements such as the formation of longer trains and the use of simpler modes of traction, or even double stacks,

on certain segments. Here again, links to ports, routes across natural barriers, crossings through densely populated areas and the extension of links to the East will provide the basic template. Within this overall system, land-based services to ports would seem to offer a means of initiating the synergistic relationships which could lead to the creation of a genuine intermodal network at the European level.

The case of NDX offers an interesting example in this respect. This new association of operators, including DB, is attempting to supply door-to-door services without making the integration of the entire transport chain a strategic objective. NDX purchases rail traction services for shuttles feeding major ports, as well as Barcelona in the South. NDX is not seeking to compete with the railways but is trying to find an original strategy in this new intermodal network.

Recent observations bear out the existence of synergies at the level of operators and even at the level of rail operations when full trainloads are assembled from mixed traffic in a given terminal.

However, the variety of examples demonstrates that scenarios can be drawn up for different levels depending upon whether the network will be:

- Restricted to a small number of corridors, a trend already starting to become apparent;
- Restricted to a “core” network, consisting of a small number of corridors linked by rail transfer points with rapid transshipment between trains;
- A central network, widely accessible from all regions through gateways providing access to peripheral countries; from this stage onwards, major synergies between the port feeder network and the continental intermodal transport system may be envisaged in rail operations;
- A general European network, in which combined transport is offered as a genuine alternative to road transport, providing links to different regions through a vertically-organised system into sub-systems providing services at the local level.

The configuration of the network will be shaped by the geography of trade and the new intermodal “economy” outlined in the study on operating modes.

It will also depend, however, on the interplay between actors and the institutional framework which ultimately prevails.

2.3. Broad scope still remaining for actors

Land-based feeder services to ports have long been the preserve of inland transport operators, even though the organisation of such services could be dictated by the major specialist transit carriers in the maritime sector or even by forwarding agents.

Rail feeder services remained closely controlled by the national railways, which often failed to take proper account of the need to co-ordinate rail investment with the development of container terminals in port areas.

For many years, inland waterway access services to ports suffered from the difficult relationship that existed between port operators and carriers. The two sides are now talking to each other and links are being set up between their respective information systems, either following pressure applied by the port authorities or in response to port operators and users who are aware of their common interests.

However, the recent period has primarily been marked by the growing involvement of maritime and port operators in inland shipment legs, as shown by the carrier haulage policies of certain forwarding agents, the development of inland maritime terminals by maritime or port operators, and the initiatives to set up rail shuttle services recently taken by actors from the maritime and port sectors, initiatives in which the national railways have always been involved (NS or DB).

The intermodal sector is clearly in a period of transition. Following the organisation of intermodal transport on a co-operative basis by the rail companies, the system is now far more open and there are now new entrants (forwarding agents, port operators, new railway companies) offering new services. While the rule used to be one of co-operation and the share-out of markets, competition is now putting pressure on former alliances and the new lines of co-operation have not yet been clearly drawn up. Uncertainty over rail tariffs and rules for the allocation of port and rail investment simply adds to the feeling that the current period is one of transition. The Commission has set out guidelines, but these are unlikely to be implemented in the immediate future.

This phase could last for some time were it not for the growing importance of port access services, the supply of which is recognised as a “promising” market and one that is currently attracting interest from the largest operators in the maritime and inland shipping sectors. While these operators obviously include the national railways of EU Member States, they also include railway companies from the United States whose operators have already penetrated the market -- notably in the United Kingdom. This development lies behind the debate over “freeways” and “freightways”, in which systems are opened up to new railway operators on the one hand while, on the other, established national companies are eager to show their willingness to capture new markets and to demonstrate the benefits to be gained from renewed co-operation.

As traffic volumes grow, the situation is likely to change rapidly. ERS, NDX and EWS are simply new ventures in which each party is attempting to introduce new forms of organisation but without actively seeking confrontation. NS cargo and DB, one of its sponsors, are making active efforts to facilitate agreements with their former partners at the national level.

In another example, French railways and Belgian railways have given priority to new forms of co-operation by opening a one-stop shop for services and by making additional capacity available along corridors for intermodal transport, although it is still too soon to talk of “freeways”. Combined transport operators, whether they are linked to national railway companies as subsidiaries or through shareholdings, are, without doubt, the most vulnerable actors. There are two reasons for this: uncertainty over pricing levels with regard to infrastructure use; and the desire of national rail operators to develop their own marketing policy with regard to feeder services to ports. Combined transport operators do have business capital but do not have a funding capacity or resources comparable to those of other actors, particularly for investment in inland terminals. For the time being, a strategy of adjustment has been sufficient to cope with the increased volume of traffic, but in the future such a strategy will not be sufficient to ensure the emergence of a modern, intermodal system capable of meeting the new requirements of customers in a new European context.

The four scenarios outlined above will therefore be governed not only by the performance of new operating systems but also by the strategies of actors.

1. The corridor-based approach, providing links between the largest sea ports, is already being pursued and, with regard to transport within continental Europe, has already been applied to the main transalpine routes and certain links with the United Kingdom, Scandinavia and the Iberian peninsula. Priority has been given to shuttle and full train-loads for this mode of operation. However, differences between rail user charges within Europe, which can vary by a factor of 1 to 10 between two different countries, as in the case of France and the Netherlands or Germany and Austria, undoubtedly cannot remain at such high levels, even if shuttles operating at regular intervals enjoy highly favourable conditions in countries that impose high user charges. This infrastructure usage charge is estimated to amount to a third of the cost of rail traction (for a country occupying a mid-ranked position in the current performance league).
2. The creation of a high-density rail hub is based on the assumption that the national rail companies rediscover a forward-looking approach to development and set up efficient transshipment centres for trains. The techniques that might be used are currently under discussion and could be implemented, but would require major investment which solely national railway companies could provide. In such a scenario, the traffic flows concerned would not be limited to port feeder traffic, and the flow of containers on inland routes would therefore determine the routes of the main rail lines.

The design of a hub-and-spoke network goes hand in hand with that of a dedicated freight network (or network designed primarily for freight) in future plans for a revamped railway system and offers scope for further innovations such as long trains.

3. The scenario of a centralised network in which traffic is channelled through gateways is also based on a number of practical “examples”. The development of such a network would be contingent on combined transport actors being prepared to work closely enough together to ensure that traffic could be collected efficiently within areas of the requisite size, such as the Italian peninsula, the Iberian peninsula and now certain central European countries. Train movements within a centralised network would undoubtedly be less efficient than in the previous scenario. Train formation and marshalling operations would sometimes have to be carried out using more traditional means as well as existing marshalling yards and railheads. Links with inland waterway networks would also have to be put in place. This would allow rail to increase its share of port feeder services but not to become the dominant mode, since it would nonetheless remain highly dependent on pricing levels.
4. The fourth scenario, which is that of an intermodal rail network providing services to different regions, is highly dependent on the policy decisions taken by EU Member States with regard to the promotion of intermodal transport and the taxation of road transport. In such a scenario, container traffic would simply be a component of a much larger system encompassing trade within continental Europe.

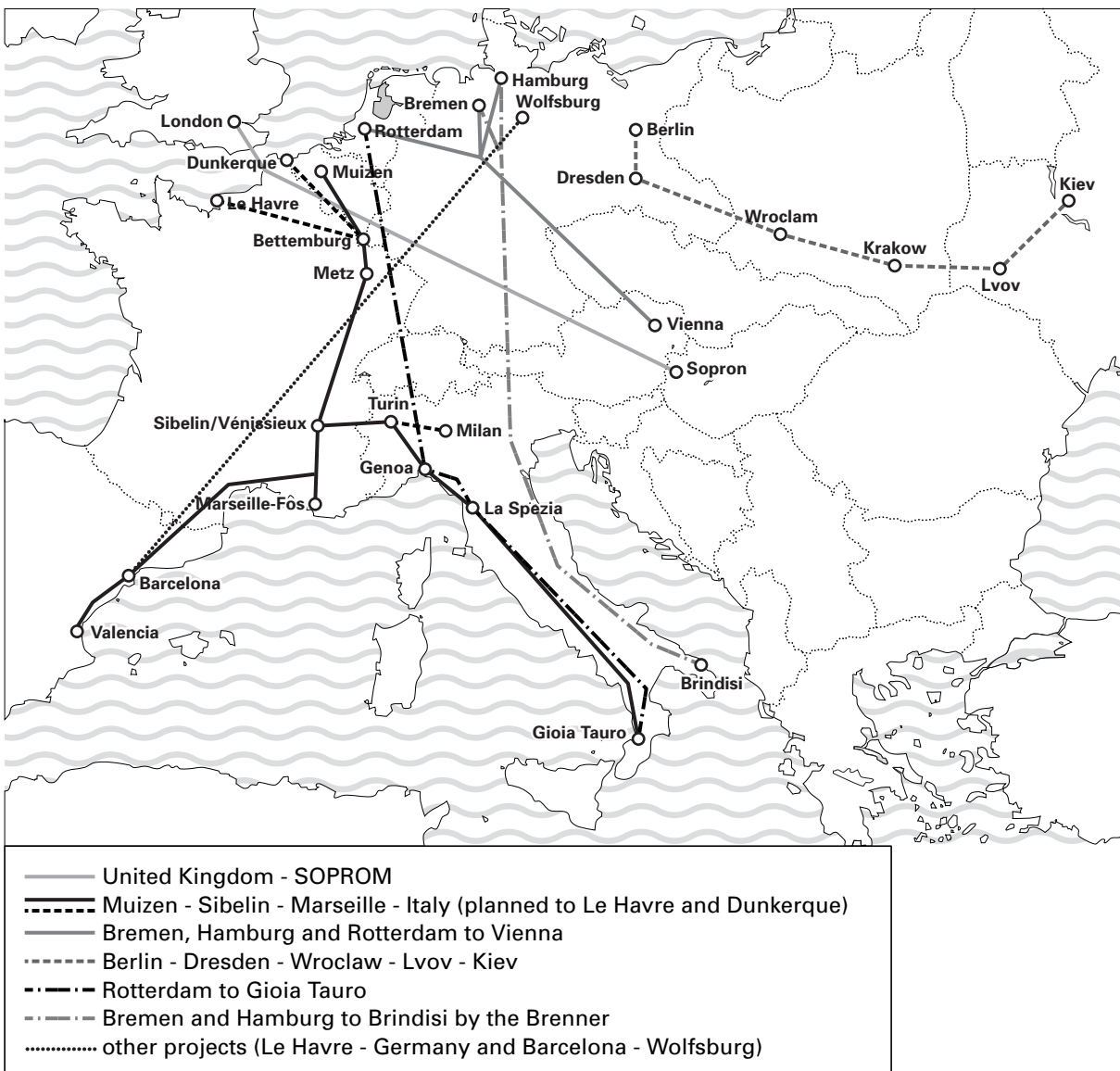
Whatever the case may be, port traffic will in all probability remain the catalyst for such change, particularly since it directly concerns densely-populated areas and environmentally-sensitive areas at a time when decisionmakers are forced to contend with strong growth in traffic levels.

In conclusion, the container transport sector is undergoing very rapid change in terms of both the volume of goods transported and the modes of organisation used within the sector. Without denying the existence of a number of bottlenecks in areas where traffic density is highest, or the problems involved in crossing natural barriers, the supply of services to ports is often contingent not so much on infrastructure as new operating systems and the quality of the services provided. Such services are helping to bring about far-reaching change in the very way in which inland intermodal transport is organised; what policymakers have laboured to achieve over the past twenty years, namely, the promotion of intermodal transport, is gradually starting to become a reality in response to the powerful economic stimulus of port feeder services, which are raising the efficiency of organisational modes and redefining the roles of the actors concerned. What the institutional sphere was unable to accomplish on its own, namely, the reorganisation of rail operations, is perhaps being brought about in the main transport corridors in Europe by the powerful stimulus of the global market, provided that the authorities are prepared to provide the accompanying or supervisory measures needed to ensure that the entire combined transport sector can benefit from these changes.

Notwithstanding the above, it would be wrong to underestimate the new role that the older and well-established railway companies -- whose ability to act and to plan initiatives remains undiminished -- can play. Whatever the case may be, the supply of transport services to ports offers an approach which cuts across modal and national divides and which, in return, offers new opportunities that can now be applied to all internal trade within the European area.

ANNEX

THE EUROPEAN FREIGHTWAYS AND FREEWAYS



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SUMMARY

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Dublin, May 1998

1. THE ROLE OF SEAPORTS IN THE TRANSPORT CHAIN

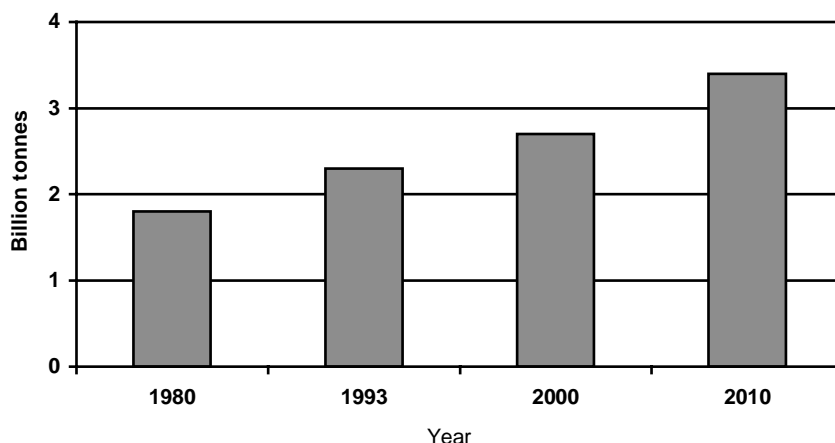
Sea ports are critical nodes in the transport chain, facilitating both trade flows and, to a lesser extent, passenger flows. According to the European Commission (1997), sea ports in the European Union (EU) handled approximately 2.7 billion tonnes of cargo in 1996. This represented more than 90 per cent of the EU's trade with third countries and approximately 30 per cent of intra-EU traffic; in addition, EU sea ports facilitate the movement of more than 200 million passengers every year (European Commission, 1997). Table 1 illustrates the regional distribution of sea port freight traffic in the EU, while Figure 1 charts the growth of trade handled at EU sea ports from 1980, and gives forecasts for such trade to 2010.

Table 1. **Estimated turnover in EU ports by region in 1993**
(millions of tonnes)

Region	Deep Sea	Inter-Regional	Regional	Total
Baltic Sea	47	121	98	266
North Sea	359	494	355	1209
Atlantic	136	219	19	374
Mediterranean	270	146	245	661
Total	812	980	717	2510

Source: European Commission, 1997.

Figure 1. Trade handled by EU sea ports



Source: Pallis, 1997.

According to the European Commission (European Commission, 1997), competition has intensified significantly among ports across Europe -- this has resulted from the completion of the EU internal market, technology changes in the transport sector, and the ongoing development of inland transport networks across Europe. Heaver (1995) noted that the port industry, like many industries, is subject to increasing amounts of competition with implications for both national port policies and for individual ports. Goss (1990), drawing upon Verhoeff (1981), discussed five different forms of competition which ports are subject to, namely: competition between whole ranges of ports or coastlines; competition between ports in different countries; competition between individual ports in the same country; competition between the operators or providers of facilities within the same port; and competition between different modes of transport. An example of the existence of interport competition is evidenced by Gripaios and Gripaios (1995), whose review of Plymouth in England indicated that the impact of a port on its local economy is exaggerated and they showed that ports often serve industry in areas distant from their own. Effectively then, the hinterlands of ports overlap, and this is patently illustrated by, for example, the spatial allocation of Roll-On/Roll-Off (RoRo) freight traffic (discussed later) between ports in both the Republic of Ireland and Northern Ireland.

With regard to the actual management of ports, Baird (1995) put forward four main models, or types, of port administration (Table 2) which can be adopted by policymakers, ranging from a pure public sector model to a pure private sector model. Baird noted that “*while governments elsewhere tend to adopt a mixed public/private approach, with regulatory control always left in the public sector, this is not the case in the UK*” (in the UK, the extant model of port administration is largely Type 4 of the four models shown in Table 2, i.e. pure private sector; in contrast, in Ireland, the extant model of port administration is largely Type 2 of the four models shown in Table 2, i.e. public/private). The operational efficiency and cost structures of sea ports can have a considerable impact upon the performance of the wider economy. Consequently, there is currently considerable interest in the present trend towards reforming the operational and institutional structures of ports¹.

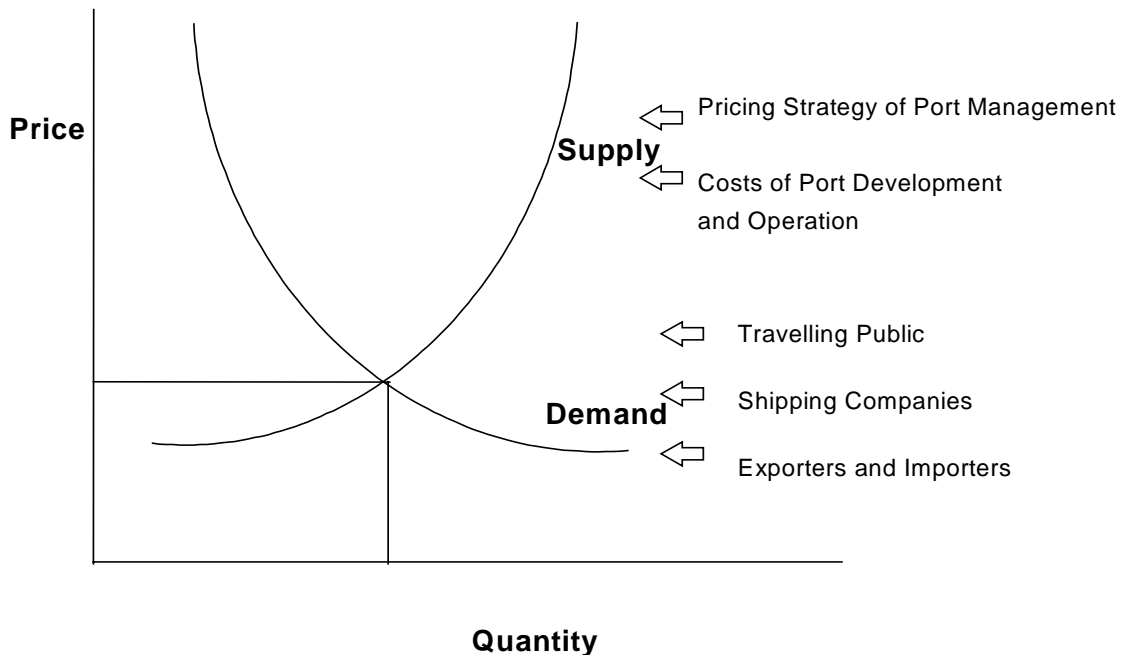
Table 2. **Four models of port administration**

Models	Port functions		
	Land ownership	Regulation	Cargo handling
1. Pure public sector	Public	Public	Public
2. Public/private	Public	Public	Private
3. Private/public	Private	Public	Private
4. Pure private sector	Private	Private	Private

Source: Baird, 1995.

West (1998) showed (Figure 2) the considerations that interact in the market for port services: the challenge for policymakers and individual port operators is to ensure that a correct balance is struck between the supply of port infrastructure and the market demand for this infrastructure. West suggested that ports can adopt pricing and marketing strategies which can be any of the following: profit maximisation, throughput maximisation or welfare (i.e. social) maximisation. The strategy adopted by individual ports impacts on the dynamics of demand by passengers, freight shippers and ferry companies for these ports, and consequently affects the spatial distribution of traffic.

Figure 2. **The market for port services**



Source: West, 1998.

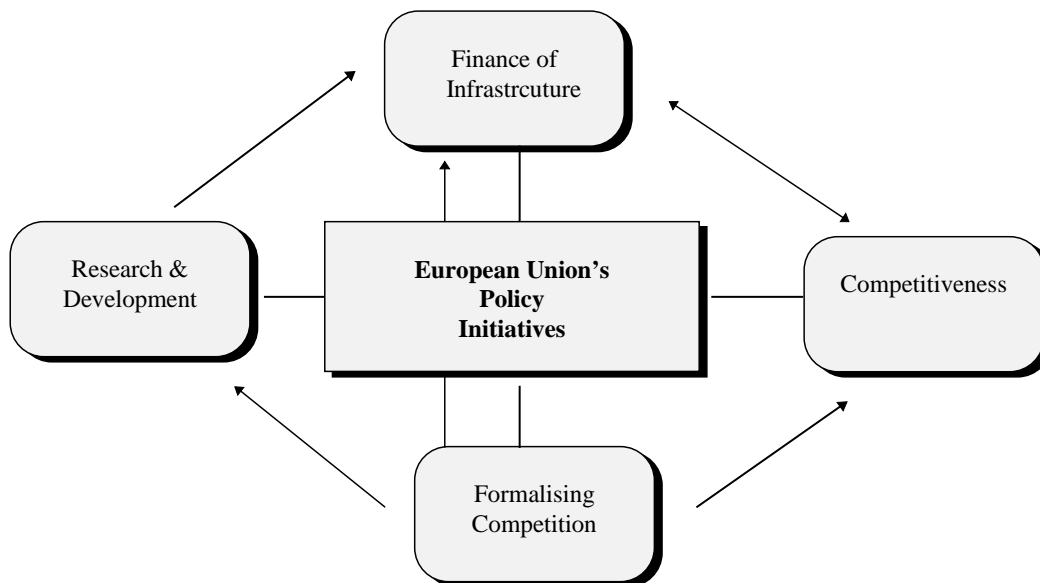
Clearly then, the *raison d'être* of all ports has evolved considerably from their historical position as nodes for trade serving local hinterlands -- ports have evolved, and continue to evolve, as technological and commercial entities operating in competitive, dynamic and diverse markets with

associated challenges for both policymakers and individual port managers. Baird (1997), quoting Frankel, has noted that *“inevitably, what we are continuing to witness is the transformation of the traditional role of the seaport, from that of a refuge for significant numbers of relatively small ships, to today’s specialised transport interface for small numbers of much larger vessels.”*

Pallis (1997) points out that the competitiveness of European ports is a key point for the success of EU strategy and he illustrates (Figure 3) the main EU policy proposals in this regard:

- Improvement and modernisation of ports’ infrastructure and their inclusion in the trans-European transport network;
- Creation of a competitive playing field;
- Advance of research and development (R&D) for ports; and
- Support of setting up an enhanced dialogue between all partners, to address relevant problems.

Figure 3. EU policy proposals



Source: Pallis, 1997.

2. GENERATION OF SEA PORT TRAFFIC

In order to fully explore the various issues impacting upon land access to sea ports, the four general stages of the classic transport model will be considered. Furthermore, although many ports handle both passenger and freight traffic, the remainder of this paper will focus exclusively on freight traffic. The four general stages of the classic transport model (see, e.g., Ortuzar and Willumsen, 1994) are:

- *Trip generation*, i.e. in this case, the generation of freight traffic in different geographical regions;
- *Trip distribution*, i.e. in this case, allocation of the freight traffic generated in the different geographical regions to different destinations (markets);
- *Modal split*, i.e. the allocation of the freight traffic to different transport modes, or (as increasingly is the case) combinations of modes;
- *Trip assignment*, i.e. the assignment of the various trips by each mode/combinations of modes to their corresponding networks.

