Serie Research Memoranda

Barriers and Missing Networks in European Infrastructure: Inland Waterways and Coastal Transport

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1. Preamble

The European countries are increasingly showing the signs of an integrated economy, in which trade barriers are more and more removed and spatial interactions are