In the next chapter, we will consider assignment of freight traffic to transport networks and the implications of this for land access to sea ports. We will now, however, first consider the key drivers of freight traffic generation, distribution and modal split. Specifically, what is behind the growing volumes of international trade evident today? The various data presented in Chapter 1 of this paper suggest that sea ports handle large and growing volumes of freight traffic, clearly a function of the aforementioned growing volumes of international trade.

According to *The Economist* (1997), while the global economy has been expanding at 3 per cent per year, the volume of world trade has been rising at a compound annual rate of about twice that: in 1996, some \$5.2 trillion of goods were sent from one country to another, up from \$2 trillion a decade earlier. Obviously, the worldwide decline in trade barriers and liberalisation of trade, together with the emergence of hitherto dormant economies such as China, have been key catalysts leading to growth in international trade. Another key catalyst is undoubtedly, however, the falling cost of getting goods to market. This can be attributed to three key drivers, namely: (i) the reducing transport intensity of freight (i.e. goods are getting smaller, lighter and more valuable and thus the transport cost as a proportion of freight value is falling); (ii) deregulation of transport, making transport services cheaper and more efficient; and (iii) the emergence and growth of containerisation and intermodal transport and the use of telematics in transport, also making transport services cheaper and more efficient. Globalisation and the continuing evolution of manufacturing practices (the emergence and evolution of practices such as mass customisation of products, design for manufacturability, supply-chain integration, centralised distribution, etc.) are also facilitating this growth of international trade.

Analysis of the aforementioned catalysts for international trade would suggest then that volumes of international trade into the future are set to increase, thus leading to increased freight for sea ports. There are, however, two other important factors which have to be taken into account which may impact upon such growth, one obvious, the other perhaps not so obvious. Firstly, there is the omnipresent threat of recession, either localised or indeed on a global level. The economic difficulties of the Asian economies at the time of writing is an obvious pointer in this regard. The second factor concerns the externalities associated with transport consumption. The three key drivers identified above which reduce the cost of getting goods to market, together with globalisation and adoption of new manufacturing practices, have led, obviously, to greater consumption of transport. One need only witness the impact of the centralisation of inventory and just-in-time (JIT) inventory management practices leading to greater traffic congestion. A variety of externalities of course occur with greater transport consumption (see, for example, Jones and Short, 1994) -- pollution, accidents, congestion, etc. Browne (1993) has argued that if companies are forced over the long term to internalise the costs associated with these externalities then a new pattern of storage and distribution may begin to emerge, in effect reducing overall transport consumption.

It was noted in Chapter 1 that we are continuing to witness the transformation of the traditional role of the sea port, from that of a refuge for significant numbers of relatively small ships, to today's specialised transport interface for small numbers of much larger vessels. In addition, the role of the port in the wider transport chain is evolving. The aforementioned discussion has illustrated the fact that ports are but one node in multimodal transport chains, which in turn are influenced by the many and varied factors in the global trading environment. Consequently, the exact nature of future traffic flows through sea ports is difficult to predict. From a modal split perspective, however, it is possible to predict that, increasingly, such sea ports will be part of multimodal transport chains to a greater degree, and furthermore such ports will aim to exploit the benefits of intermodal transportation to a much greater extent. The key driver in this regard is clearly a function of the need to reduce the externalities associated with the consumption of transport.

3. ASSIGNMENT OF FREIGHT TRAFFIC TO SEA PORTS

Having discussed the various issues associated with the generation and distribution of freight traffic and the use of different modes and combinations of modes, it is now appropriate to turn to the central context of this paper, namely, the assignment of this freight traffic to the different sea ports. Freight traffic does not, of course, arbitrarily assign itself to different sea ports -- such assignment is the function of route decisionmaking by the relevant actors in the transport chain. So how do such decisionmakers decide what sea ports and routes to choose? This question will now be explored in two stages: (i) in this chapter, some of the literature on route choice will be reviewed and (ii) in the next chapter, the results of empirical research in the Irish RoRo freight market will be reported upon with a view to drawing inferences for the wider issue of land routing of sea freight in general.

The literature² on the broad area of carrier selection and modal choice yields a multiplicity of generic decision factors. Wilson *et al.* (1986), for example, classified the factors which influence general mode choice decisions into the four groups shown below:

- Characteristics of the transport system (*shipping cost, transit time, loss or damage, ontime delivery*);
- Characteristics of the shipment (*frequency of shipment, size, value*);
- Characteristics of the carrier (*tracing capability, co-operation with shipper, geographic coverage, availability of pickup services*);
- Characteristics of the shipper (*experience, frequency of review of transport choice*).

Murphy and Hall (1995) reviewed a range of studies from the 1970s, 1980s and 1990s which evaluated modal or carrier selection decisionmaking in transport. The aggregate rankings across all of the studies of the relevant variables which determined choice are shown in Table 3. Murphy and Hall add that "new" variables are emerging from studies of transport choice in the 1990s -- such variables include "rate negotiation", "service negotiation", "carrier response in emergencies", "willingness to improve service quality" and "quality of dispatch personnel". They add, however, that more definitive conclusions will require further research. Hall and Wagner (1996) provided evidence to show that the key selection criteria for one mode or modal segment may not be applicable or critical for another mode or modal segment, hence it is important to attempt to distill the more critical factors for a

specific context. D’Este and Meyrick (1992) distinguished, in transport choice, quantitative factors (e.g. frequency, cost), which could potentially be measured and compared in an objective manner and qualitative factors (e.g. marketing, tradition, etc.), which were more subjective.

Table 3. **Variables affecting freight transportation choice**

	Rankings		
	1970s	1980s	1990s
Reliability	1	1	1
Freight rates	4.5	2	3.5
Transit time	2	3	5.5
Carrier considerations	6	5	2
Shipper market considerations	4.5	5	3.5
Over, short and damaged	3	5	5.5

Source: Murphy and Hall, 1995.

Given the range of pertinent choice factors, it is important when studying transport choice to capture the impact of all of these factors, including those qualitative factors which may be difficult to measure. An immediate concern arises as to the relative importance, in the context of the port/ship choice process, of factors related to ports and factors related to ships, and to ascertain which group of factors are dominant in route decisionmaking (i.e. given a choice between a number of different ship services, will factors related to origin and destination ports influence which ship service is chosen more so than factors concerning the ship services themselves). These issues are discussed next.

So do shippers choose the port first, or the ship service first, or both together? Slack (1985), who examined the criteria which shippers employ in selecting ports on the containerised traffic trade between the North-American Mid-West and Western Europe, found that decisionmakers are influenced more by price and service considerations of land and ocean carriers than by perceived differences in the ports of entry and exit. D’Este and Meyrick (1992) asked respondents in their study of the Australia -- Tasmania RoRo freight market which was chosen first -- port or ferry -- in choosing between different routes. Twenty per cent of their respondents selected the port before selecting the ferry, twenty per cent selected the ferry before selecting the port, and the remaining sixty per cent stated neither i.e. the port is one of a number of factors used in selecting the preferred route. It could be argued however that factors related to the port would be of greater importance on shorter routes (the crossing in the aforementioned D’Este and Meyrick study took 14 hours whereas for example crossings can be as short as 2 hours in the Irish market) -- on shorter routes time delays at the port would be relatively more significant than would be the case with longer journeys; similarly port costs would also be relatively more significant on shorter journeys where total costs are obviously less than those incurred on longer journeys. Finally, Fleming (1997) showed that competition in the maritime container trade to and from the US West Coast is among carriers, not among port authorities.

It is now appropriate to attempt to define exactly what are the pertinent port and ship related factors which influence overall route choice. Table 4 lists, in descending order of importance, factors considered important in port/shipping company choice which were identified in three studies which

looked at port/shipping company selection in the maritime context. At this juncture it is important to note that the importance of service factors cannot be underestimated. In a comparatively early paper Cook (1967) noted the importance of service factors, and not just cost factors, in transport selection. D'Este and Meyrick (1992) also observed this and cited a variety of previous studies (including Cook) where this was also the case.

Brooks (1995) has noted that ferry choice selection criteria are a moving target over time and vary significantly between segments of a market; she believes that ferry choice has shifted from a process involving a short timeframe with few decisionmakers to a process which is more complex and has a longer timeframe -- this effectively reflects the shift seen in many areas of business where interfirm relationships have moved from an adversarial or transaction basis to a more partnership or relationship-driven basis. In essence this calls then for the researcher to adopt a broad, holistic view of port/ship choice and to put it into its proper context of the firm operating in the dynamic, competitive business environment.

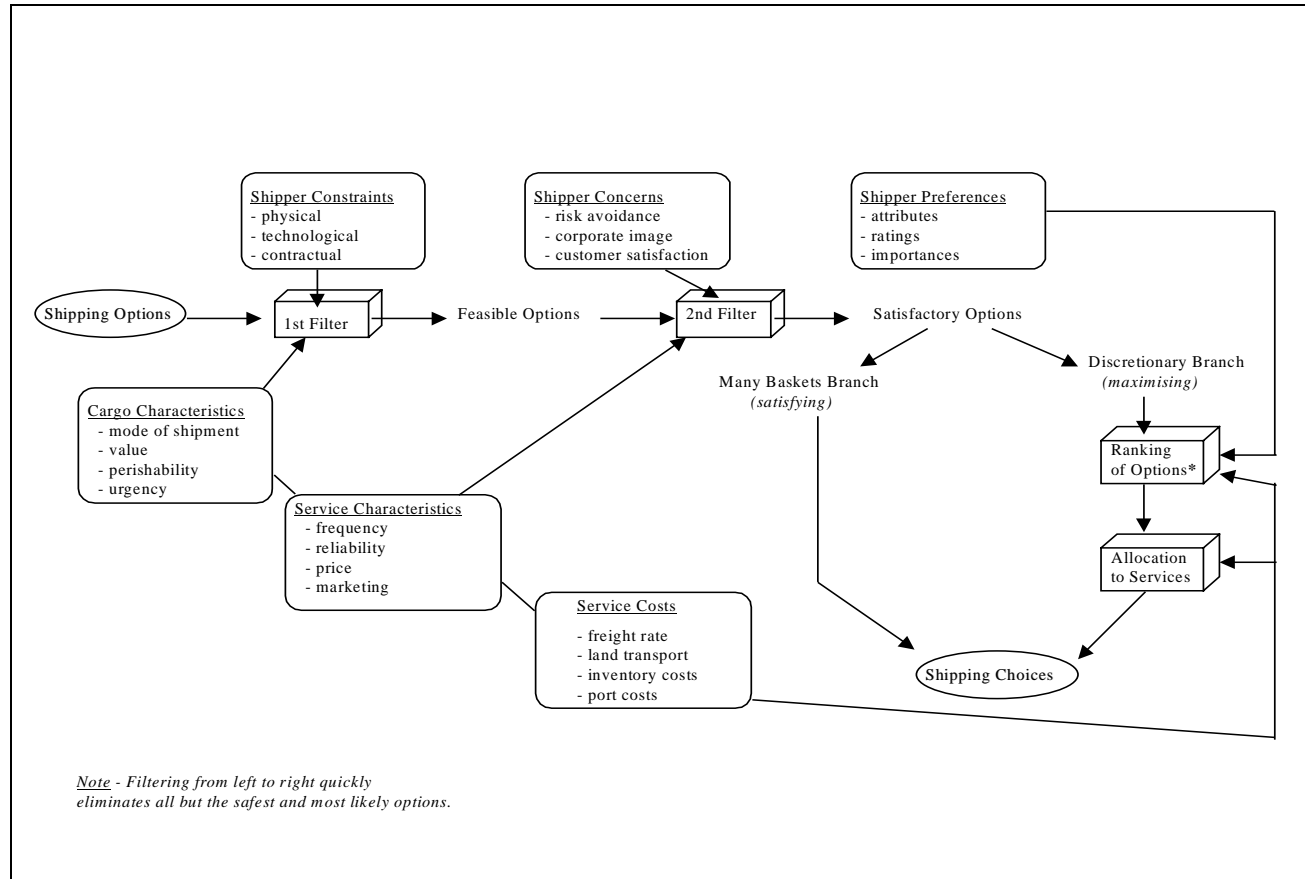
D'Este (1992) developed a conceptual model of RoRo ferry selection -- this is shown in Figure 4. In summary, satisfactory route options are decided based on a mix of issues, such as the characteristics and constraints of the shipment, service requirements and relevant cost factors; these satisfactory route options are then subsequently divided into two groups: (i) those options which are used some of the time and which are merely only satisfactory, but which serve to spread the shipper's risk by patronising a number of ferry companies; and (ii) those options which the shipper selects after a thorough comparison of all options and which afford the maximum possible satisfaction to the shipper.

Table 4. **Factors important in port/Shipping company choice**

Matear and Gray (1993) -- Irish Sea: all Maritime traffic types	Spencer <i>et al.</i> (1992) -- RoRo across the English Channel	D'Este & Meyrick (1992) -- RoRo between Australia and Tasmania: ferry factors	D'Este and Meyrick (1992) -- RoRo between Australia and Tasmania: port factors
Punctuality of ferry	Service frequency	Frequency	Proximity to origin
Space availability	Convenient schedules	Price	Port turnaround time
Service frequency	Delays, cancellations	Transit time	Record of strikes
Response to problems	On fastest route to dest	On-time	Loading facilities
Value for money rate	Space availability	Damage	Port marketing
Ferry arrival time	Fast check-in/disembark	Commitment	Port charges
Ferry departure time	Speed of customs	Problems	Tradition
Sea crossing time	On cheapest route to dest	Technology	
Low freight rate	Low tariffs	Extra space	
Carrier relationship	Port vehicle congestion	Door-to-door	
Proximity to freight dest	Pre-booking facilities	Flexible contracts	
Proximity to freight origin	Chance for driver break	Long contracts	
Special rates/discounts	Ferry drivers' facilities	Promotion	
Shipper preference	Congested roads to port		
	Standard of these roads		

Note: The factors are ranked in descending order of relative importance.

Figure 4. Conceptual model of the ferry choice process



Source: D'Este, 1992.

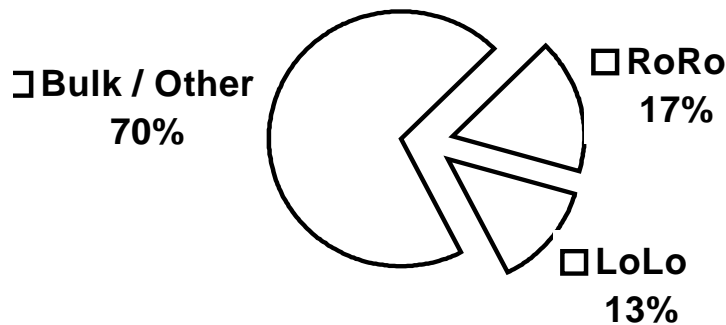
4. EMPIRICAL RESULTS FROM THE IRISH MARKET CONCERNING ASSIGNMENT OF FREIGHT TRAFFIC TO SEA PORTS

In this chapter, the results of empirical research in the Irish RoRo freight market are reported upon, with a view to drawing inferences for the wider issue of land routing of sea freight in general. Firstly, however, some background information is provided on the Irish market.

4.1. The Irish market

Figure 5 illustrates the different categories of goods handled at ports in the Republic of Ireland in 1996. The “Bulk/Other” category comprises bulk liquid, bulk solid, break bulk and all other goods. Unitised cargo is divided between Lift-On/Lift-Off, abbreviated as LoLo, and Roll-On/Roll-Off, abbreviated as RoRo. RoRo comprises only 17 per cent of all maritime freight handled at Republic of Ireland ports when measured in volume terms -- the RoRo share, if measured in value terms (unfortunately such data is unavailable), would however be much higher, as more valuable cargoes tend to go by RoRo as opposed to by the other maritime modes.

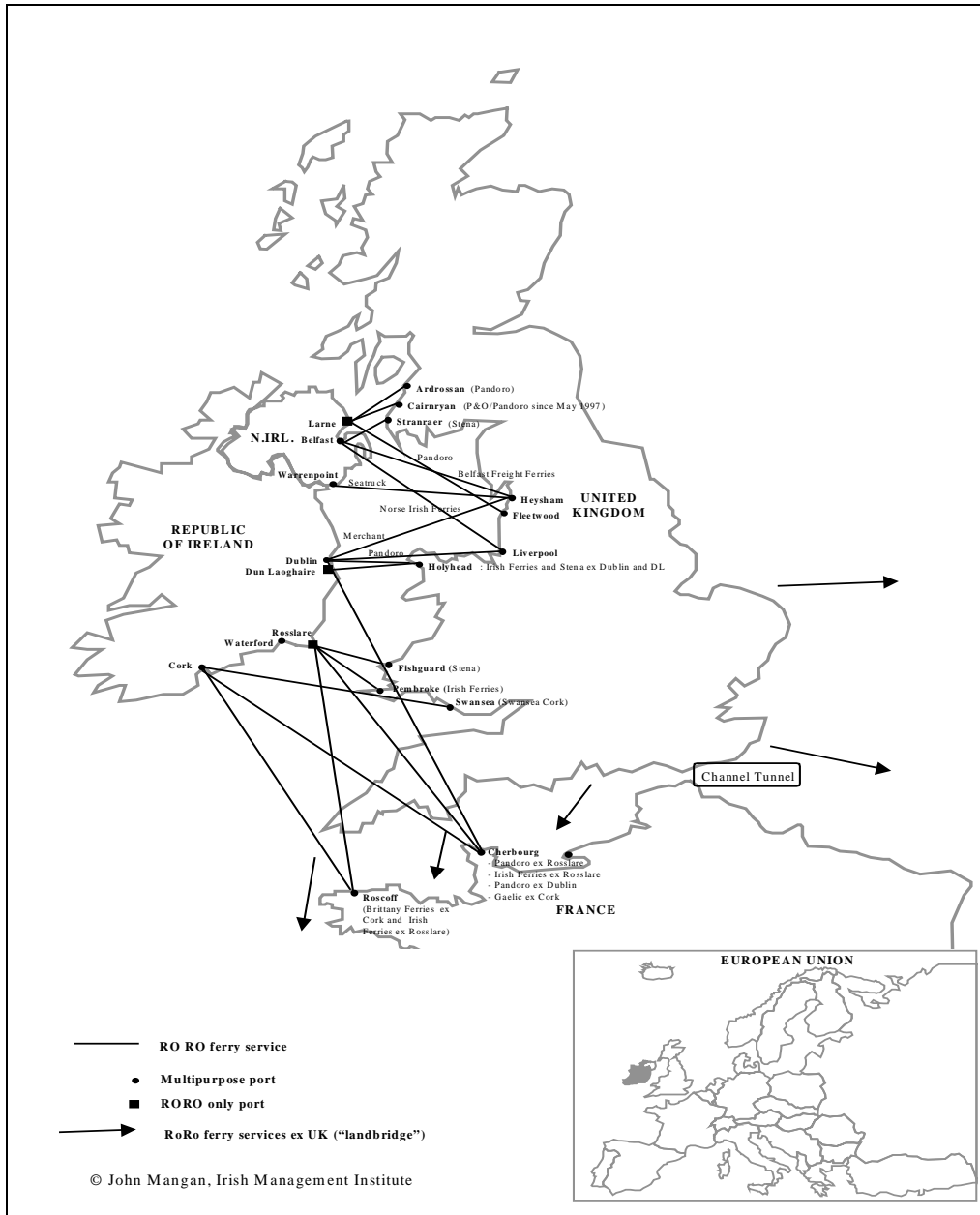
Figure 5. **Different categories of goods handled (volumes) at Republic of Ireland ports in 1996**



Source: Data from Irish Central Statistics Office, *Statistics of Port Traffic*, in 1996.

Figure 6 illustrates the various RoRo routes to and from both Northern Ireland and the Republic of Ireland. At present there are in the region of forty-five RoRo sailings capable of carrying freight from Irish ports every day. Table 5 and Figure 7 show the growth, and relative corridor shares, of RoRo traffic at Irish ports from 1990.

Figure 6. RoRo Routes to and from Ireland



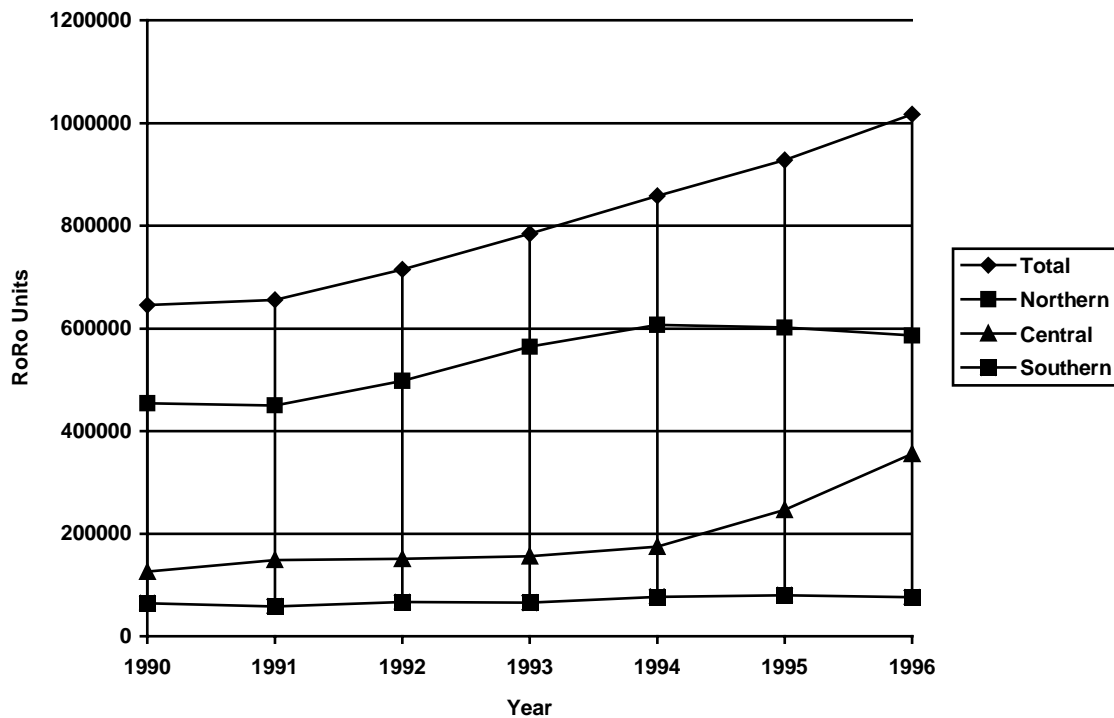
The Irish RoRo freight market has thus been growing at some 10 per cent per annum in recent years -- if this exponential rate of growth continues then the volume of units carried could double in a period of just seven years. Analysis of certain data provided by the Irish Central Statistics Office showed that the top four commodities (in value terms) carried by RoRo to and from Ireland are: office machinery and data processing equipment; electrical machinery, appliances, parts etc.; meat and meat preparations; and miscellaneous manufactured goods.

Table 5. **RoRo freight units (import and export) at Irish ports***

<i>Northern Corridor:</i>	1990	1991	1992	1993	1994	1995	1996
Belfast	79 226	89 564	138 217	131 160	149 657	167 037	282 604
Larne	332 566	319 521	312 333	364 076	376 678	375 077	280 099
Warrenpoint	42 423	40 849	47 486	68 422	80 290	59 573	22 757
<i>N. Corridor % total traffic</i>	<i>71.0%</i>	<i>68.6%</i>	<i>69.7%</i>	<i>71.8%</i>	<i>70.7%</i>	<i>64.9%</i>	<i>57.5%</i>
<i>Central Corridor:</i>	1990	1991	1992	1993	1994	1995	1996
Dublin	101 943	122 986	115 921	122 355	133 746	205 311	340 983
Dun Laoghaire	23 813	25 283	34 278	33 391	40 418	40 713	14 695
<i>Southern Corridor:</i>	1990	1991	1992	1993	1994	1995	1996
Rosslare	61 541	56 096	64 658	61 726	72 094	73 589	70 147
Cork	3 246	1 575	1 971	3 587	5 020	6 412	6 104
<i>Total Traffic:</i>	1990	1991	1992	1993	1994	1995	1996
	644 758	655 874	714 864	784 717	857 903	927 712	1 017 389

* Data from the Irish Central Statistics Office, *Statistics of Port Traffic*, published annually, and from *Trade at the Principal Ports*, published annually by the Department of Economic Development, Belfast.

Figure 7. **RoRo freight units (import and export) on the three corridors***



* Data from the Irish Central Statistics Office, *Statistics of Port Traffic*, published annually, and from *Trade at the Principal Ports*, published annually by the Department of Economic Development, Belfast.

A key feature of the Irish RoRo freight market, as illustrated by the data in Table 5 and in Figure 7, is the comparatively disproportionate (though recently decreasing) volume of traffic carried on the Northern Corridor. Assuming an origin/destination spread of RoRo freight traffic broadly in proportion to economic output in the Republic of Ireland *vis à vis* Northern Ireland, it is evident that a significant share of the Republic of Ireland traffic has been in the past, and to a lesser extent still is, availing of RoRo ferry services to and from Northern Ireland ports. The usually cited reason for this scenario is the higher frequency of cheaper sailings with shorter sailing times from the Northern Ireland ports. It needs to be stressed, of course, that there is nothing wrong with Republic of Ireland shippers using Northern Ireland ports -- they are merely making what they perceive to be the optimum choice in a free market. It does, however, raise the question of whether or not inefficiencies exist in the whole RoRo freight market as a result of shippers having to route their traffic through distant ports in order to avail of what they perceive to be the best ferry route choice.

It is also interesting to note that the RoRo trade is effectively “westbound led” into Ireland -- Central Statistics Office data shows that in 1996 some 3.3 million tonnes were imported by RoRo into Republic of Ireland ports, while 2.5 million tonnes were exported by RoRo out of Republic of Ireland ports.

4.2. The research effort

With regard to the actual empirical research effort, issues arising from both the literature (discussed in part in the preceding chapter) and from discussions with a variety of industry experts were given due regard during the development of a survey instrument. The literature review and discussions with industry experts also led to the proposition of the following broad research question which the survey instrument sought to explore (eighteen other more specific research questions which dealt with the decisionmaking process, decisionmakers and influences on decisionmaking, were also defined):

Ferry selection in the Irish RoRo freight trade is a complex process involving a multiplicity of factors and a variety of decisionmakers, and is dependent upon both the nature of the products being shipped and the dynamics of market demand for these products.

In total, six drafts of the survey instrument were developed between January and May 1997; these were pilot tested with a variety of respondents, including hauliers, manufacturers, a number of industry experts, statisticians (in order to ensure that the results obtained with the questionnaire would be subsequently analysable) and a number of academics. Concerning pertinent port/ship choice factors, Table 6 shows the listing of factors which were included in the final survey instrument.

Table 6. **Port/ferry factors included in the final survey instrument**

- Facilities onboard the ferry for drivers
- Proximity of ports to freight origin/freight destination
- Port and ferry chosen is on the fastest overall route to destination
- Preference of the consignor/consignee
- Space is available when needed on the ferry
- Intermodal/connecting transport links at ports
- Port/ferry chosen is on the cheapest overall route to destination
- Speed of getting to/through ports
- Ferry service suitable for unaccompanied traffic or special cargo
- Delays due to driving bans, tachograph/weight/security checks
- Opportunity for driver rest break
- Cost of ferry service/discounts
- Sailing frequency/convenient sailing times
- Availability of information on the different sailing options
- Risk of cancellation/delay

It was decided to restrict the survey effort to companies located in Ireland (both North and South) engaged in the import and/or export RoRo freight trades. Furthermore, it was decided to split the survey effort equally between hauliers (the term haulier is used here in its broadest sense and can be taken to include freight forwarders, integrated carriers etc. -- in other words, any third-party service provider who will carry RoRo freight) and manufacturers (while most manufacturers subcontract the carriage of RoRo freight to third parties, it was nevertheless felt that the views of such manufacturers on RoRo ferry selection would be of considerable relevance to the research effort).

A detailed exercise was undertaken in order to identify the whole population of potential respondents and then to select a representative sample of respondent companies for the survey effort (there is no single listing of all RoRo freight shippers in Ireland and it would have been unreasonable, and indeed invalid, to expect all ferry companies and hauliers to provide detailed listings of their customers; similarly, for practical purposes, it would obviously have been impossible to interview each member of the whole population of potential respondents).

Fifteen different sampling frames were used in an attempt to define the population of potential respondents. These sampling frames included listings provided by industry experts, listings obtained from company directories, companies identified from observation at individual ports, etc. It is important to note that many of these sampling frames were overlapping; none of them was, however, a definitive listing of all members of the entire population of potential respondents.

Statistical techniques were employed in order to obtain some indication as to the appropriate size of the required sample and subsamples, given the variability over the whole population of the parameters to be measured, the degree of precision required for each of the parameter estimates and the total population size. Firms were ultimately selected from the set of sampling frames based on a number of criteria including, *inter alia*, the total number of sampling frames they appeared in, ensuring that the different subgroups within the whole population were represented, ensuring a correct balance of the different commodity flows (identified above), etc. Expert judgement with regard to company selection was also very relevant -- a number of companies, for example, were added to the sample listing during the survey effort as a result of the expert advice of a number of respondents.

Once potential respondent companies were identified, an effort was made to select an individual within the target company who was the most appropriate candidate to answer the questions posed in the survey instrument.

The final sample of companies interviewed comprised twenty-nine hauliers (four of these were located in Northern Ireland, the remainder in the Republic of Ireland) and twenty-eight manufacturers and other users of RoRo freight services such as retailers, etc. (three of these were located in Northern Ireland). A total of fifty-seven interviews were thus completed -- it was intended to conduct a total of sixty interviews; however, it was not possible to arrange an interview with one selected company and the responses from two other companies were not of sufficient quality to merit their inclusion in the survey.

The responses from individual interviews, together with all of the responses aggregated together, were subjected to an in-depth analysis to yield the results which will be discussed later. During the survey it became apparent that many of the respondent hauliers were moving towards the provision of a total logistics service for their clients, as opposed to just providing haulage. In addition, there appeared to be a tendency among both manufacturers and hauliers that, once goods were available, they were speeded onto the next ferry to their destination, almost regardless of their relative urgency.

4.3. Modelling port/ship choice

D’Este (1992) categorised the various approaches to modelling ferry choice into three broad categories (this classification has been used by the author to generate the three listings of modelling approaches shown in Figure 8).

Figure 8. **Approaches to modelling ferry choice**

<p>Input-oriented modelling <i>e.g.</i> - importance means - factor analysis - Aaker and Day model</p> <p style="text-align: center;"><i>marketing application?</i></p>	<p>Outcome-oriented modelling <i>e.g.</i>- logit modelling - decision trees* - OR approaches* <i>e.g.</i> shortest path - Analytic Hier Process</p> <p><i>but</i> - mathematical optimum solution? - instead likely to have range of feasible solutions</p> <p style="text-align: center;"><i>policy application?</i> (*assume decision structure known in advance)</p>	<p>Process-oriented modelling <i>e.g.</i> - input-oriented modelling techniques - attitudinal questioning - scenario testing - gather operational and descriptive data - cognitive mapping - script theoretic modelling</p> <p style="text-align: center;"><i>user application? e.g. interactive DSS</i></p>
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Input-oriented models: these relate to the range and relative importance of the various factors that influence ferry choice, but they do not give an insight into the actual decisionmaking process.

Outcome-oriented models: these are concerned with developing mathematical formulations which attempt to predict the decision outcome (i.e. which ferry is chosen), at least in an aggregate sense.

Process-oriented models: these models attempt to explain how decisionmaking actually occurs (an example is D’Este’s model shown in Figure 4).

It was not possible to build a statistically reliable outcome-oriented model to predict RoRo ferry choice in the Irish market (a logit model was attempted). There were two reasons for this, namely, that (i) the sample was too small -- normally such models are only reliable if built using a very large number of survey responses; and (ii) there was very little evidence in the dataset which showed a linkage between characteristics of decisionmakers, their environments etc., and their actual choice of specific routes. The lack of an outcome-oriented model is in any event of no great loss to this research: D’Este (1992) suggested that such outcome-oriented models “*tended to be broad-brush and mechanistic in nature with their success judged by their predictive power rather than their explanatory ability.*” In truth, such “macro” models would have very little credibility with regard to this research. A “magic potion” which would automatically predict traffic distribution over different choice options would be totally unreliable -- the RoRo freight market is more complex than that! What is of course required, as D’Este suggests, is an in-depth explanation of actual decisionmaking. Much of the discussion, then, concerning the results of this research effort centres around input- and process-oriented modelling.

4.4. Input-oriented modelling: Finding out what is important in RoRo ferry choice

The three input-oriented modelling approaches listed in Figure 8 were used to analyse the relative importance scores which respondents assigned to the fifteen different port/ferry selection factors (Table 6). Two of the three input-oriented modelling approaches attempted are discussed next. *Factor Analysis* was also attempted but is not reported on here as it did not prove to be as insightful as the other two techniques.

The simplest of the three input-oriented modelling approaches is to calculate mean factor importance values. Table 7 illustrates the hierarchy of mean importance across the whole sample (in the survey instrument, scores ranged from 5, very important, to 1, not at all important) of fourteen of the fifteen different choice factors measured in the survey effort (in Table 7 it is under the second column titled “Mean importance”; one factor, “Preference of the consignor/consignee”, is not shown in this table as it is not relevant to the other data, which will be discussed later, in the table -- in any event, it was ranked fourteenth least important). Space availability on ferries, followed by sailing frequency and convenient sailing times, followed by risk of cancellation/delay, were the three most important factors. Cost only came sixth (this could of course be attributed to the fact that price differences between the ferry companies are minimal). Other less obvious issues which proved important included delays due to driving bans, tachograph checks, etc. (many respondents felt that Irish hauliers were discriminated against by English and Welsh police forces), security of units onboard ferries, ferry company customer service (especially the attitude of ferry company staff to drivers), etc.

A comparison between the hierarchy of mean factor importance obtained in this study (Table 7) with hierarchies obtained in comparable studies (Table 4) raises some interesting issues. Across all of the studies, service issues dominate over cost issues (though to a lesser extent in D’Este’s study). The Irish market, viewed from the perspective of both this study and Matear and Gray’s study, is characterised by a heavy emphasis on space availability. Sailing frequency was viewed as a very important issue across all of the studies.

The survey data was disaggregated to see if there were any differences in relative factor importance among different respondent types. Hauliers and manufacturers differed in relative factor importance; notable differences between both groups were: space availability was deemed especially important by hauliers; hauliers also viewed the suitability of the ferry for special or unaccompanied cargo as more important; manufacturers viewed availability of information on the different sailing options as more important; hauliers viewed the opportunity for driver rest-break as more important. There were other minor differences between different respondent types -- for shippers of accompanied RoRo, sailing frequency and convenient sailing times were especially important; for small shippers, space availability was especially important; for shippers to the North of England, speed of getting to/through ports was regarded as especially important.

Table 7. Mean importance ratings and identifying determinants of choice
(The Aaker and Day model)

<i>Factor</i>	<i>Mean Importance</i>	<i>Performance 1</i>	<i>Performance 2</i>	<i>Different?</i>	<i>Salient?</i>
<i>1. Space available when needed on ferry</i>	4.578	4.4	3.9	Y1	S1
<i>2. Sailing freq./convenient sailing times</i>	4.408	4.1	3.9	N	
<i>3. Risk of cancellation/delay</i>	4.340	3.9	3.7	N	
<i>4. Port and ferry on fastest overall route</i>	4.160	3.9	3.6	N	
<i>5. Proximity of ports to origin/destination</i>	4.083	4.2	3.9	Y2	S3
<i>6. Cost of ferry service/discounts</i>	4.000	3.9	3.4	Y1	S1
<i>7. Speed of getting to/through ports</i>	3.959	3.7	3.8	N	
<i>8. Port/ferry on cheapest overall route</i>	3.776	3.7	3.5	N	
<i>9. Ferry suitable for unacc. or special cargo</i>	3.558	3.8	3.9	N	
<i>10. Delays due to driving bans, tacho., etc.</i>	3.543	3.6	3.4	N	
<i>11. Availability of info on sailing options</i>	3.314	3.8	4.0	N	
<i>12. Facilities for drivers</i>	3.250	4.2	3.7	Y1	S2
<i>13. Opportunity for driver rest-break</i>	3.118	4.0	3.4	Y2	S3
<i>14. Intermodal/connecting transport links</i>	2.093	3.3	3.0	N	

Y1 indicates significantly different at the 95 per cent confidence level, Y2 significantly different at the 90 per cent confidence level, N no significant difference. Salient factors (i.e. determinants of choice) have been identified as follows: S1 indicates highly salient factors -- those with importance above 4 and significant performance differences at the 95 per cent confidence level; S2 indicates less salient factors -- those with importance above 3 and significant performance differences at the 95 per cent confidence level; S3 indicates less salient factors again -- those with importance above 3 and significant performance differences at the 90 per cent confidence level.

Very few respondents regarded any factor as “not negotiable” (i.e. the particular port/ferry option would not be chosen if this factor were lacking in any way) -- the most common “not negotiable” factor was “space availability on ferries” which was regarded as not negotiable by twelve respondents (which obviously ties in with its number one mean importance ranking).

The input-oriented modelling approach with the most validity, and particularly in the context of this research, is the *Aaker and Day Model* (see, for example, Brooks, 1995). Brooks distinguishes between factors which are judged to be *important* in port/ferry choice and factors which are actually *determinants* of port/ferry choice -- she calls such *determinants* of port/ferry choice “salient factors”. Many factors then may be judged to be important by a large proportion of decisionmakers but may not actually have a major impact on the purchase decision.

In the *Aaker and Day Model*, the salient factors are identified by :

- (i) asking respondents if they regard the factor as being important or not, *and*
- (ii) seeing if two choice options perform differently on this factor.

In this survey then, factor importance was measured by asking respondents to rate the importance of the fifteen aforementioned port/ferry choice factors (Table 6); statistically significant differences in factor performance were then determined by asking respondents to rate the performance of fourteen of the same fifteen factors (the factor “preference of the consignor/consignee” was eliminated from this part of the analysis) for both their chosen port/ferry option for a hypothetical shipment and for a second choice port/ferry option for the same hypothetical shipment. The analysis (the data is shown in Table 7) revealed the following hierarchy of salient factors:

- Space availability on ferries;
- Cost of ferry service/discounts;
- Facilities for drivers;
- Proximity of ports to origin/destination;
- Opportunity for driver rest break.

Therefore these factors, above others, are the *key determinants* of port/ferry choice in the Irish RoRo freight market.

4.5. Process-oriented modelling: Exploring how port/ferry choices are made

In the survey, a variety of questions were asked in order to generate a greater understanding of both the mechanics of actual decisionmaking and to generate an understanding of the context within which decisionmaking occurs.

The nature of the relationships and agreements between manufacturers and the hauliers transporting their RoRo freight, and between hauliers and the ferry companies on whose vessels the RoRo freight was carried, was explored. The survey indicated that some 64 per cent of all manufacturers’ RoRo traffic is covered by agreements with hauliers which last for periods longer than six months, with the remaining traffic covered by agreements which last for a shorter length of time.

The exact contractual nature of such agreements, however, varied significantly across all respondents -- some respondents had no written contracts in place between manufacturers and hauliers while others had very formal agreements in place.

A similar picture emerged concerning agreements between hauliers and the ferry companies. The survey indicated that some 62 per cent of all hauliers' RoRo traffic is covered by agreements with ferry companies which last for periods longer than six months, with the remaining traffic covered by agreements which last for a shorter length of time. Again the exact contractual nature of such agreements varied significantly across all respondents -- some respondents had no written contracts in place between hauliers and ferry companies while others had very formal agreements in place. In essence then, there appears to be a tendency towards long-term agreements between all of the parties engaged in the RoRo freight trade; the contractual relationship between all of the parties, however, appears vague. Nevertheless, most respondents agreed that the relationships between all of the parties were mutually beneficial and that a high level of trust exists between all of the parties who interact with each other.

“Vertical integration” (where firms seek to extend their competitive scope by controlling, or at least positioning themselves, in more stages of the industry's value chain) was frequently evident across the RoRo freight market -- examples include :

- Large hauliers, as well as providing standard logistics services such as groupage and cross-docking, are also providing various value-added services to manufacturers, including, for example, “vendor hubbing” where they hold high-value inventory items under customs bond, acting as “turnkey suppliers” and engaging in light manufacturing, e.g. producing discs and packaging for PC manufacturers, providing “pick and pack” services, whereby individual stock items from various different product lines are stored by the haulier on behalf of manufacturers and are retrieved, packaged and delivered to individual customers, etc.;
- Many of the larger hauliers also extend their product offering through strategies such as painting their vehicles in customer's colours, placing customer service staff on manufacturers' premises (“implants”), etc.

In decisionmaking concerning port/ferry choice, the overall origin-destination route, followed by the ferry service, followed by the port, was the relative order of perceived importance among respondents, with both the port and ferry service being chosen together, not separately, as the most common scenario. A total of 78 per cent of respondents stated that they generally did not explore all possible port/ferry route options when deciding on routings for RoRo freight, but instead only considered the most appropriate port or just stuck with the port/ferry options which they generally used. Furthermore, 42 per cent of respondents said they only revise their route choices once a year, 24 per cent said they would revise them every few months and the remaining respondents said they would revise their choices more frequently. Cost and service deficiencies were cited as the principal factors which would lead them to revise their route choices.

Respondents were asked to choose a port/ferry routing for a hypothetical shipment in the survey effort. Once they had chosen a port/ferry routing, they stuck fairly rigidly to their original choice regardless of changes in the nature of the shipment -- in some instances, changes in shipment perishability and whether a shipment was accompanied or unaccompanied did sometimes lead

respondents to revise their original choices. Changes in shipment frequency, value or whether the traffic was guaranteed for a short *versus* a long period, did not appear to alter the original choice, except in a very small number of instances.

Overall then, it can be concluded from the preceding analysis that decisionmakers are generally satisfied with certain options and seldom actually engage in objective assessment of available choices. Respondents were also asked to indicate both their short-term and long-term objectives in the context of port/ferry choice. Their short-term objectives centred on service performance issues while their long-term objectives centred (rather obviously) on profitability.

Respondents varied in the number of port/ferry combinations they used for their largest/most frequent shipment from one to four, with two combinations (49 per cent of respondents) being the most common scenario. A total of 20 per cent of respondents, however, used the same ferry company on more than one route for this largest/most frequent shipment, thus splitting the traffic over different routes, but using the same ferry company. Fluctuating availability of traffic from manufacturers, risk and a desire for market stability were the three main reasons cited for using more than one port/ferry option for the largest/most frequent shipment. In some instances, the location of the hauliers depot dictated which port/ferry options they used.

Manufacturer respondents varied fairly evenly in the number of hauliers which they used for the carriage of their RoRo freight traffic from one haulier (25 per cent) to four hauliers (17 per cent). Some Irish-based multinational manufacturers were tied by global agreements between their head office and one carrier.

In the survey, an attempt was made to explore the role of various communications technologies in port/ferry choice. Among the surveyed companies, use of technology increased with firm size -- some of the smaller hauliers did not even have office PCs. Apart from this, however, use of the various technologies did not appear to visibly impact upon port/ferry choice. What was, however, apparent was that tacit information³ -- as opposed to information sourced through marketing or electronic channels -- played a central role in ferry choice. Drivers were usually the essential conduit of this information. Decisionmakers appeared to be fully aware of all service offerings and their performance and appeared to have extensive market knowledge.

The bulk of decisionmaking concerning choice of port and ferry service appears to be made by hauliers/forwarders -- in the survey, respondents allocated an average weighting of 84 per cent to hauliers, based on their relative role versus manufacturers in decisionmaking. Manufacturers thus appeared content to delegate port/ferry choice to hauliers as part of the service which they expected them to provide. There are often media reports of manufacturers supporting transport infrastructure investments in their region (especially port and airport infrastructure) -- the evidence from this study is that many manufacturers have little knowledge concerning the routing of their freight, and this would thus appear to question their role in favouring infrastructure investment in certain regions.

Very little difference in approaches to decisionmaking existed between different respondent types in the survey. The difference was minimal between importers and exporters. There were some differences in decisionmaking with regard to RoRo traffic to continental Europe -- these generally centred on varying preferences among respondents between the landbridge over the UK option versus the direct sailing option; in many instances, the preference was related to the relative enforcement of weight and tachograph regulations in different locations.

Overall, the impact of vehicle drivers on decisionmaking concerning port/ferry choice cannot be underestimated -- the constraints imposed by the regulations which govern their work (driving hours, unit weight limits, etc.), combined with their impressions of customer service onboard ferries, seem to be given significant weight during the ferry selection process.

Finally, among respondents, the main calls for new/improved RoRo freight services from Ireland centred on more high-speed ferries, more direct sailings to continental Europe and more later/midnight sailings.

5. CONCLUSION

This paper attempted to illustrate the important and changing role of the sea port in the transport chain. The many factors relevant to the generation and assignment of freight traffic to sea ports were next reviewed. The main body of the paper presented empirical results from a study of RoRo freight traffic in the Irish market and the assignment of such traffic to sea ports.

The latter study suggested that space availability on ferries, followed by sailing frequency and convenient sailing times, followed by risk of cancellation/delay, were perceived by respondents to be the three most important factors in choice of port and RoRo ferry service. It was also shown, however, that the factors which actually *determine* the choice of a port and RoRo ferry service by decisionmakers (revealed through the *Aaker and Day Model*) were, in descending order, space availability on ferries, cost of ferry service/discounts, facilities for drivers, proximity of ports to freight origin/destination and opportunity for driver rest-break.

Many of the third-party service providers in the study were providing enhanced value-added services for their manufacturer customers in addition to the basic carriage of RoRo freight. In keeping with the contemporary trend in the evolution of business relationships from an adversarial, multisource model to a partnership model defined by buyers having single or few sources of supply, many of the parties engaged in the Irish RoRo freight trade had long-term agreements with a select, very small number of suppliers (i.e. manufacturers were using a small number of key hauliers, hauliers in turn are using a small number of key ferry services). Also, in keeping with this trend and as a result of economies of scale in the long-term bulk purchase of space on ferry services, shippers tended to route individual shipments, regardless in many instances of shipment characteristics (i.e. origin, destination, value, etc.), on their selected core ferry services. Instances where hauliers used more than one ferry company were usually in an effort to reduce risk and ensure market stability.

Overall in the study, the role of the port as distinct from the ferry service, in the context of selecting routings for RoRo freight, appeared to be minimal. Also, many decisionmakers were not engaging in routine objective assessment of all available port/ferry options and generally stuck with chosen port/ferry options for extended periods of time. Drivers (in the context of both their perceptions of ferry service offerings and the regulations which govern their work) appeared to be of

critical importance in port/ferry choice and, furthermore, they were most often the essential conduits of the tacit knowledge which defines how the RoRo freight market functions. Finally, the bulk of decisionmaking was undertaken by hauliers on behalf of manufacturers.

The implications then of these empirical results need to be considered in the context of the wider European maritime freight markets.

NOTES

1. *Maritime Policy and Management*, an international journal of shipping and port research, contains a number of interesting contributions on port reform throughout the world -- see, for example:
 - (a) Ircha, M. (1997), Reforming Canadian Ports, *Maritime Policy and Management*, 24 (2), pp. 123-144;
 - (b) Misztal, K. and J. Zurek (1997), The privatization of Polish ports -- the present situation and outlook for the future, *Maritime Policy and Management*, 24 (3), 291-297;
 - (c) Saundry, R. and P. Turnbull (1997), Private profit, public loss: the financial and economic performance of UK ports, *Maritime Policy and Management*, 24 (4); and
 - (d) Mangan, J. (1998), Strategies for developing port administration in Ireland, forthcoming in *Maritime Policy and Management*.
2. The literature on modal choice and carrier selection is quite extensive -- see, for example, Hall, P. and W. Wagner (1996), Tank truck carrier selection by bulk chemical shippers: an empirical study, *Logistics and Transportation Review*, 32 (2), 231-244, for a summary of transportation choice research since the 1970s.
3. One definition of tacit information is that it is the informal occupational lore generated by workers grappling with everyday problems and passed on in informal settings. In the RoRo freight trade then, such tacit knowledge might, for example, encompass issues such as the propensity of certain ferry companies not to sail in certain weather conditions, or routes to be avoided when carrying loads over the legal limit -- such knowledge is typically built up over a period of experience and passed on verbally by workers on both an intra- and intercompany basis.

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NETHERLANDS

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OPTIMISATION OF LAND ACCESS TO SEA PORTS: BEYOND INFRASTRUCTURE

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Rotterdam, March 1998

1. INTRODUCTION

In the past, sea ports were transshipment points and storage centres for commodities. Their markets were spatially concentrated and their hinterlands were structured along natural transport corridors such as rivers and mountain passes. Their focus is now shifting towards the hinterland. Port competition in Europe is not being fought out on the quayside anymore, but on the transport routes to the hinterland.

This paper seeks to answer the question of whether physical infrastructure is sufficient to optimise inland accessibility, or whether the knowledge available in a port community can play a role in improving a port's access to its hinterland. It seeks to make a contribution to the subject of port development and infrastructure from the standpoint of the rise of the knowledge-based economy (OECD, 1996).

As Fleming and Hayuth (1994) point out, a port handles two kinds of traffic flow: one is generated by a port's central position in relation to a regional hinterland, the other is generated by its *en route* or intermediate location. The two kinds of traffic represent two different spatial scales on which a port's inland accessibility can be plotted. The first type of flow relates to the port's immediate hinterland while the second relates to regions farther away. In this paper, we concentrate on the latter spatial perspective.

After some theoretical considerations on inland accessibility, the paper reviews the present situation with regard to land access to European ports. Relevant fundamental changes are described, and the shortcomings of an approach that focuses solely on infrastructure are explained. The role of knowledge in optimising inland accessibility is then outlined, and illustrated by the examples of Hamburg and Rotterdam.

2. LAND ACCESS TO SEA PORTS: SOME THEORETICAL CONSIDERATIONS

Accessibility is not an unambiguous concept. Many different definitions of accessibility and many ways of measuring it can be found in the literature (Pirie, 1979; Martellato *et al.*, 1995). The basic concept of accessibility has two aspects. Firstly, any location offers opportunities to the actors who have chosen it. Secondly, in order to exploit those opportunities, it is necessary to bridge a distance. Both aspects, opportunity and the effort required to bridge a distance, are key ingredients of accessibility.

In economic theory, the costs/benefits of reaching a place are combined in a so-called potential function, as first developed by Steward (1947). A potential function expresses the attractiveness of a location in terms of its accessibility to the relevant location factors in its surroundings. This expression is called a location potential. A location potential is the sum of the supply of location characteristics in all places j around a given location i weighted by the generalised transport costs from i to j . In contrast with direct monetary costs, generalised transport costs also include the cost arising from the risks and time required to bridge a distance. Generalised transport costs are considered to rise exponentially: the further away a destination is, time- and risk-related costs will increase more than proportionally (Klaassen, 1987).

Drawing on the concept of location potential, we define the inland accessibility of a sea port i as the demand for transshipment in terms of imports to and exports from a set of places j in the hinterland of the port weighted by the generalised transport costs between i and j . On this definition, inland accessibility denotes the attractiveness of a sea port as a transshipment point for a shipper in a given area. In selecting a port, carriers and forwarders weigh the revenue to be made from providing a service to the customer against the generalised transport costs involved in reaching the customer through that port. The number of places reachable from the port and the number of shippers served by the port will be all the greater in that the generalised transport costs are lower, *ceteris paribus*. The balance between marginal revenue and costs determines the spatial boundary of the port's market reach, corresponding to its hinterland¹. As the revenue from and costs of supplying a product to a customer vary between goods, the inland accessibility of a port may differ from one logistic chain to another.

The inland accessibility of a port does not only differ between logistic chains, it is also dynamic. It can change due to fundamental developments in technology, economy and society, which have an impact on shippers' demand for transshipment as well as on generalised transport costs. For the port authority, the demand for transshipment to/from the hinterland is exogenous. Maritime transport to/from a given area depends on a range of political, economic and technological factors. To a large extent, generalised transport costs are exogenous for the port as well. This holds especially for natural factors such as mountains and rivers that determine the effort required to bring a good to the hinterland. However, the port authority can influence the level of generalised transport costs in some ways. For example, by lobbying successfully for new infrastructure or by promoting new transport services, it can improve access to the region. Generalised transport costs can thus be considered a means for ports to improve inland access and to enlarge their hinterland.

Transport links between ports and the hinterland consist of transport infrastructure and services. Transport systems can generate both economies and diseconomies of scale. A marginal increase in volume can result in lower per unit costs in the case of underutilisation and in higher per unit costs in the case of overutilisation. Historically, port operation has shown economies of scale, especially in recent decades, when costly transshipment facilities for unitised cargoes have been built in anticipation of growing demand and increasing scale in the shipping industry. Ports with high transshipment volumes have gained scale advantages over ports with lower transshipment volumes. Not for nothing has the credo of port managers been: "volume attracts volume". Economies of scale in terms of transshipment volume result in lower generalised transport costs, for instance, in the form of lower tariffs and more frequent services.

The economies of scale generated in transshipment can be translated into improved land access to the port. With a higher volume and thus lower generalised unit transport costs, a port can penetrate more efficiently and more deeply into the hinterland. This mechanism may be compared to throwing

a stone into the water: a large stone will cause ripples farther away than a small one. Intermodal transport systems seem especially suited to transforming scale advantages during transshipment into better land access in terms of efficiency and spatial reach (Van Klink and Van den Berg, 1998). This is because intermodal transport requires relatively high volumes and long distances to be commercially viable. By investing in intermodal transport, ports can gain a competitive edge over other ports and improve their “hinterland potential”. Efficient intermodal systems can result in easier access to locations that are further away from the port than to places that are nearby, so that the former form part of the port’s hinterland while the latter do not. The corollary of this is that the port’s traditional market -- the area contiguous to it -- is being replaced by hinterlands structured along transport corridors (Van Klink, 1995).

3. LAND ACCESS TO EUROPEAN SEA PORTS

Land access to European ports varies according to transport modes, generalised transport costs and spatial scope. In other words, for the same effort (in terms of journey times or monetary costs), a different range of destinations can be reached from two or more sea ports. The differences in accessibility can be illustrated by the modal split of inland transport from the ports of Antwerp, Rotterdam and Hamburg (see Table 1). The table shows the modal split for all cargoes; if only containers are taken into consideration, the share of road transport is much higher -- 65 per cent in the case of Rotterdam and Antwerp.

Table 1. **Modal split of inland transport** ⁽¹⁾

	Road	Rail	Inland waterway
Antwerp	39	28	33
Rotterdam	28	5	67
Hamburg	44	40	16

- (1) All cargoes, inbound and outbound, excluding sea-sea transport and pipelines.
- (2) Pipeline transport is not included since -- given the huge volume of pipeline traffic via Rotterdam -- it would distort the picture.
- (3) 1995.

Source: Nationale Havenraad, 1996.

Good inland accessibility has become a matter of strategic importance for sea ports. Without efficient land access, they are unable to serve new markets and run the risk of losing existing markets. The pressures are coming from various -- interrelated -- directions:

- The first is the growth of transshipment, resulting in congestion in the ports themselves and on routes to the hinterland. When container cargoes are broken up into thousands of units in a port, transport links to inland markets inevitably come under pressure;
- Secondly, shippers and carriers increasingly rate ports on their accessibility -- for example, the frequency of inland transport services and transit times -- as well as on traditional factors such as transshipment costs. This is the consequence of the integration of logistic chains and the growth of door-to-door transport services;
- A third factor is society's demand for more environmentally friendly transport. Inland transport is causing a lot of environmental problems. This is especially true of port regions due to the concentration of traffic;
- Finally, European integration and the collapse of the Iron Curtain have increased the need for efficient access to the European hinterland. To benefit from the opening up of new markets, ports need to improve their access to areas outside their traditional hinterland.

The strategic emphasis on inland accessibility has been translated into numerous projects in the European port industry. *Grosso modo*, the projects can be grouped into three categories:

- Projects to increase infrastructure capacity or to create capacity for alternative transport modes;
- Projects providing new transport services to existing or new destinations;
- Projects to reorganise the transport system and to promote flexibility and efficiency.

These projects have two spatial scales -- the port region itself and the corridors to the hinterland. Many projects aim to improve links to the immediate hinterland in order to reduce congestion and pollution in the port region. Infrastructure improvements and reorganisation of the transport system are dominant at this spatial level. Information technology plays a central role in the reorganisation of transport systems. In some cases, a transport planning centre is set up to optimise transport flows and to prevent unladen hauls. Projects to improve the corridors from a port to its hinterland aim to achieve a modal shift and/or to win new customers. At this spatial level, infrastructure projects may be accompanied by the introduction of new transport services.

National governments and sea ports in Europe seem to put the most emphasis -- in terms of investments -- on new or improved connections to the hinterland (Nationale Havenraad, 1996). The Betuwelijn and IJzeren Rijn are two well-known examples of infrastructure projects designed to improve the quantity and quality of access to the hinterland from Rotterdam and Antwerp, respectively (Grey, 1995). In the case of Hamburg, inland waterway access to central Europe is being improved by the extension of the Mittelland Canal, and the railway line between Hamburg and Berlin is being electrified (Cass, 1997). In the case of Bremen, the rail connection towards Berlin is being reopened. The rail connection between the port of Le Havre and Strasbourg is being upgraded because at present rail traffic has to go through (congested) Paris. In addition to building new infrastructure to improve transport links to the hinterland, several ports are expanding their port infrastructure. Antwerp is giving consideration to the construction of a second railway line in order to open up the port to its hinterland. In Genoa, the Voltri port is being connected by a new railway line to the national rail network, while in Hamburg the rail infrastructure in the port area is being modernised.

The most important trend in new transport services is the introduction of rail and barge shuttle services. These services are meant to improve land access to ports in terms of reliability and transit times. In the past decade, numerous intermodal initiatives have been implemented and intermodal

services now operate from north-west European sea ports. Direct rail services from Mediterranean ports to inland destinations also started recently. For instance, shuttle trains from Genoa to Munich and Basel were introduced in 1997. Shuttle services are jointly operated by public and private partners. The participation of public parties is warranted on strategic grounds and by the high initial costs of implementing such transport concepts. Private actors range from traditional rail operators to intermodal carriers and shipping lines. In some ports, even freight forwarding companies have started intermodal services.

Efforts to improve the efficiency and quality of the inland transport systems of European sea ports are increasingly shaped by EU policies. The infrastructure component of transport systems is influenced by the strategy for Trans-European Networks (TENs). The TENs are considered to be the arteries of the European internal market. The main goal of the TENs is to connect national networks to one another, to improve the interoperability of networks and to enhance economic cohesion. Remarkably, only a few ports are directly involved in TEN priority projects (Rotterdam: Betuweline; Antwerp: Ijzeren Rijn and Hamburg: Berlin railway). One EU policy that is relevant to the service component of the transport system is the introduction of so-called freeways. The freeway concept is based on the idea of providing a one-stop shop for rail carriers on transport corridors. In 1998, three freeways came into operation: Rotterdam–Gioia Tauro, Rotterdam–Vienna and Hamburg–Brindisi. With its growing involvement in the planning and operation of the European transport system, the European Union is able to influence land access to ports and thus their competitive position. Because it can influence their competitive position, the common transport policy is a sensitive issue in the European port industry.

The above overview of projects shows that ports are focusing on physical infrastructure and transport services to optimise their inland accessibility and to improve their market reach. The belief in scale economies is thus still very much alive. However, it may be asked whether such a belief will still be appropriate in the future, given several fundamental changes taking place in the environment in which ports operate.

4. FUNDAMENTAL CHANGES IN THE ENVIRONMENT IN WHICH SEA PORTS OPERATE

4.1. From natural resources to knowledge as the basis of wealth

Society is becoming increasingly knowledge-based. Competitive advantage is no longer derived from the production of tangible goods but from the collection and use of information for the design, production and distribution of goods and services. The skills needed to transform information into knowledge require continuous education and training. The information society is therefore a learning society (EC, 1996; OECD, 1996). The availability of information, readiness to learn and the ability to collect, transform and apply information have become the new sources of value. Enterprises and locations without sufficient interaction with these sources will fall behind in the global race. New branding opportunities will emerge from third parties that neither produce nor deliver a primary product (Evans and Wurster, 1997).

4.2. ICTs: from planning aids to management tools

Information and communication technologies (ICTs) have become strategic weapons in the transport industry. They are no longer simply aids to transport planners but are playing an increasingly crucial role in decisionmaking: they tell the planner what to do or can even dispense with human intervention. In the last few years, software for route planning has improved the efficiency of transport, for example, by reducing unladen journeys. Virtual transport booking offices have been set up. The Internet is emerging as a communication tool that is supplanting long-standing initiatives to introduce EDI in ports. ICTs add to the transparency of transport markets and enhance the fluidity of traffic patterns: if parameters change, the computer simply re-routes the transport chain. Clearly, these developments are making sea ports more dependent on carriers and shippers.

4.3. From nations to regions

Thanks to information technology and liberalisation, borders between countries are becoming increasingly blurred. New spatial-economic entities, based on interaction between networks of economic activity, are emerging. As a result of the decentralisation of powers from national governments, these economic regions or “region-states” (Ohmae, 1995) are also going to play a political and administrative role. Regions with long-established historical identities, such as Catalonia and Scotland, are profiting from this trend but regional-type entities are also starting to take shape in areas such as the Maastricht-Aachen-Liege triangle and the area between Barcelona and Toulouse. Thanks to their networks of economic activity and their freedom to make policy, these regions can carve out their own identities. To cater for differences in economic performance and tastes between regions, international shippers are having to adopt a more dedicated marketing and supply strategy.

4.4. From production to assembly

As the time it takes to get a product to market becomes more and more important and consumers become more and more demanding, lean production and distribution systems are required to respond flexibly to rapidly changing markets. Production lead times in low-cost countries overseas have become too long in various production chains. Computers, clothing and other time-critical products are increasingly brought to market in accordance with the concept of postponed manufacturing. Products are assembled from components and customised close to the final customer in regional markets. Regional assembly operations are designed to respond to changing demands as quickly as possible: if the geographical pattern of demand shifts, operations can be relocated and transport routes changed. The transition from global production to regional assembly results in complex logistical operations and sets international shippers high demands in terms of reliability and flexibility.

4.5. From in-house to third-party logistics

In line with the need for lean production and distribution systems, the trend towards outsourcing of logistics services continues. In the past, when logistics were performed in-house, shippers used to rely mostly or even exclusively on one port. In contrast, third-party logistic service providers use several ports. They select ports which have optimal transit time/cost combinations in order to optimise the door-to-door flow of goods and related logistics operations. This may mean that

containers of the same shipper are shipped through different ports. In some cases, the outsourcing of logistics tasks may lead shippers to view transport and the role of sea ports in the transport chain in the same way as they view a telephone call: nobody is interested in which exchanges are used to route a call. In this view, ports without a strong base of industrial and logistical activities remain anonymous transshipment points.

4.6. Central Europe: from East to West

Immediately after the fall of the Iron Curtain, consumers in central Europe turned to western products. More recently, companies have shifted their sourcing to the West. After a phase of decline, central Europe – in particular Poland and Hungary – now seems to have entered a phase of expansion. Besides investing to take advantage of the growth of consumer markets, western companies are also using the region as a low-cost production site for western markets. The inflow of consumer products and semi-finished products has increased dramatically. In some cases, the attractiveness of the region as a production site has resulted in flows of cargo to the area from overseas, for example, when a Korean car manufacturer locates a transplant in Poland. For West European ports, serving the maritime transport needs of central Europe is a strategic challenge.

4.7. Quality of life: from environmentalist rallying-cry to key location factor

Since the report by the Club of Rome in the 1970s, environmental protection has been on the political agenda. The idea has recently taken hold that there is not just a moral obligation to society to preserve the quality of the environment, but that a high-quality environment can also make a location more attractive to citizens and companies. For, given the growing prosperity in western countries, quality of life has become a factor in the choice of where people want to live. As knowledge-based service companies are not constrained by traditional location factors, they can give consideration to the aspects that their employees appreciate. Consequently, quality of life is becoming a key location factor for more and more companies. To improve the quality of life they have to offer, regions and cities are seeking to reduce pollution from industry and traffic and to improve their cultural and recreational facilities.

4.8. From unrestricted to selective mobility

The growth of road traffic has caused environmental problems and affected the accessibility of economic centres. Further traffic growth will no longer be tolerated by society. Long-distance road haulage and traffic within urbanised areas are being curtailed and business travel is being given priority over private travel. Switzerland, Austria and France have already taken measures to restrict truck traffic at weekends. Trans-Alpine traffic has been seriously hit by these measures. But measures to curb road traffic entail a restriction on the freedom of travel of citizens and enterprises. Consequently, they will seek alternative modes and routes or, if no alternatives are available, will travel less. The development of selective mobility in general and the policy of restricting long-distance road haulage has dramatic consequences for ports, since the role of the truck in inland transport has grown since the introduction of the container.

4.9. Rail transport: from national bureaucracies to international competition

Rail transport in Europe is controlled by national railway companies. This has led to inefficient and inflexible rail operations and impeded the growth of rail transport. Steps have been taken in only a few countries to transform the bureaucratic railway undertakings into companies operating on commercial lines. Another impediment to intra-European rail transport is the fact that the railways are organised on national lines. The liberalisation of rail transport must remove both of these barriers. Third parties are getting permission to run trains themselves. Freeways are being developed to offer shippers easy rail access and an integrated transport product on corridors through several countries. As a consequence of these policy initiatives, new rail transport providers are springing up to exploit the new opportunities.

5. THE IMPACT OF INFRASTRUCTURE SHORTCOMINGS ON EFFORTS TO OPTIMISE LAND ACCESS TO PORTS

The far-reaching changes currently taking place would seem to indicate that sea ports will develop in new directions. It is increasingly difficult for ports to predict and plan ahead for changes in their environment as new patterns of traffic flows start to emerge, new transport operators and suppliers of logistical services enter the market and new demands are placed on efficiency and reliability. In short, these changes make it difficult to answer questions such as "Who are the port's customers?", "What logistic services do customers need?", "What is the origin/destination of shipments?" and "Which port will customers choose?"

One effect of this change in growth dynamics will be the emergence of so-called "transit time competition", i.e. ports will no longer compete (solely) in terms of transshipment efficiency and tariffs, but also in terms of the speed and reliability of shipments to destinations on the continent. Transit-time competition will require ports to focus on transport links and the development of "relational hinterlands". In such a context, the competitive position of a port will be governed not only by the demand for services in its traditional hinterland, but also by developments in areas outside its immediate market. One example of the latter is the introduction of a block train service between Rotterdam and Barcelona, which makes it possible time-critical products from Asia, destined for North-West Europe, to be transhipped in Barcelona and transported over the final leg of the transport chain by rail.

Another effect of these far-reaching developments is that ports will no longer be chosen with reference to vessels but in terms of individual containers. Increases in transport volumes and fiercer competition has led to the emergence of a number of consortia in the shipping industry. To tighten control over their operations, several shipping lines have decided to operate their own inland transport services. Despite the popularity of the gateway concept (only a very few mega-ports will tranship intercontinental cargoes), it is expected that all major ports in Europe will continue to be served directly by these consortia. Given that expectation and in view of the current stance of shipping lines to inland operations, the question now facing ports is no longer whether they will get the vessel but whether they will get the container, in that, while a container vessel might call at both Rotterdam and Hamburg, a container being shipped to the Czech Republic will be unloaded in the port which offers the best onward shipment option for that particular container.

This increased complexity means that ports can no longer be certain of maintaining their share of the growing volume of transport operations. Moreover, the fundamental changes currently taking place challenge the assumption that land access to ports can be improved by focusing solely on the economies of scale that can be achieved through improvements to physical infrastructure alone. There are three reasons for which an approach based solely on physical means of bridging distances will fall short of its objectives:

- Firstly, in a rapidly evolving and complex world, physical infrastructure simply cannot keep pace with changing patterns of transport and demand for logistic services as well as the volatility of transport flows, given the long lead times for planning, construction and amortizing infrastructure projects. Roads and railways do not fit into a “lean and mean” world;
- Secondly, transport infrastructure on major routes in Europe is being upgraded to meet certain basic standards, partly as a result of current investment in trans-European networks. Consequently, ports will enjoy the same quality of land access (Rietveld, 1997) and infrastructure will not be the sole factor in hinterland competition between ports;
- Thirdly, as argued earlier, transport infrastructure can generate both economies and diseconomies of scale. Efforts by sea ports to achieve ever-greater economies of scale may well be negated by growing congestion and social resistance. Moreover, more infrastructure to optimise inland accessibility will make ports even more dependent on the shipping lines and encourage them to seek even greater economies of scale which, as stated above, will ultimately prove fruitless.

Adequate infrastructure to provide access to the hinterland is a necessary, but not a sufficient, condition for a port to be able to compete for a strong and sustainable position in the future. To optimise land access on the basis of market dynamics, port authorities must look beyond infrastructure and assign a higher priority to the intangible aspects of accessibility. These intangible aspects will play an increasingly important part in determining the choice of port by transport operators, given the complexity and the dynamics of the market. The role of intangible needs in transport behaviour is consistent with the concept of generalised transport costs that include the psychological characteristics of the transport need, such as the strategic interests of the shipper, his familiarity and experience with transport systems, his attitude towards risk-taking and his cultural background. The deployment of knowledge is a prerequisite for responding to changing market circumstances and giving a content to the intangible aspects of accessibility.

6. KNOWLEDGE CAPACITY AS A NEW ELEMENT IN LAND ACCESS TO PORTS

Port cities, like all urban conglomerations, traditionally served as knowledge centres (Knight, 1995). This role has been largely overlooked due to the pressure on ports to accommodate rising volumes of transshipments. Know-how now plays an increasingly important role in the transport and logistics sectors, as a result of the growing complexity of logistical and transport operations. Given the growth in market demand for knowledge, sea ports should view the expertise of their port community as a strategic asset. The presence of many actors in the port community and the

information available on transport flows through the port mean that the port has a variety of knowledge resources at its disposal, ranging from familiarity with customs procedures and transport modes to know-how regarding product demand and the political situation in inland regions.

The knowledge base of the port can be deployed to reduce generalised transport costs and improve land access to ports. For instance, port actors can profit from the knowledge they have available to:

- Develop technologies to extend conservation times for perishable goods to allow use of other modes of transport;
- Develop techniques for increasing the density of cargoes in order to reduce transport volumes;
- Promote new (combinations of) transport modes and routes;
- Transmit methodologies for infrastructure construction and operation to neighbouring regions;
- Develop new logistical techniques for delivery and distribution;
- Suggest new techniques for freight distribution and collection in specific markets and regions;
- Suggest new ways of combining shipments in order to reduce traffic and the number of unladen hauls;
- Generate and disseminate insights into market developments in inland regions;
- Assist shippers with customs procedures.

By focusing on their core business, many industries have become unfamiliar with external logistical procedures and techniques, particularly the smaller shippers who cannot keep pace with market dynamics and logistic innovations. With its knowledge base, the port can fill this gap and act as a logistics facilitator for shippers. To be able to advise shippers, ports must focus on shippers and their needs. They must also combine the expertise of different actors such as freight forwarders, intermodal operators and customs authorities. Meeting customers' needs should be the primary goal of the advice given by ports. This may mean that tying in transport flows to the port -- which may be another objective of exploiting expertise -- may not be possible in all cases, implying that the ultimate advice to a shipper might be to choose another port.

Another way in which ports can exploit know-how in order to pursue their strategic goals is to participate in the development of a network of inland terminals within Europe. Developing and rationalising intermodal transport operations places great demands on the structure and operation of inland terminals. By investing in inland terminals and participating in their operation, a sea port can establish itself in inland regions. Inland terminals may be considered as "extended gates" for sea ports, through which transport flows can be better controlled and adjusted to match conditions in the port itself. In this way, inland terminals can help to improve land access to ports in both physical and psychological terms. If a terminal is integrated into a comprehensive logistics centre, including a business park for some of the subsidiaries of companies operating within the port, it can play an even greater role in reducing psychological distances, in that such a centre can facilitate business contacts and the transfer of knowledge.

Although the knowledge available in the port community is wide-ranging, expertise is often fragmented. Furthermore, because each actor in the port has his own particular commercial objectives, it is difficult to pool the collective knowledge of companies. Many ports seem to lack both the strategic willingness and the financial and organisational capability to offer expertise from the port

community as a single commercial product. In other words, the knowledge capacity of ports remains underdeveloped. Knowledge capacity can be defined as the capacity of actors to work together in order to create, attract, exchange and use knowledge.

To improve the knowledge capacity of ports, it is essential that individual actors learn to view their expertise as an asset. In addition, port authorities need to familiarise themselves with the local knowledge base and local relationships among actors should be strengthened. As innovations often come from outside, it is important to attract new actors in order to create a basis for a new strategic approach to the hinterland. Private banks appear to be one sector that is interested in becoming involved in port development both within the port itself and in the hinterland. Sea ports could establish “knowledge forwarders” to encourage actors to focus on know-how as a factor in competition. Such an organisation would bring parties together on a project basis to give advice to shippers and encourage investment in the hinterland. Given their neutrality *vis-à-vis* the local business community, the port authorities would seem to be the appropriate actor to operate as a knowledge forwarder. However, to be able to operate in an enterprising and flexible manner, port authorities will first have to obtain the right to operate outside their jurisdiction and in the private sector.

The following section discusses the role of know-how in optimising land access to ports with regard to transport flows from the ports of Hamburg and Rotterdam towards central Europe.

7. HAMBURG VERSUS ROTTERDAM

central Europe is the arena in which European ports will compete for market share and in which the need for a better focus on land access from ports is fast becoming clear (Baker, 1997). This region is considered to be on the threshold of strong economic growth which will generate additional maritime cargo flows. One factor in the growth of transport flows is the establishment of assembly plants in central European countries to serve the rapidly developing market in the region and to use the area as a low-cost production base from which to supply the European Union (Cook *et al.*, 1997). The Korean car manufacturer Daewoo, for example, has invested in plants in Poland and the Czech Republic, and has plans to assemble cars in Ukraine. Another example is the Japanese automobile manufacturer Suzuki, which has built an assembly plant in Hungary. These factories generate large volumes of inbound traffic, since a large proportion of the parts to be assembled are sourced overseas.

Several ports are seeking to improve their access to central Europe in order to benefit from the anticipated growth of maritime transport. In the Le Havre–Hamburg range, Rotterdam and Hamburg are both striving to establish themselves as the transshipment hub for central Europe. A study of the Dutch Central Planning Agency into access from the Netherlands and Germany to other European regions has shown that Rotterdam enjoys slightly better access to central Europe than the ports of Hamburg and Bremen (Brus, 1997). This study, whose results are summarised in Table 2, was based on the concept of “potential”. The potential for growth in transport from ports to inland regions was calculated by taking the added value of seventy regions in Europe as the standard for demand for transshipment services, while the travel time between the port and the respective regions was taken as the standard for generalised transport costs. Rotterdam scores better by virtue of its location on the Rhine estuary and its central location in western Europe, which offers advantages in terms of transport by both inland waterway and road.

Table 2. **Indices for access from ports to regions within Europe**

	Road	Inland waterway	Rail
Rotterdam	100	100	100
Hamburg	85	68	92
Bremen	83	67	92

100 = highest index.

The German ports of Hamburg and Bremen are indeed handicapped by their relatively peripheral location in Europe and the lack of natural linkages with the present economic heartland of western Europe. However, the North German ports of Bremen and, in particular, Hamburg have traditionally served as maritime transshipment points for the Czech Republic, Poland and Hungary. Even during the Communist era, the Port of Hamburg was used by East German and Czechoslovakian shippers and carriers; indeed, the state company CSPL owned a terminal in the port. One reason for this was the Treaty of Versailles, under which Czechoslovakia acquired the right to use the River Elbe and the Port of Hamburg for a period of 99 years (Nuhn, 1996). Another reason for the linkage between Hamburg and central Europe lies in the course of the River Elbe, which provides access to the Czech Republic and southern Poland. Lastly, mention should also be made of the strong position which German forwarding companies enjoy in the region and which is geared towards the use of national ports.

In view of the traditionally strong links between Hamburg and the countries of central and eastern Europe, the collapse of the Iron Curtain has opened up dramatic new opportunities for the Port of Hamburg. Actors from both the public and private sectors in Hamburg have responded enthusiastically to this challenge. New life has been breathed into long-established relationships. Infrastructure, particularly road and rail links to the new *Bundesländer*, has been modernised and extended. Between 1990 and 1996, transshipment operations in Hamburg grew by some 18 per cent, driven primarily by shipments to and from central Europe.

Besides geographical and historical factors, the introduction of block trains to destinations inland has been a major factor in the relative success of Hamburg as a centre for traffic flows to central Europe. Apart from the services operated by traditional rail operators, such as Intercontainer and Transfracht, freight forwarding companies have also acquired a share of certain shuttle services. In addition, Hamburg-based freight forwarders, such as HHLA, Buss and Eurokai, have invested in terminals in the hinterland, thereby creating their own port networks which they can use to control certain shipments between the port and regions inland. This strategy of acquiring stakes in inland terminals has enhanced the reputation of the port. Furthermore, through their presence in the hinterland, the port actors concerned have been able to gain experience of local markets and thereby gain know-how that can subsequently be used to advise others.

Another important factor that has contributed to the accessibility of Hamburg from inland regions in central Europe is the work of the Hafen Hamburg Verkaufsförderung und Werbung (HHVW). The HHVW operates as a marketing board by assisting clients both from overseas and from the hinterland. The HHVW has representative offices in, *inter alia*, Prague, Warsaw and Budapest. HHVW also provides an advisory service to (potential) customers. To answer specific questions, the HHVW can call upon the collective knowledge of various actors and thereby formulate joint solutions. In this way, HHVW has been able to harness the collective expertise of the Port of Hamburg and use it to

improve land access to the port, given that shippers from central Europe do not know how to operate in a private transport market and meet current logistical requirements while overseas shippers do not know how to operate in western and central Europe.

The Port of Rotterdam owes its current position to the excellent access it enjoys to the Ruhr by both inland waterway and road. Although Rotterdam is the largest port of Europe in terms of transshipment volumes, access to central Europe from the port leaves much to be desired. The port has a major share of trade in the Baltic region solely by virtue of its short sea shipping services, and this share is itself primarily accounted for by flows of Russian oil exports through Rotterdam. Because the port has no natural access to central Europe -- the Rhine, to which Rotterdam owes its present position, does not provide access to this region -- its role in the region remains limited.

Since 1989, the volume of freight transshipments relating to central Europe has grown slightly. The opening of the Rhine-Main-Danube Canal in 1992 resulted in the introduction of several inland shipping services to southern Germany, Austria and Hungary. The canal primarily seems to play a psychological role. Given the numerous locks on the canal, containers are frequently transported by rail along the route of the canal. The strongest growth to date has been in the Baltic trade.

As in the case of Hamburg, geography and history have been major factors in the present limited access that Rotterdam enjoys to central Europe, another factor being German railways' policy of promoting German ports rather than Dutch or Flemish ports. However, another reason for the limited access to central Europe lies in the Port of Rotterdam's inability to organise capacity in a way that would reduce the distance between central Europe and the port in physical and psychological terms.

Since 1989, the Port of Rotterdam has launched several initiatives to open up the central European market for shipments via the port. However, the port's attempts to attract freight shipments to or from the region appear to lack the necessary scale or level of entrepreneurship needed to ensure their commercial success. One example of this is the lack of regular rail services. The fact that there are so few of such services is a typical Catch 22 situation: because there are no cargoes it is not possible to operate rail services at an economically acceptable price; as a result, it is not possible to attract cargoes. The few block trains that do run between Rotterdam and the region have a low occupancy rate and continually run the risk of being halted at short notice. Another example of the lack of common initiative may be seen in the failure of the plan to acquire a stake in an inland terminal and distribution centre in the city of Győr (Hungary) and to use these facilities as a Dutch bridgehead to the central European market (Van Eck and Van der Honing, 1993). The share of the Rotterdam port – port authority, ECT and Eurotrafo – in the Czech terminal operator CSKD Intrans in August 1998 may bring a change in the relationship between the port and Central and Eastern Europe.

The Rotterdam Port Promotion Council (RPPC) represents the Rotterdam port community. Unlike the HHVW in Hamburg, the RPPC does not act as a knowledge broker. Its main task is to organise trips for Rotterdam businessmen and politicians to destinations in the hinterland and to act as host to foreign shippers. Besides the RPPC, the Rotterdam Port Authority is also involved in the marketing of port services. Over the past few years, the Port Authority has pursued an active marketing policy and has sought to attract shippers to Rotterdam by offering dedicated transport services. This policy proved successful in attracting the Chrysler company to Rotterdam and the Chrysler assembly plant in Austria is now served directly from overseas by a dedicated shuttle train from Rotterdam. In this particular case, under the auspices of the Port Authority, several companies in the port pooled their expertise to develop a dedicated solution for Chrysler's transport needs.

8. CONCLUSIONS

- Inland accessibility is now a major factor in the development strategies of sea ports and one which the growing volume of transshipment operations, the emphasis placed on the integration of logistic chains, increased environmental concerns in society and the enlargement of the European market have made increasingly important;
- In their effort to optimise land access to their services, sea ports are focusing on what has been called the “scale economies machine”, i.e. an approach which considers the provision of more physical infrastructure and transport services as the main basis on which to outperform other ports in the hinterland;
- However, the role played by infrastructure in improving land access to ports will ultimately be limited by a number of emerging trends. Firstly, infrastructure cannot keep pace with rapidly changing patterns of transport and demand for logistical services. Secondly, the comparative advantage of infrastructure will decline as the result of the upgrading of major transport infrastructure in Europe to basic standards. Thirdly, because of growing congestion and social resistance, the economies of scale afforded by infrastructure would appear to be finite;
- In the future, infrastructure will be a necessary but not sufficient condition for optimising a port’s market reach. Port authorities must look beyond infrastructure and assign a higher priority to the intangible aspects of accessibility. The deployment of knowledge will be a prerequisite in this respect;
- Ports should make use of their knowledge base of the port to gain access to markets. For example, a port can act as a logistics facilitator for shippers and thereby secure transport flows for the port. Knowledge can also be used to develop networks of inland terminals;
- In order to use knowledge to optimise land access to ports, the expertise of individual actors should be pooled on a project basis with a view to advising shippers on the services available and to securing investment in facilities in the hinterland. Ports should therefore develop their knowledge capacity;
- The case of Hamburg has shown that the Port of Hamburg has the organisational ability needed to exploit the knowledge it has at its disposal. The HHVW functions as a marketing board and as broker of the expertise available within the port community. In this respect, the Port of Hamburg has an advantage over the Port of Rotterdam in terms of the ability to penetrate the market in central Europe. Making use of knowledge to penetrate markets has been put on the agenda in Rotterdam, but as yet there is no organisational structure in place;
- The role which it is proposed that knowledge should play in optimising land access to ports does not mean that investment in physical infrastructure is no longer necessary, nor does it mean that the emphasis placed on achieving economies of scale should be abandoned. Brainpower should serve as a complement to infrastructure. The informed application of brainpower coupled with dialogue with shippers and inland regions may provide a basis on which to develop guidelines for the construction of new infrastructure and thus allow a balance to be struck between economies of scale and those of scope;

- Making use of knowledge to optimise land access to ports can help sea ports -- whose role hitherto had simply been that of a transshipment point -- transform themselves into service centres for logistical and transport services. New jobs created through the application of knowledge can also help to strengthen the economic basis of ports which had been adversely affected by the development of containerisation and automation;
- In this new role, ports are given an opportunity to organise their own hinterland. Weigend's (1958) definition of hinterland as an "*organised* and developed land which is connected with a port by means of transport lines" thus takes on added significance.

NOTES

1. A simpler way of defining a port's hinterland is to consider freight rates from the port to the interior only (Mayer, 1957; Kenyon, 1970). By this definition, places that can be served more cheaply by one port than by other ports, belong to that port's hinterland.

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OTHER CONTRIBUTIONS

During the Round Table Ronde, several participants submitted written contributions. These contributions are reproduced below as complementary information.

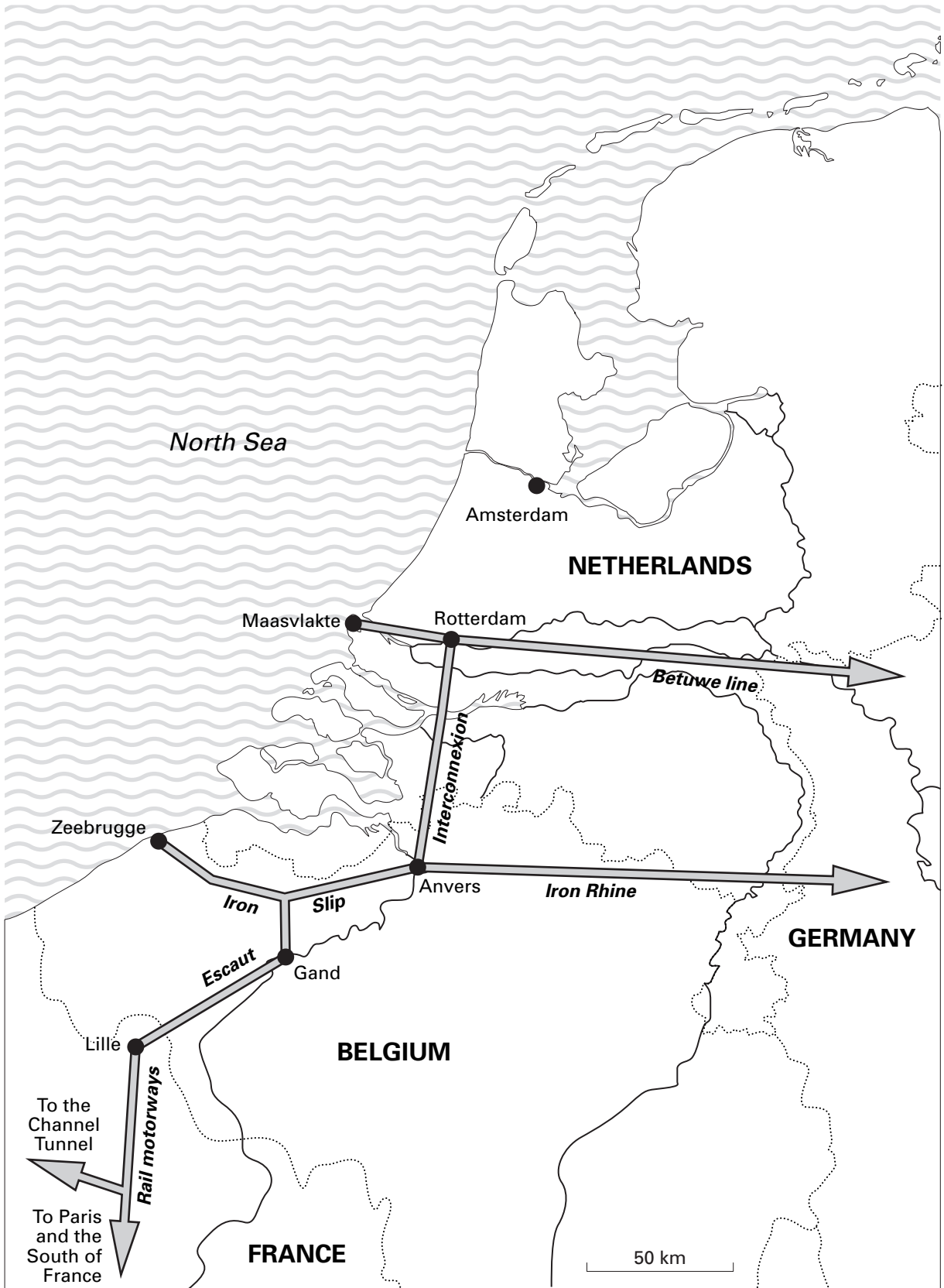
BELGIUM	J. Charlier	145
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BELGIUM

Jacques CHARLIER
Université Catholique de Louvain
Institut de Géographie

**PROPOSITION FOR AN INTERCONNECTION BETWEEN THE BETUWE LINE
AND THE IRON RHINE AND A LIAISON WITH FRANCE**

Cf. map below.



GREECE

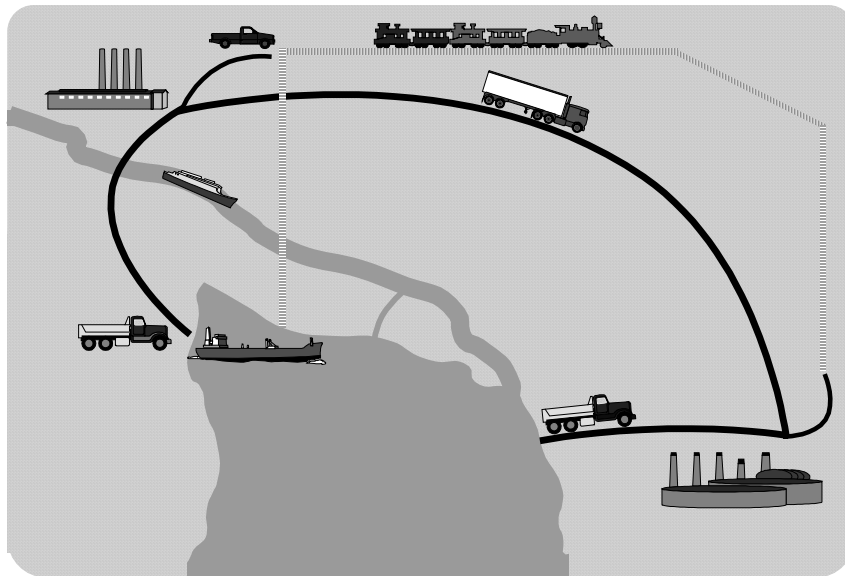
Vassilios PROFILLIDIS
Department of Transportation
Democritus Thrace University
Xanthi

THEORETICAL AND PRACTICAL ASPECTS
CONCERNING LAND ACCESS TO SEA PORTS

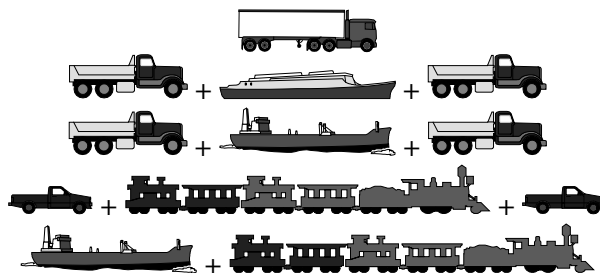
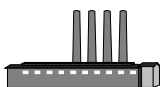
1. General form of freight demand

High rates of world trade (almost twice the rate of world GDP) require an efficient, reliable, competitive and economic system of freight transport.

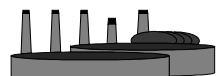
Figure 1



Point i



Point j



Freight Demand D_{ij} from point i to point j can generally be expressed as [1]:

$$D_{ij} = f\left(A_i, B_j, O_i, P_j, e^{-b \cdot C_{ij}}\right)$$

Where O_i : Production of product in point i
 P_j : Demand of product in point j
 C_{ij} : Generalised cost for freight transport
 A_i, B_j, b : Parameters

Generalised cost C_{ij} in freight transport is in turn expressed as [1]:

$$C_{ij} = f_{ij} + b_1 \cdot S_{ij} + b_2 \cdot \sigma S_{ij} + b_3 \cdot W_{ij} + b_4 \cdot P_{ij}$$

Where:

Directly influenced
by the transport
mode +

f_{ij} : Fare for freight transport from i to j ;
 S_{ij} : Total travel time from origin point i to destination point j
 (transshipment included);
 σS_{ij} : Variance of total travel time;
 W_{ij} : Waiting time from the moment demand has been manifested until
 the beginning of the transportation procedure;

P_{ij} : Probability of losses, alteration of products, robberies.

All parameters affecting the generalised cost of freight are directly influenced by both the transport mode and the transshipment.

2. A survey of problems and improvements in Greek freight forwarding

Freight forwarders are usually involved in the logistic chain of transport between the shipper and the transporter. An extended survey has been conducted on Greek freight forwarders and here are some of the findings [1]:

Reasons for preferring road transport

- Speed of shipment;
- Door to door transport;
- Simple procedures and flexibility;
- Accuracy of shipment;

- Low transport cost;
- Availability of vehicles.

Reasons for preferring rail transport

- Low cost;
- Non-availability of road vehicles;
- Availability of rail vehicles;
- Security.

Reasons for not preferring rail transport:

- High shipment times;
- Uncertainty of time of delivery of goods;
- Very bureaucratic procedures;
- High cost;
- Behaviour of personnel.

3. Internalisation of external costs

Whereas the policy of the European Union is for each transport mode to pay (to a certain extent) for its external costs, this still remains a far-from-attained target. Table 1 shows the quantification of external costs of various transport modes for the 15 countries of the European Union + Norway + Switzerland and Figure 2 the comparative external costs. Table 2 gives prices of external costs for road and rail transport in the case of Greece. It is clear that if a partial internalisation of external costs is adopted, then this will radically change the modal split.

**Table 1. External cost by different transport modes
(15 countries of EU + Norway + Switzerland) [2]**

Transport mode	External cost for 1991 (in billion ECU)	% of the specific transport mode in the total external cost
Road	250.1	92.2
Rail	4.6	1.7
Air	16.0	5.8
Inland navigation	0.7	0.3

Figure 2. **Comparative external cost of various transport modes** [2]

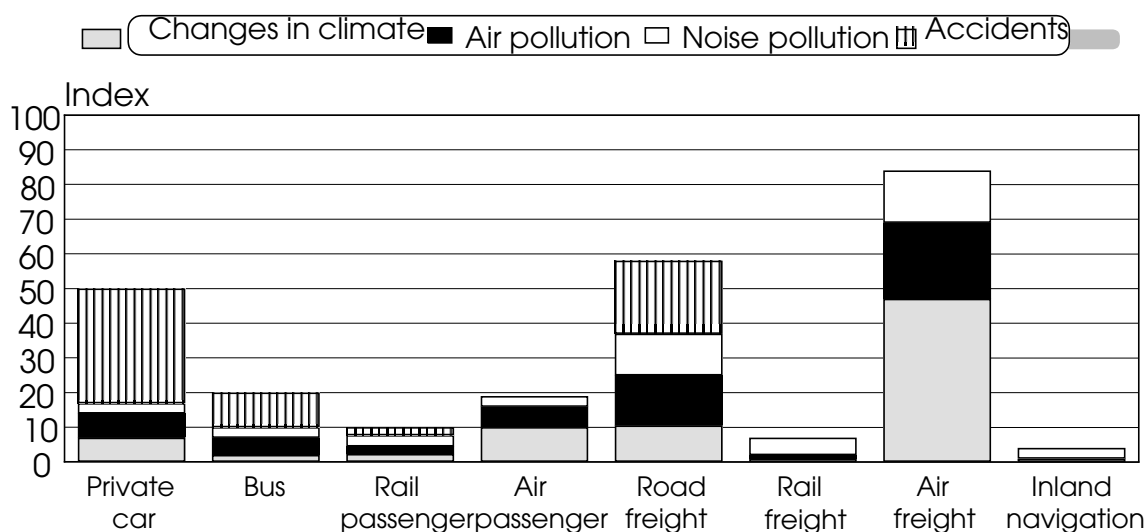


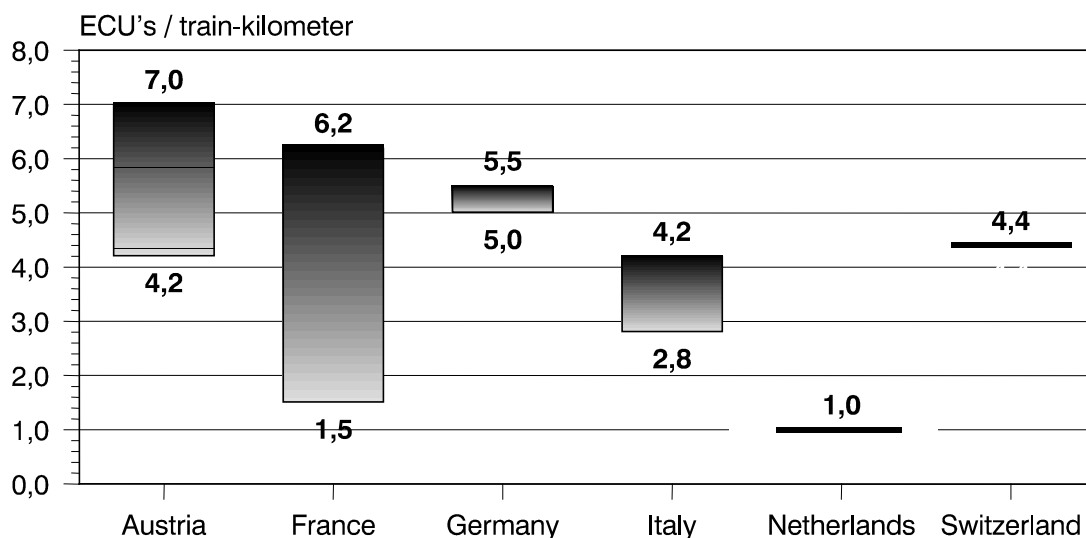
Table 2. **External costs for road and rail transport in Greece (ECU/100 passenger-km or tonne-km)** [3]

	<i>Road</i>		<i>Rail</i>	
	Passenger	Freight	Passenger	Freight
Pollution	1.16	1.65	0.24	0.15
Noise pollution	0.24	1.26	0.24	0.17
Accidents	1.74	0.31	0.29	0.10
Total	3.15	3.21	0.77	0.42

4. Rail freight corridors and differences in tariffs concerning the use of rail infrastructure

In order to put an end to the inertia of the rail sector and steer it to a more commercial approach, the European Commission decided, in 1991, on the separation of infrastructure and operation. All rail operators must pay some fees for the use of infrastructure. However, freedom in methods of tariffication has resulted in considerable differences in tariffs in Member countries, as shown in Figure 3 for the case of the North-South Rail Freight Freeway. For instance, the Netherlands have adopted very low tariffs in order to give comparative advantages to the port of Rotterdam. It is clear that a policy of land access to sea ports needs a global and stable frame of tariffication for both rail and road infrastructure.

Figure 3. Differences in tariffs for running the North-South Rail Freight Freeway [3]



5. Liberalisation and transport costs

Experiences with liberalisation of road transport show significant differences from one country to another depending on the characteristics of the market (Table 3). Whatever the case may be, liberalisation will lead to lower fares, which in turn will influence a reduction in transport costs. The share of the various components of combined transport is illustrated in Figure 4. In spite of continuous efforts, combined transport, in many cases, is not in a competitive situation compared to road transport. From Figure 4, it is clear that the rail component is very important to the total cost of combined transport.

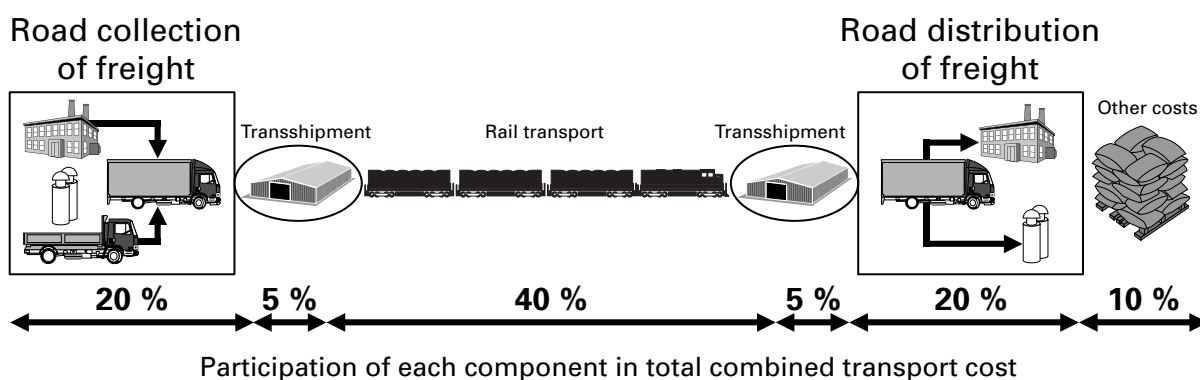
Table 3. **Impact of liberalisation of road freight transport**

Country Parameter studied	Great Britain	USA	Australia	France
Increase of efficiency of road freight transport	X	+	?	?
Reduction of share of rail freight transport	X	+	+	X
Tendency to oligopolistic situations	X	+	+	?
Less services in agricultural areas	X	X	X	X
Reduction of fares in road transport	X	+	X	?
Negative consequences on road safety	X	X	X	X

Country Parameter studied	Estimation of the likely impact of liberalisation of road freight transport within Europe
Increase of efficiency of road freight transport	+
Reduction of share of rail freight transport	+
Tendency to oligopolistic situations	+
Less services in agricultural areas	X
Reduction of fares in road transport	X
Negative consequences on road safety	X

Legend
+ : Significant impact of liberalisation
X : No significant impact of liberalisation
? : Vague impact - information insufficient

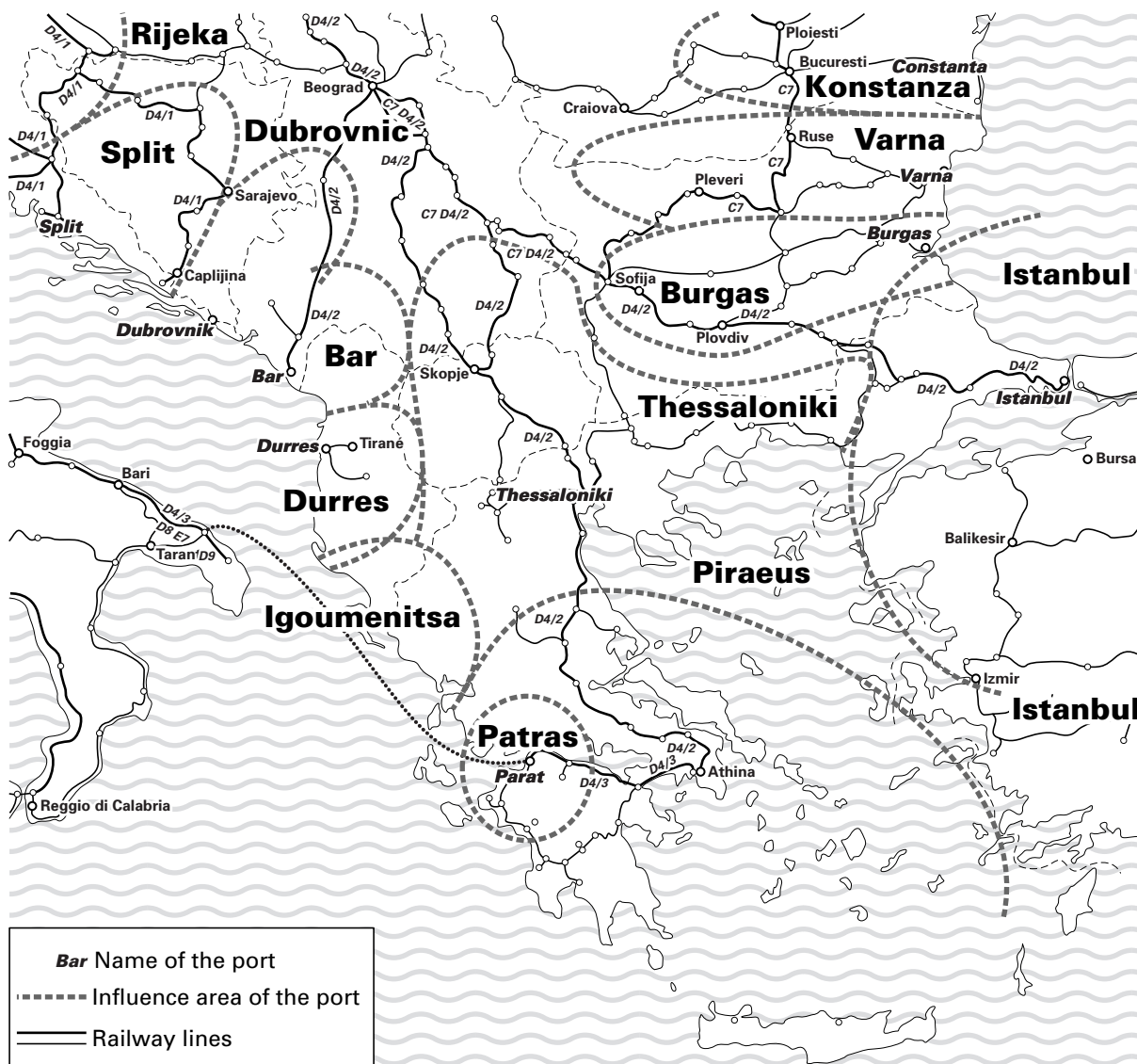
Figure 4. Cost components of combined transport



6. The situation in the Balkans

Since the liberalisation of the economies of the Balkan countries [5], the increasing role of ports has emerged. The ports of Istanbul and Thessaloniki (Figure 5) have rediscovered their traditional hinterlands. Durres in Albania, Igoumenitsa in Greece and Burgas in Bulgaria will also regain their hinterlands. However, the major problem for all these ports will be inadequate land access, in spite of efforts to upgrade European axes IV and IX both for road and railways.

Figure 5. Ports in the Balkan Peninsula and their influence areas



7. The evolution of container traffic in the ports of Piraeus and Thessaloniki

Container traffic in the two largest ports of Greece, Piraeus and Thessaloniki, (Figures 6 and 7) has been critically influenced by the conflicting situation and embargo in the former Yugoslavia. In spite of all this, container traffic continued to increase and prospects after the normalisation of the political situation in the Balkans are more encouraging.

Figure 6. Evolution of container traffic in the port of Piraeus [1]

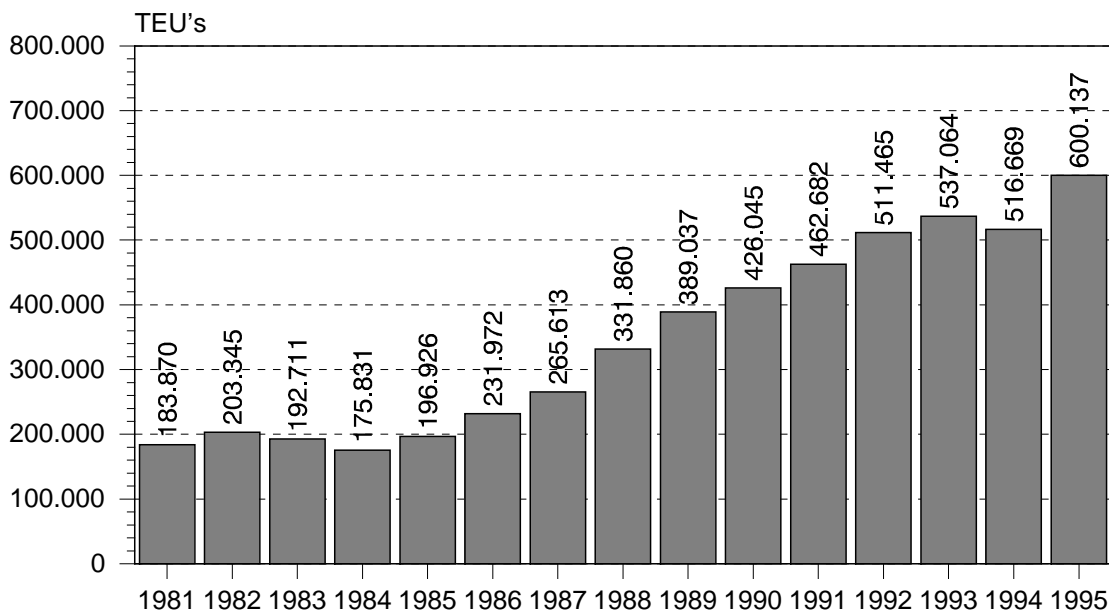
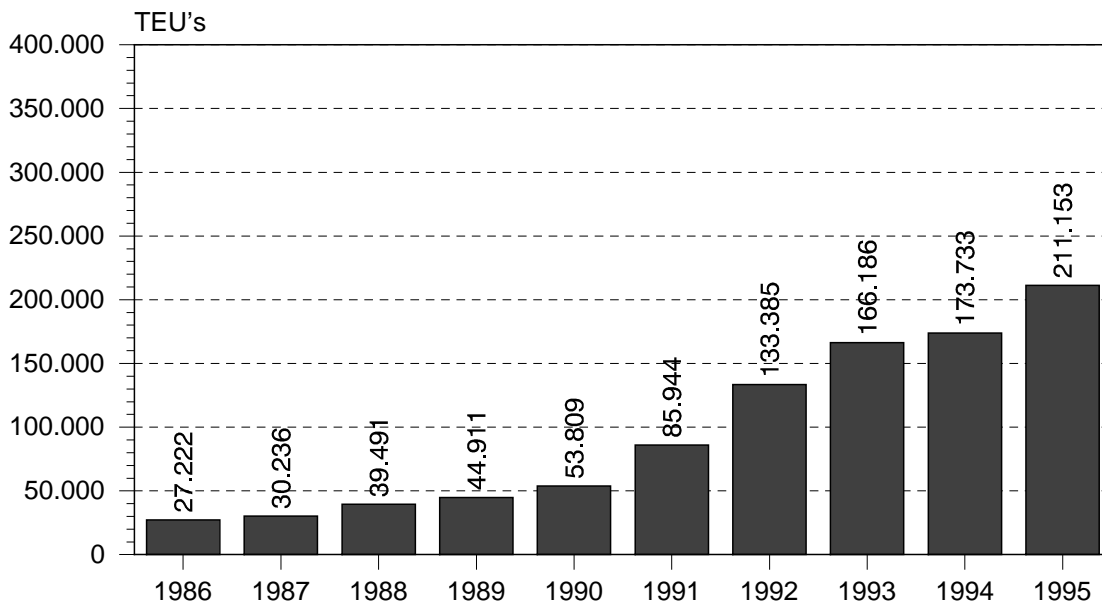


Figure 7. Evolution of container traffic in the port of Thessaloniki [1].



8. Concluding remarks

Land infrastructure (road, rail, inland navigation) to sea ports is not a purpose *per se* but aims toward an efficient transport procedure from an origin location to a destination area, which requires speed, low costs, efficiency and reliability. Liberalisation procedures place all transport modes (principally the railways) before new challenges: they must realise that they cannot operate differently from other competing modes and must adopt a more entrepreneurial approach towards their clients. However, liberalisation cannot automatically lead to the desired organisation of the market. A global policy and vision from international authorities are also necessary. Due to their past heritage, some European ports (Eastern Europe, Balkans) have insufficient land access to sea ports. New infrastructure, new policies, new organisation: these will all need not only money and human effort but also time to be realised.

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JAPAN

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DISECONOMY OF LAND ACCESS TO SEA PORTS: THE JAPANESE EXPERIENCE

**CONTRIBUTION OF TERMINAL AUTOMATION TO
INLAND ACCESS TIME AND COST**

Abstract

A tremendous number of trucks, which deliver marine containers between ports and shippers, are waiting for hours in queues at the terminal gates of major Japanese ports. This paper examines how terminal automation can compensate for the losses from queuing caused by the conventional terminal, which results in delays in the distribution between ports and shippers. First, the queuing of trucks in the Port of Tokyo is observed as an example for the analysis of this paper. Then the losses incurred by queuing per terminal are estimated by observation together with the running cost of a truck loading a marine container. Second, we assume an ideal, automatic terminal that causes no queue outside the terminal. Then the estimation of queuing losses caused by the present, conventional terminal in the Port of Tokyo is compared with the cost of introducing an automatic terminal into the port. The comparison shows how long it takes to achieve the compensation. Since the smoother inland access to ports without queuing also contributes to significantly minimise shipper's lead-time, this paper also calculates the estimated inland access time to the Port of Tokyo, assuming there was no queue at the terminal.

1. Introduction

The total cost of international container transport is roughly divided into three parts: the operational cost of ocean-going vessels, the terminal cost and the inland transportation cost. The discussion on how to benefit from shipping business should, of course, be aimed towards minimising the total cost. However, we cannot achieve the minimisation by improving either the shipping line's operation or the offshore terminal operation unless the inland transportation segment is taken into account. In the case of Japanese container ports, road networks were constructed around the port areas by the Government in the early days of containerisation. Unfortunately, they were not arranged for the ports' activities but rather for the neighbouring large cities based on their city planning.

Naturally, most roads outside the terminals in Japan have often been blocked by general traffic emerging from the cities. It is obvious that the consequences become more severe for the shipping business when container trucks join the traffic on the roads. The traffic capacity of the roads is quickly saturated in the morning, and then huge queues of trucks originating from container terminal gates appear in the port areas and last until the evening.

2. Problem of Inland Access to Ports

This is actually occurring at Japanese ports every day although the foreign counterparts who are involved in the shipping business in Japan pay little attention to the fact. Figure 1 shows, for example, a photograph of heavy queues of trucks, which was taken on a road in the Port of Tokyo in 1996. Figure 2 also shows the statistical result of a survey^[5] in which the length of the queue at a terminal gate in the port was observed. It was reported that the longest queue at a peak hour consisted of more than 80 trucks on the road. Moreover, the longest waiting time during the queue reached more than four hours.



Figure 1 Bottleneck Problem at Terminal Gate in Japanese Container Port (in1996)
 Courtesy of Tokyo Univ. of Mercantile Marine

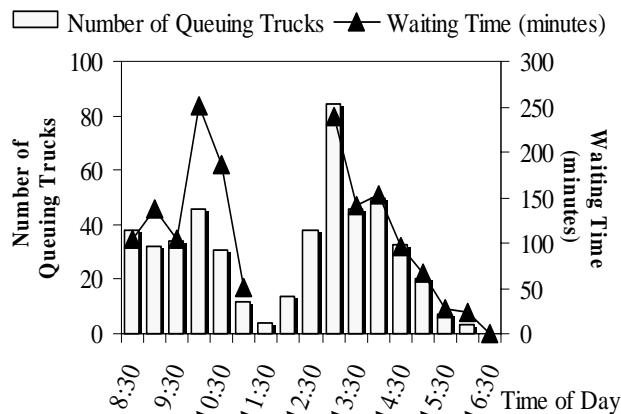


Figure 2 Number of Queuing Trucks and Waiting Time in Port of Tokyo

Source: Tokyo University of Mercantile Marine, observed at a terminal gate in 1996

3. Wasting Time and Cost in Queuing

This queuing loss was recently revealed in the value of unit cost that was being wasted by a truck in Japanese port areas. A major Japanese trucking company, which delivers marine containers, reported to a newspaper^[4] that the unit cost was presumably equal to JP¥120 per minute, per truck. This value should never be neglected for shipping business in Japan. For example, a simple calculation in Table 1, which assumes an average number of truck entries per year at a container terminal in the Port of Tokyo, shows tremendous losses of more than JP¥2 billion per year. The trucking companies accessing the terminal have been suffering losses during the waiting queues for years. This calculation only includes trucks loading containers but trucks unloading containers which can also cause queues are excluded. Therefore, the real loss to the trucking industry may be greater than this estimation.

Table 1. Total Loss of Queuing Trucks in Japanese Ports
- A case study of a container terminal in the Port of Tokyo in 1996 -

(a) Average waiting time in queue at gate per truck	113 minutes*
(b) Gate entries of trucks loading container per year	150 000**
(c) Loss from queuing per truck	JP¥ 120 per minute***
Total loss from queuing per gate, year	JP¥ 2 034 million (a×b×c) US\$ 15.65 million (130 JP¥/US\$)
*: Observed by Tokyo University of Mercantile Marine at a container terminal gate in the Port of Tokyo in 1996 ^[5] .	
**: This number is approximately equal to the annual entries of the terminal in the year.	
***: Reported by a Japanese major trucking company ^[4] .	

In addition to the losses incurred by a truck at a gate, another critical loss from queuing also affects all shipping business: the lead-time between ports and shippers. The average distance between the port of Tokyo and shippers' inland locations was reported to be about 43 km^[2], and the average speed of vehicles on the roads around the port was measured at approximately 16.7 km/hour^[3]. From this statistical information, the average lead-time between the port and the shipper is estimated at 4.5 hours per truck. Since, in Japan, terminal gates must be open for eight hours from morning till evening in one day, this estimation implies the low productivity of a truck driver as shown in Figure 3. The average number of deliveries between the port and shippers in a day is less than two. This is a typical labour-intensive transportation market, which causes expensive services against shippers.

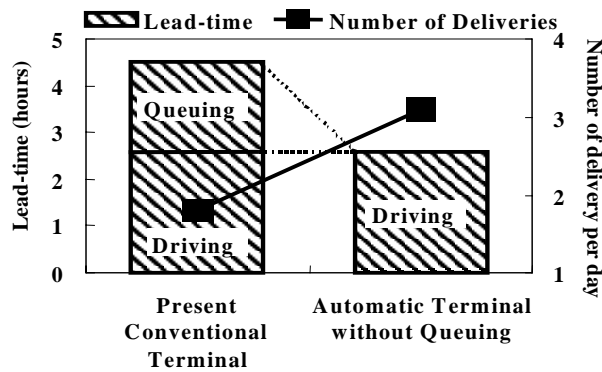


Figure 3 Lead-time and Number of Deliveries between Port of Tokyo and Shippers

Source: Japan Container Association^[2],
 Japanese Ministry of Construction^[3],
 Tokyo University of Mercantile Marine^[5]

4. Port Logistics Costs in Japan

It is predictable that this severe congestion of trucks at the gates causes serious loss to the trucking companies, which forces them to raise their tariff for delivering containers against shippers and shipping lines. Such an indirect and invisible effect on the customers makes the port logistics costs higher.

In fact, the Japanese Ministry of Transport had no choice but to admit this bad reputation after surveying the cost differences between the world's major container ports. The report announced that an average port logistics cost per 40-foot ISO container, which includes pilotage, tax, cargo handling, leasing and delivering in the port area, was 2.5 times more expensive than in Singapore^[6] (see Figure 4).

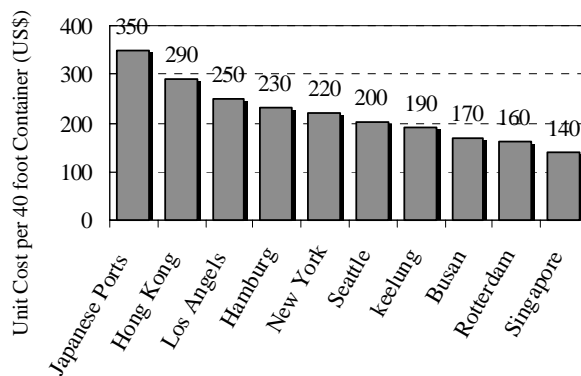


Figure 4 Port Logistics Cost per Container

Source: Japanese Ministry of Transport
 (Reported in 1994, Exchange rate: 110 JP\ per US\$)

In some countries, this sort of problem may be solved by the utilisation of rail or inland waterway transportation. Unfortunately in Japan, all of the major port areas have already been urbanised and rail transportation in the port areas ceased to exist decades ago. It is too late to reinstall rail infrastructure between the ports and the cities. There has been no available waterway for transportation in the country either. Thus, unlike European ports, most inland access to any Japanese container port is intensely limited to road

transportation in which trucking companies deliver containers between ports and shippers (see Figure 5). This is the background of the aspect shown in Figure 3, and the real reason why port logistics costs in Japan are so high^[7].

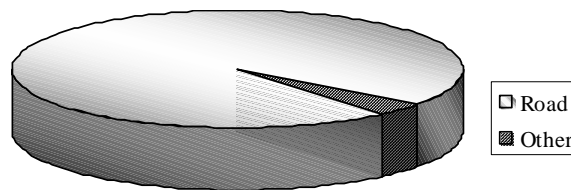


Figure 5 Modal Share of Inland Transportation for Marine Container in Japan

Source: Japanese Ministry of Transport, reported in 1989

5. Bottleneck in Terminal Operation

There may be two solutions to improving the queuing problem at the terminal gates in Japan. Firstly, the port areas' local authorities should play an important role in reforming the road networks so that the port-related traffic may be smoothly transported. However, Japan has a geographical disadvantage due to the mountainous land structure. Most of the population and industries are densely located at coastal areas, forming large cities, together with their main ports for international trade. Consequently, the land-use activity around the port areas has become busier and land prices have also been raised. In addition to this, as in all Asian countries, Japan is now being threatened by the financial and economic crisis. Local governments do not have enough resources to invest a substantial budget in either constructing or expanding road networks in the port areas.

Secondly, the shipping lines or terminal operators should also be responsible for overcoming the bottleneck problems at the gates. Historically speaking, Japanese shipping lines and terminal operators have concentrated on improving their own territory, e.g. the management of their fleets or container terminals. They have not paid any attention to what is going on outside their terminal gates at all, as if all the huge waiting queues have simply been caused by the trucking companies themselves. Neither have they taken any action to solve the problem since they opened their container ports in Japan. It is privately said that they have been choking their international competitiveness by choking their container terminals.

Regarding the above circumstances, there should be a solution within the terminal operations for avoiding queues outside the gates. If we look at the terminal operators' point of view, their particular concerns about this issue may fall into three categories, as follows:

- Possible alternatives for cargo handling operations to minimise queues;
- Degree of improvement in reducing the queues by the alternatives;
- Expenditure needed to invest in the alternatives.

This chapter examines the first two questions by the use of a simulation model which was applied to a conventional container terminal in the Port of Tokyo. The model was developed by the Tokyo University of Mercantile Marine in 1996 and calibrated by the real observation of a queue at the terminal gate, which was also surveyed by the university^[5]. The fitness of the model is shown in Figure 6. By the simulation, we suggest two simple alternatives, which are to increase the number of cargo-handling cranes in the terminal and the truck bays at the gate.

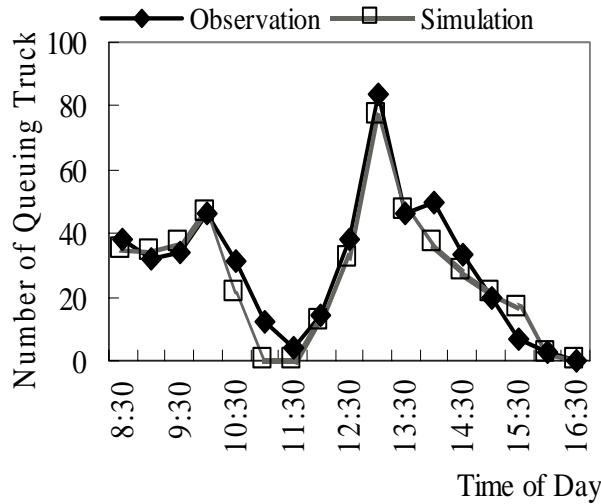


Figure 6 Fitness of Simulation Model on Queuing Trucks in Port of Tokyo^[6]

Figure 7 shows the alternative of changing the number of the cranes in the terminal. In contrast with the present operation, in which the terminal operator has introduced eleven cranes, the simulation varies in number from 11 to 13. It seems that this alternative may have some impact on reducing the queue but the degree of improvement is modest. The difference in the results between eleven cranes and twelve cranes, which means that the operator introduces one more crane into the present terminal operation, may be acceptable although further introduction of cranes may not contribute to the improvement significantly.

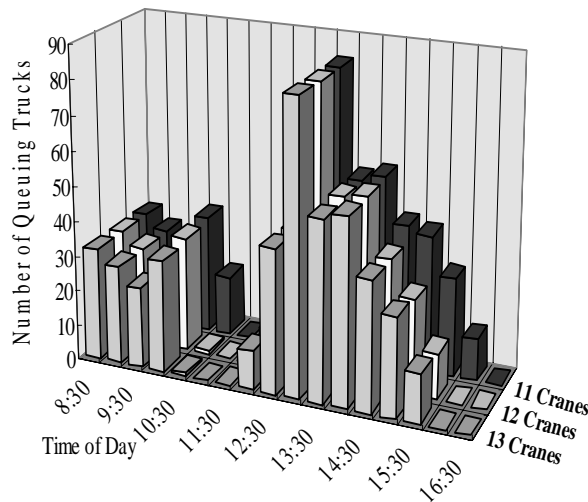


Figure 7 Alternative of Introducing Extra Cranes

Figure 8 shows the alternative of changing the number of truck bays at the gate. In contrast with the present operation, in which the terminal operator opens four bays, the simulation varies in number from four to eight. In the figure, this alternative obviously shows prominent impacts on queue reduction. It is supposed that the length of the queue would decrease by half if the operator opened one more bay at the present gate. Opening further bays is also meaningful although more than seven

bays may have fewer impacts on the improvement. However, opening extra truck bays would not be an easy task for terminal operators if they intended to introduce the alternative into their conventional terminals. They would need to employ more offshore workers as well as installing additional gate equipment. In addition, the gate operations must harmonize with the cargo handling cranes in the terminal. The more truck bays opened, the more cranes need to be operated. This consequence implies further investment by the operator.

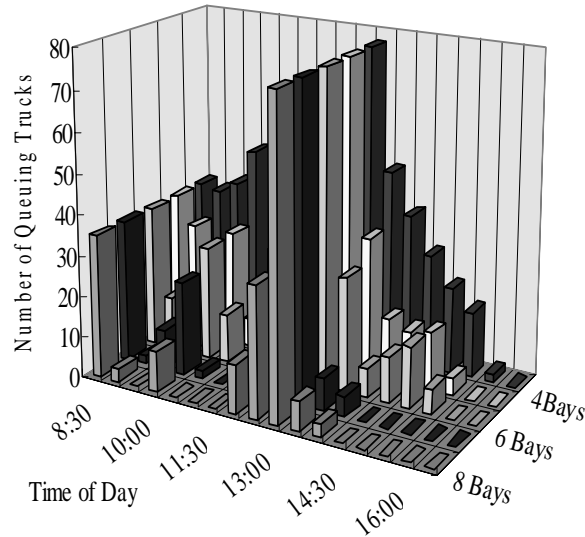


Figure 8 Alternative of Opening Extra Truck Bays

6. Terminal Automation towards Compensating Loss in Inland Access

In either case, introducing more cranes or opening more truck bays, substantial investment in container terminals is needed from the outset. Such capital cost should be carefully estimated by forecasting the point of balance where the capital cost is recovered by eliminating the losses caused by the queuing problem. Since conventional cargo-handling equipment requires human factors one by one, it may be difficult in developed countries to stimulate terminal operators to expand their system manually. In the case of the Japanese ports, the situation is much worse due to the geographical disadvantage stated in Chapter 4. The port areas are already congested not only by port-related traffic but also by the general traffic emerging from neighbouring cities. Furthermore, land prices in the port areas have already become extremely expensive. Therefore, the most cost-effective solution for reducing the queues at the present terminals in Japan may be the installation of fully automatic systems.

This paper assumes that the two alternatives discussed in Chapter 5 are introduced together into a fully automated terminal. Based on this assumption, this chapter compares the costs between the automated terminal with no loss incurred by queues and the conventional terminal with loss. Cost information on automatic systems projected at Japanese container terminals, which was consulted by JCHMA (Japan Cargo Handling Mechanization Association) in 1997, is referred to as the capital cost of the automated terminal^[1]. The value of loss wasted by trucks in the queue, mentioned in Chapter 3, is again referred to to calculate the sum of expenditure over the years (see Table 1). All the unit costs applied for the comparison are taken as constant.

According to JCHMA^[1], it costs approximately US\$360 million in Japan, by the present exchange rate, to introduce a typical automatic terminal like ECT in Rotterdam with a maximum capacity of 800 000 TEU per year. This terminal is to be equipped not only with automatic cargo-handling cranes but also with an automatic gate system which causes no queue outside the terminal. The maximum capacity is supposed to be more than double that of the present terminal in the Port of Tokyo, which is analysed in Chapter 4. Based on this condition, Figure 9 shows the balance point of the expenditure between the capital cost of the automatic terminal and the sum of queuing loss caused by the conventional terminal. The sum of the loss can exceed the capital cost by 12 years^[6].

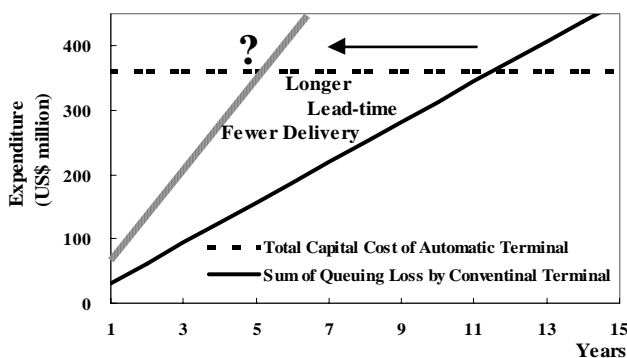


Figure 9 Cost Effectiveness between Automatic Terminal and Conventional Terminal with Loss of Queuing - A case of the terminal in the Port of Tokyo shown in Table1-

The contribution of terminal automation to eliminating the loss can be performed more quickly if the lead-time and the number of deliveries analysed in Chapter 3 are taken into account (see Figure 3). If the broken line of Figure 9 is regarded as the loss of longer lead-time with fewer delivery numbers to the port by the use of the conventional terminal, it is reasonable to consider that the point of equilibrium could be reached in less than ten years after the introduction of automation.

7. Conclusion

The results of the analysis in this paper show the remarkable finding that losses from queuing at terminal gates in ports are considerable although invisible to shippers. This also causes meaningless extra inland access time that is wasted at the queues in ports and consequently added to the shipper's lead-time. Further, if we look at the environmental issues in the neighbouring cities^[7], the total losses caused by the conventional terminal will be expanded and will accumulate year by year. Therefore, the introduction of terminal automation into ports can work to compensate the losses from queuing in the relatively short term although the initial investment is rather high.

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A MARINE CONTAINER KILLED AN INNOCENT CAR PASSENGER ON HIGHWAY IN JAPAN

It is hard to believe that we as car passengers may be exposed to mortal danger on public roads, involving us in fatal accidents with marine containers. The accident to which I refer has finally occurred in Japan, killing an innocent car passenger. It occurred in the morning of 27 January 1998 at a junction of the highway in Osaka, the second biggest city in Japan.

A marine container, which was being transported on the highway by a truck, suddenly slipped off the trailer and crushed a passenger car that happened to be driving alongside the truck. The weight of the container was more than 20 tons which is a normal weight for containers transported worldwide. The car driver died on the spot.

Driving conditions were unexceptional at the time. In the morning rush hour on a congested Japanese highway, it would not be possible for the truck driver to either drive at high speed or brake hard. So why did this happen?

Two things provide evidence of the cause of the accident investigated at the site. Figure 1 shows a photograph of the scene, taken an hour after the accident. It was apparent that the truck was driving on the curving road up to the connection with the other road when the container fell off. It was also reasonable to judge that the circling movement of the truck on the road forced the container to shift to the side following the same circling motion. As the bottom of the container was fixed onto the trailer, it swerved in the same direction. Since traffic conditions at the time of the accident would not allow the truck driver to drive recklessly, this consequence would be quite natural if the container held over-heavy or unsecured cargo.



Figure 1 Marine container killed a car passenger on Japanese highway, 27 January 1998

Figure 2 shows a picture of the inside of the container, which was also taken after the accident. This clearly proves how the cargo was loaded onto the container. It is obvious that the cargo was loaded and aligned to the side where the container rolled off, or had shifted to the side due to inadequate securing. It was not at all in the normal loading position.



Figure 2 Inadequate securing of the cargo inside the container of the accident

The most appalling aspect of this accident is not only the condition of the car involved, as shown in Figure 3, but also the treatment by Japanese law regarding responsibility for the accident. The truck driver who was transporting the container was regarded as guilty even though the accident was caused by the lack of interior security. This is a typical consequence of treatment by Japanese law. It was in fact an imported container which the driver had no right to open during transportation to the importer. No truck driver could avoid such an accident unless he was made aware of the state of security of the cargo before going on public roads.



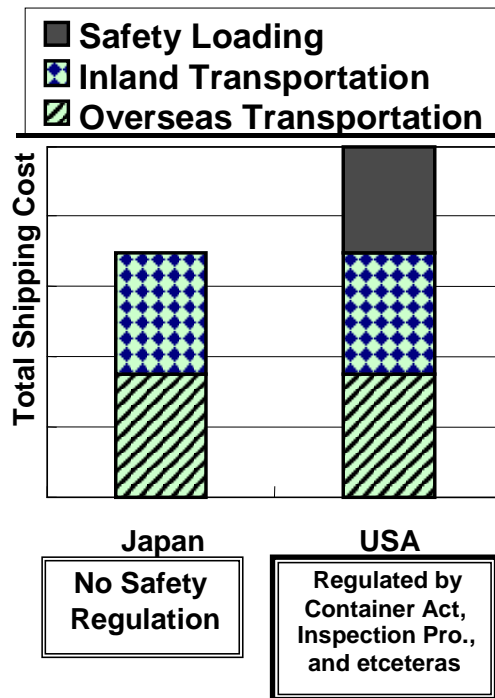
Figure 3 The car involved in the accident

Finally, I would warn those interested in this report that such accidents may well occur again anywhere if we do not correctly place responsibility on the shippers of containers. International legislation for the safe transportation of marine containers is needed as a matter of urgency.

JAPANESE UNFAIR TRADE BY NO SAFETY RULES FOR INTERMODAL CONTAINER TRANSPORTATION

Fair Trade using Intermodal Container Transportation should be based on agreed safety rules when transporting boxes from shippers to end-users. For example, the Intermodal Safe Container Transportation Act, legislated in the United States, functions not only by preventing overweight boxes being carried on highways but also by creating fair opportunities among each shipping counterpart. Such safety law also makes trade smoother between countries. However, if some countries neglect this safety concept, it is possible for shippers and the shipping lines in those countries to benefit from transporting unlawful containers.

This is actually occurring in Japan although few Americans are aware of the fact. There are no safety regulations in Japan against transporting unlawful intermodal containers. In this situation, the United States is suffering a great disadvantage when trading against Japan. The reason is quite simple. Due to the lack of regulation on the safety of containers, Japanese shippers and ocean shipping lines can ship any containers from Japan to, for example, any other Asian country even though such containers would be unlawful and not allowed to transport in the States. They are very clever in that they seldom send such containers to the States but do not care about sending them to other countries. This makes them much more competitive than the US trade industries. Furthermore, if such dangerous containers caused fatal accidents in the other countries, they could escape responsibility. In this regard, the differences in shipping costs between Japan and the United States are obvious, as shown in the figure below.



Mechanism of Eliminating Shipping Cost by Japan

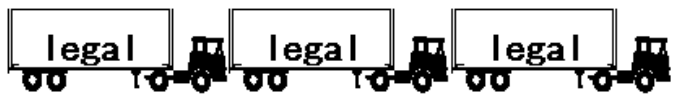
Let us investigate more practically the disadvantage the United States suffers against Japan. Because of lack of regulation like the American Intermodal Safe Container Transportation Act or the Container Inspection Program, Japanese ocean carriers and shippers can easily benefit from loading more cargoes into a container than in the States. Even if the container happened to be inspected and detected as overweight by Japanese highway police, no responsibility would fall on the ocean carrier or the shipper, only the trucking company or the driver would be prosecuted due to the present limitations of Japanese law. The figure opposite shows how they cut their intermodal transportation costs.

As illustrated here, they are cleverly reducing the number of containers loading illegally overweight cargo and coercing trucking companies to transport them without informing them of what is inside. This explains why Japanese trade has greater power than American trade!

How unfair Japanese Intermodal Transportation is!

Doesn't American ever know Japanese shippers and ocean carriers can benefit from unlawful Intermodal Containers?

No Overweight Container



**Regulated by
the Intermodal Safe Container
Transportation Act**



Free to Transport Overweight!



**No safety regulation!!
No responsibility by Shipper!!!**



Unless Japanese Government takes the action to legislate the law against the unlawful problem, American trade must suffer from the disadvantage!

POLAND

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POLISH PORTS VS. GERMAN PORTS - COOPERATION OR COMPETITION?

H.A. van Klink stated in his paper that one of the fundamental changes concerning sea ports has been that, directly after the fall of the Iron Curtain, consumers and companies in central Europe turned to western markets. Serving the maritime transport needs of central Europe has become a strategic challenge for western European ports.

It is true that the collapse of the Iron Curtain provided a spectacular opportunity (especially WR) to the *Port of Hamburg*, which has grown rapidly over the past eight years, both as a feeder port to the Baltic sea and as a port offering access to central Europe through direct train services to Poland and other central European countries. Between 1990 and 1996, transshipments in Hamburg grew by some 18 per cent. This growth resulted mainly from cargoes to and from central Europe.

The highest growth rate can be noted for container transport. In the first half of this year it increased by 9.7 per cent. The port of Hamburg deals with over two-thirds of all containers passing through German ports. Its share in this market segment is more than 25 per cent, taking into account EU ports on the North Sea (Rotterdam's share is 41 per cent). Owing to intensive investment projects, Hamburg is now a European distribution and logistics centre and is in a position to compete with Rotterdam. The market strategy adopted in Hamburg is based on expanding its hinterland through a system of rail network and container terminals. Because in ports such as Hamburg one-third of sea freight container traffic is long-distance traffic, sea ports are making an investment effort to improve infrastructural connections to the hinterland. In the case of Hamburg, the inland waterway access to central Europe is being improved by the extension of the Mittelland Canal. Examples of rail transport infrastructure projects are: electrification of the rail track between Hamburg and Berlin and the reopening of the rail connection between Bremen and Berlin.

Rail connections have turned out to be a pivotal element of Hamburg's competitive edge in container transport. As a result, the port has become an active part of the transport chain, which exerts influence on the development of national and international transport systems.

The highest growth in container traffic was observed in transit to and from Finland, Russia and Poland. In the first half of this year, the traffic to and from Poland which was handled in Hamburg amounted to almost 32 thousand TEU, which is twice as much as was handled in the port in the corresponding period of 1997. Container traffic to Poland grew by 78 per cent, and from Poland by over 125 per cent.

Road transport is still the main mode in container traffic between Hamburg and Poland. It is worth mentioning, however, that container rail transport grew by 30 per cent from January to August 1998. The Polish-German company, Polzug, whose shareholders are PKP, DB and Hamburger Hafen- und Lagerhaus (HHLA), carried around 30 thousand TEU between Hamburg and various Polish cities. The transit time of a container train is from 26 to 36 hours, depending on the place of destination. Polzug also offers its services in container traffic between Hamburg and Sestokai (Lithuania) and Kiev (Ukraine). Part of the container traffic between Hamburg and Polish ports is served by feeders of both ensigns. Of course, containers constitute only part of the total traffic dealt with in Hamburg in transit to and from Poland. In 1997, the total amount of cargo to and from Poland handled in the port of Hamburg was over 762 thousand tons, an increase of around 13 per cent on 1996.

Polish sea ports are located on the main transit routes between the North and the South. However, due to the lack of motorways as well as insufficient networks and the poor standard of the roads, the underdeveloped system of combined transport, the lack of logistics centres, and the high degree of deterioration of fixed assets in the ports, the market position of Polish sea ports is far from satisfactory.

The recession at the beginning of this decade resulted in a drop in demand for ports' services. Following that difficult period, the turnover of the ports has been increasing. The increase results mainly from the high rate of economic growth in recent years, as well as intensified trade and restructuring of the ports.

Table 1 shows the traffic in Polish sea ports in 1995-96. Table 2 presents container traffic in Polish ports.

Table 1. Transshipments in Polish sea ports in 1997

Content a - in thous. tons b - 1996 = 100		Total	Coal	One	Grain	Timber	Crude oil	Other bulk	General cargo
Total	a	50 984.7	17 677.2	3 505.4	2 012.1	63.5	7 924.1	8 852.7	10 949.7
	b	104.1	106.8	97.1	56.0	48.1	117.0	106.7	109.0
Gdansk	a	18 199.9	6 636.1	4 64.8	345.5	12.9	5 791.4	3 126.9	1 822.3
	b	107.9	108.3	2 32.3	79.3	586.4	110.4	107.1	93.8
Ferry terminal	a	26.4	-	-	-	-	-	-	26.4
	b	163.0	x	x	x	x	x	x	163.0
Gdynia	a	9 088.4	1 869.1	92.5	823.4	8.8	732.8	932.1	4 629.7
	b	104.9	108.4	84.7	50.9	419.0	110.9	111.9	124.6
Szczecin ^{a)}	a	14 282.8	4 347.8	1 088.9	746.9	41.8	1 005.3	4 468.3	2 583.8
	b	102.6	99.6	102.9	59.8	104.5	181.1	106.4	105.1
Swinoujscie	a	8 610.0	4 204.6	1 859.2	20.3	-	394.6	279.1	1 852.2
	b	98.6	104.9	82.9	62.5	x	128.5	98.6	99.4
Ferry terminal	a	1 446.9	-	-	-	-	-	-	1 456.9
	b	104.0	x	x	x	x	x	x	104.0
Kolobrzeg	a	122.1	-	-	40.8	-	-	24.9	56.4
	b	79.1	x	x	66.8	x	x	83.0	91.1
Darlowo	a	7.3	-	-	7.0	-	-	0.3	-
	b	3.0	x	x	4.6	x	x	27.3	0.0
Elblag	a	641.4	619.6	-	-	-	-	21.1	0.7
	b	180.8	191.9	x	x	x	x	70.1	36.8
Ustka	a	32.8	-	-	28.2	-	-	-	4.6
	b	67.4	x	x	60.5	x	x	x	219.0

a) With other ports of the Oder River estuary.

Table 2. **Turnover of containers in Polish sea ports in 1996-97**
(in whole numbers)

Content		Loaded			Empty		
		Total	In	Out	Total	In	Out
Total	1996	84 527	46 418	38 109	31 117	7 865	23 252
	1997	94 778	55 705	39 073	29 597	6 068	23 529
Gdansk	1996	499	69	430	1 630	19	1 611
	1997	690	197	493	1 108	-	1 108
Gdynia	1996	82 374	45 746	36 628	21 563	6 707	14 856
	1997	93 046	55 123	37 923	25 682	5 521	20 161
Szczecin	1996	1 654	603	1 051	7 924	1 139	6 785
	1997	1 042	385	657	2 807	547	2 260

The data presented above show that the traffic in Polish ports amounts to only 20 per cent of traffic served in German ports. The figure with respect to general cargo is only 10 per cent.

The port of Gdynia is the main Polish port in the area of container traffic. It has regular land and sea connections with Finland, Sweden, England, Germany, Holland and other countries. Table 3 shows the turnover of the Baltic Container Terminal in Gdynia.

Table 3. **Port of Gdynia Holding container turnovers in 1985-97**
(thousand TEU)

Year	1985	1990	1991	1992	1993	1994	1995	1996	1997
Ro-Ro	15	36	30	27	22	24	22	26	23
Lo-Lo	80	82	84	70	92	98	118	130	155
Total	95	118	114	97	114	122	140	156	178

The port of Szczecin-Swinoujscie specialises in multimodal traffic, which is served by the ferry terminal at Swinoujscie and the ro-ro terminal in Szczecin. The main traffic connections in Szczecin-Swinoujscie are to Sweden and Finland. Ferry traffic from the Swinoujscie terminal faces severe competition from the ports of Rostock, Warnemunde, Sassnitz and Mukran, which have taken over some cargo from Poland and the South West.

The crucial question which needs to be answered is how Polish ports can effectively compete with German ports, especially with Hamburg. It is worth emphasizing that *in the future, infrastructure (for the western ports WR) will become a necessary but not a sufficient condition to optimise market reach. Port*

authorities have to look beyond infrastructure and give more value to intangible aspects of accessibility (H.A.van Klink), while Polish ports still focus on physical infrastructure and transport services to optimise their inland accessibility and improve their market reach.

The Polish plans for motorway construction are very ambitious. Concessions to construct a 150-kilometre motorway section from Gdansk to Torun have already been granted. The Government has approved the ODRA 2006 programme, which aims at improving the navigability on the Oder. Rail tracks connecting Polish ports and their hinterland are regularly modernised in order to comply with the parameters stipulated in the AGC and AGTC agreements signed by Poland. The investments are, however, very capital-intensive and cannot be financed in full from the central budget. International financial institutions were rather reluctant to finance the construction of tolled motorways in Poland. Thus, the original programme, which assumed the State's participation at the level of 10 per cent, has to be reviewed and modified. Moreover, it may be expected that western European countries will be more interested in the development of transport infrastructure in the West-East corridor.

The incorporation of central European states into the European Union should result in higher trade flows and intensified sea cargo traffic in this part of the continent. German ports are already preparing to increase their market share in the area, as they have a much stronger position than Polish ports in this respect.

In addition, Polish ports compete with one another. The rivalry between the ports of Gdynia and Gdansk with regard to constructing Europort on the Baltic in Gdansk -- a modern terminal for unloading and processing grains and animal fodder -- may be a good example here. In 1996, the Gdansk Port Board signed an agreement with Europort Inc., an American-Canadian consortium, which stipulates the construction of a terminal for grains. The terminal would occupy 59 hectares of land and part of the existing ore wharf. The capacity of the terminal should be 3 million tons per year. It is expected to handle both the import and export of grains to and from Poland, Hungary and the Czech and Slovak Republics as well as trade between Canada and the US and the former Soviet countries. It is worth mentioning that the Baltic Grains Terminal in Gdynia has a capacity of 1 million tons per year. It is only 25 kilometres from Gdansk. Thus, Gdynia questions the viability of constructing the Europort in Gdansk since the Gdynia port uses only half of its capacity in the newly-modernised grains terminal. The latter is expected to be further developed in the very near future.

This conflict proves that in market economy conditions it is hard to avoid competition between ports which are located so close to each other. The rivalry may be very destructive for both sides. From the macroeconomic point of view, it seems necessary to adopt a strategy of collaboration when faced with the growing competition from western ports (especially German ports). Moreover, a bilateral agreement would not only lessen the domestic competition but would also create proper conditions for better penetration of the hinterland.

Finally, it is time to ask the question whether it is in the interest of the economies of western European countries to develop turnover in the main sea ports. M.-M. Damien answered this question in her paper for ECMT Round Table 107 on "What Markets Are There for Inland Waterways?"¹ Assuming that annual economic growth in western Europe will be rather small (2-2.5 per cent) and that the high growth rate in the CEE will continue, she suggested two possible scenarios for the future.

The first scenario assumes that the Baltic ports will become much more important. The ports of North-West Europe (Rotterdam, Hamburg, Antwerp, Zeebrugge, Le Havre) will retain their position. The cargo container traffic in Polish ports (Gdynia, Swinoujscie) will increase. The traffic in the North-South corridor will increase as well. It will take place on the Oder-Danube waterway, which is planned to be developed. Since the traffic in the East-West corridor will also increase, the markets of Russia and other CIS countries will become strategically important for Germany, Holland and Poland. The question which arises here is whether the traffic from western European ports will be served only by land transport or will be first directed to Polish ports.

Should the traffic from western European ports to Russia and other CIS countries be served by land transport, only the second scenario assumes that Baltic ports will not develop markedly. The main western European ports will increase their turnover. Despite the increase in traffic in French ports, which may result from the Seine-North and Rhine-Rhône connections, land transport will not be effective. The traditional North-South and East-West corridors will be jammed. Land transport will also contribute to the destruction of the natural environment. Traffic in Europe may increase by 30-40 billion tons per year. The situation will progressively worsen if the present modal split continues and if the policy of uncontrolled growth in land transport to main European sea ports prevails.

NOTE

1. Damien, M.-M. (1997), Paper presented at ECMT Round Table 107, *What Markets Are There For Inland Waterways?*, ECMT, Paris.

SUMMARY OF DISCUSSIONS

SUMMARY

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INTRODUCTION

The emergence of intermodality as a major trend in transport at the global level is leading to changes in the design of logistics systems and poses a number of questions regarding territorial development. Recent years have seen a sea-change in the basic structure of the transport sector which has brought substantial growth in containerisation, the emergence of megacarriers, construction of ever-larger container ships, greater density of transport flows, and so forth.

These developments have been largely responsible for the major changes taking place in logistics systems and are a serious source of concern to ports. Some ports, either because they are too small or are not located near to transshipment points, fear that they may be left on the sidelines. Because inland transport costs are higher than maritime shipping costs, one of the issues that is central to these concerns is also that of the quality of inland transport links.

The Round Table examined all of the factors determining the quality of inland transport links by considering, firstly, the issue of growth in trade and port administration and, secondly, the question of land links to ports.

1. GROWTH IN TRADE AND PORT ADMINISTRATION

Until the recent financial crisis in Asia, international trade had been growing extremely rapidly. Container traffic worldwide has risen substantially and there is still scope for further expansion. By the year 2020, traffic flows could conceivably be as high as 100 million TEUs. Coping with this growth poses an enormous challenge.

There are three reasons for this growth: the increasingly widespread use of containers, which means that the problem for ports is no longer how to attract vessels but how to attract containers; the formation of shipping consortiums, which has helped to concentrate container traffic flows; and lastly, the much larger size of container vessels which has made it necessary to upgrade port infrastructure to cater for high-volume flows. The advent of containerisation, nevertheless, has led to greater diversity in routing criteria.

It is remarkable to see how technical advances have made it possible to substantially increase the size of vessels, with the result that, in terms of transport costs, distant countries are now extremely accessible. The most costly component of the transport chain is the inland leg, and it is over this leg that prices are most competitive in the transport sector. This explains why forwarders fight so hard to gain control over inland transport operations.

Against this background, it is worth bearing in mind that Europe is a maritime continent and that ports are areas where highly sophisticated logistic activities are concentrated. Indeed, in this respect it is possible to talk in terms of logistic polarisation. This is by no means a recent development. Historically, ports have always been trading areas that have subsequently developed into industrial zones.

Not all goods arriving at a port are subsequently dispatched over great distances. Some are shipped out again by sea but many are processed *in situ*.

As the volume and concentration of transport flows has increased, so too has the number of distribution centres located in port areas. Over 50 per cent of European distribution centres are located in the northern range between Le Havre and Hamburg. There is fierce competition between ports to attract trade flows and also to attract activities. The interplay between actors is a determining factor in this competition, although the institutional framework for such competition has not yet been fully defined (e.g. the respective role of the public and private sectors, charges for using infrastructure, etc.). There is competition between not only "ranges" but also ports, depending upon the extent to which ports have been integrated into operators' networks. It is a fact that competition between ports has increased, even between ports that are not located in the same geographical area in Europe. As a result, the *core business* of ports no longer consists in loading/unloading operations and the concept of a protected *hinterland* is no longer valid.

It would seem that, over the course of the 1990s, the highest traffic gains have been in medium-sized ports and that the larger ports have become less attractive. The larger ports have had to contend with problems arising from infrastructure congestion, which in the case of Japan have been severe, and the resultant damage to the environment. The increase in the size of ports generates diseconomies of scale. As a general rule, although economies of scale can be achieved in the primary and secondary sectors, it is far more debatable whether they can be in the service sector. Concentration, which lies at the heart of environmental problems, is still taking place although within certain limits, as consortiums increasingly start to think in terms of networks.

In many cases, the success of a port will depend upon its ability to harness all the know-how and expertise of its actors. There are still cases where know-how remains dispersed and is not perceived as a vital asset. Yet, for some of the experts at the Round Table, know-how is at least as important as the availability of infrastructure, in that price differentials are not particularly important with regard to port operations in Europe and the area where competition will be strongest will be over the ability to organise the handling of goods. Moreover, the quality of land links to ports in Europe is frequently high, which means that quality of services will not necessarily be a determining factor in the choice of port.

It is perfectly possible -- and this was a point which the Round Table emphasized -- that there may be some inertia, as in the case of operators who grow accustomed to dealing specifically with certain actors. The outcome of this is that decisions and choices are not reviewed continuously but only when things go wrong or when new competitors emerge.

2. LAND LINKS TO PORTS

Although road currently remains the dominant mode, the railways and the inland waterways are starting to make inroads. Rail and the inland waterways can only be successful if they are closely integrated into the operations of container terminals.

In general, the road infrastructure inside ports is saturated, resulting in long delays in loading containers. In view of this congestion, rail and the inland waterways are perfectly credible alternatives.

In the case of the inland waterways, the aim must be to restore the confidence of forwarders in this mode of transport and to allow them to negotiate transport contracts freely.

Inland waterways can be incorporated into logistic chains in which regular services and low costs are more important than speed of delivery. An additional one or two days in terms of transport time will not make much difference in the case of a container arriving from the Far East which has already spent over 20 days being shipped by sea. In order to secure their future, the inland waterways must be integrated into existing transport systems. For example, the link between maritime transport and a final delivery leg by inland waterway would appear to be a perfectly logical one and the interface between maritime shipping and inland waterway transport is already highly developed in ports such as Antwerp or Rotterdam. The maritime shipping market is an extremely promising one, but it would seem that, in practice, the link between maritime shipping and inland waterway can sometimes pose problems. Maritime operators do not always think about using the inland waterways and port practices often penalise inland navigation.

However, the future for the inland waterways would seem to be assured since it will be difficult for road to absorb the explosive growth in freight transport predicted by analysts. Congestion in the road network, particularly on infrastructure serving ports, acts as a brake on expansion of the road sector. Nonetheless, the inland waterways must show that they are capable of learning how to attract and then keep their markets, since they cannot presume that, even in the case of apparently captive markets, they will automatically be chosen by operators.

No form of inland transport costs less than the inland waterways once a cargo has been loaded. Transshipment costs are high, however, which reduces the competitiveness of inland waterways. To lower their transshipment costs, forwarders must invest in new equipment, which they will only do if, once again, they have confidence in the future of the inland waterways, that is to say, if they can establish lasting links based on contracts entered into freely. In turn, inland navigation must opt for innovation, which would assume that appropriate measures are taken to encourage the formation of groups of enterprises or of co-operatives so that the inland waterway sector can modernise the way in which it functions.

Public investment in transshipment terminals would be one way to stimulate this mode of transport, but under no circumstances should exceed 50 per cent of the total cost of installations. Furthermore, past experience has shown that it is unwise for public authorities to be involved in decisions regarding the location of ports and logistic centres. This type of investment should primarily remain the prerogative of the private sector, which is better placed to judge the timeliness of building multimodal platforms that make provision for inland waterways. At the same time, the emphasis must be placed on existing facilities rather than incessantly seeking to build new terminals,

as proposed in certain international master plans for the transport sector. What is important is to be rigorous in choosing investment, but in some countries this would mean governments turning their backs on a policy of disinvestment. More generally, the aim must not be to seek systematically to complete a given network, since in some cases the investment required is exceedingly high and either cannot be justified in terms of economic viability or is fiercely opposed on environmental grounds.

In the case of rail, it needs to be said that, in terms of the overall costs, i.e. the cost including transport time, on-time deliveries, tracing capability, etc., services are not always competitive. The railways will only be successful if they can substantially lower their tariffs.

Participants at the Round Table felt that the rail sector would also have to innovate by designing simpler and more direct transport services.

Freight corridors are already a reality, but perhaps it is necessary to go even further and consider the possibility of setting up networks dedicated solely to freight. Corridors alone are not enough, and *slots* need to be introduced for freight shipments. Rail operators can make a real contribution by organising complete train-loads or block trains.

It stands to reason that combined transport should be able to offer a widespread alternative network to road. What we are seeing, however, is widespread competition between different actors (shipping companies, port operators, rail networks, subsidiary networks, etc.) and the rules of the game have not yet been finalised. As a result, the railways dominate the sector and perhaps it might be preferable to dismantle the monopoly they have on traction to ensure greater competition or at least greater transparency, notably in the invoicing of traction prices. It is worth noting in this respect that freight corridors (freeways and freightways) are not fully utilised. Perhaps over time an entrepreneurial spirit will emerge which will allow the possibilities they offer to be fully exploited. If the freeways have proved to be a failure until now, it is because of the inefficiency of the railway companies. These companies need to be made to adopt a new approach by being urged to take initiatives. Far too often they remain inactive, preferring to wait and see what happens. Another problem that needs to be addressed is the clash of interests between the railway companies and their subsidiaries specialised in combined transport. Obviously, uncertainties over infrastructure user charges, too, discourage companies from taking the initiative. As a general rule, the railway companies fully cost projects before they actually carry them out.

Again with regard to combined transport, a sector in which all railway companies appear to be losing money, the experts at the Round Table felt that the authorities should choose between a policy aimed at ensuring a balance between modes and one of liberalisation. Combined transport cannot compete with a road sector which, once it had been liberalised, saw prices collapse. However, the experts at the Round Table did not feel that this was a sufficient reason to challenge such a policy or to justify the subsidising of combined transport activities. Current developments, unless accompanied by a reform of the railways, are doomed to failure. The main issue is to increase the productivity of rail networks in order to reduce the cost of traction on main routes. This could be achieved through longer trains, quicker marshalling of wagons (which accounts for 25 per cent of costs) and faster delivery of wagons by giving priority to freight. This would generate savings of around 20 to 30 per cent in traction costs.

There are two conflicting strategies towards tariffs in the combined transport sector:

- Keeping in place tariffs which do not cover costs, which require subsidies but which also imply maintaining the *status quo* in terms of the services offered;
- Higher tariffs which would allow combined services of higher quality to be offered and which, above all, would permit investment. This is a strategy which would allow operators to take a long-term approach, but is also one which would require the short-term transitional arrangements to be properly determined.

It would seem that, at present, the rules regarding the rail sector are neither clear nor transparent. Even though social harmonization and competition policy may help to improve the balance in the transport market, it is nonetheless a fact that greater competition in the rail sector would help to secure the productivity gains that are apparently indispensable.

In considering the role played by infrastructure, it would seem that it is not a determining factor in areas which are well equipped in that respect. This would suggest that the role played by organisational factors is paramount. However, it is also true that there are some regions in Europe which do not have sufficient infrastructure and there is, therefore, a need to provide for funding mechanisms to help these regions catch up.

Cabotage is being increasingly integrated into logistics chains. Cabotage is a specific activity which is distinct from maritime shipping. The profit margins on cabotage are low, however, due to lengthy procedures in ports and cumbersome customs formalities. In this respect, the actions of customs authorities can make it impossible for ports to work efficiently, hence the need to harmonize and simplify procedures. *Feeder*ing cannot be developed unless it is properly integrated into the individual links of the inland transport chain and is conditional on co-operation between short sea shipping operators and inland transport operators.

Improving land access to sea ports requires action by all the actors -- of which there are many -- involved in:

- The creation of inland terminals and the transformation of their role to ensure that all port terminals are integrated into a logistic chain. Such terminals would allow part of the distribution system to be moved outside the port area, thus releasing capacity in ports. These terminals will, in due course, become sites where logistics activities will be concentrated. They will be used to group freight shipments, an activity no longer carried out in ports. Care must nonetheless be taken not to create new bottlenecks at the level of terminals;
- While port authorities have little room for manoeuvre, as managers they must adopt a proactive approach to the improvement of sea port accessibility. Rather than issuing new regulations, they must start thinking *collectively* with all the actors involved. It must be stressed yet again that knowledge, which at present is often dispersed in ports, and the application of that knowledge has an essential role to play in this process. A change in this respect can influence the intangible but basic elements of accessibility and reduce the general costs of access;

- Maritime shippers, because they want to increase their share of *carrier haulage* in order to control the chain and the associated costs, also have a role to play in this respect. While their aim is to cut costs by streamlining inland transport operations, the approach they have adopted lies purely at the microeconomic level and, consequently, they cannot develop a rational and closely-knit network. Moreover, not all maritime shippers have the same strategy and they exhibit opportunistic forms of behaviour;
- The railway companies are still the main actors in this area by virtue of the dominant position they enjoy, but until now they have acted extremely cautiously;
- The public authorities regulating the markets must above all stabilize the institutional environment and clarify, with regard to the ports, the respective roles of the public and private sectors. Administrative and customs procedures must be simplified. Access to networks must be liberalised and the rules of competition harmonized. Rules must be drawn up with regard to the internalisation of costs, and efforts to combat crime are part of the sovereign powers of public authorities;
- The European authorities must integrate ports into genuine networks and must not limit themselves to creating corridors. They must give priority to an intermodal approach which places all modes on the same footing.

CONCLUSION

We are faced with a world that is undergoing rapid change. In view of this, ports must be allowed to evolve as freely as possible and no attempt should be made to impose a standard model for either port administration or inland transport services to ports. In addition, all the participants at the Round Table stressed that there was a real problem with rail services and felt that the current approach of railway companies to combined transport operations was flawed.

It is of paramount importance to determine the logistics requirements of forwarders and, among all the logistic changes imaginable, greater consideration should be given to the concept of a dedicated rail freight network. Releasing capacity and determining priorities may allow the rail sector to play a larger role than it does at present, provided that all the changes aimed at lowering the costs of service have been properly implemented. The inland waterways must be encouraged to adopt an entrepreneurial approach and not to expect the authorities to provide for their needs.

The inland waterways must invest in areas that are already saturated so that all modes of transport can compete on an equal footing. Account must also be taken of the need to invest in peripheral areas in Europe where significant lags have built up over time. In view of the current increase in container traffic in particular, seaports will ultimately serve as a template for the entire intermodal transport system in Europe. Ports must therefore be integrated more closely into the Trans-European Network rather than simply being attached to the latter through links.

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PRINTED IN FRANCE
(75 2001 06 1 P 1) ISBN 92-821-1261-6 – No. 51541 2001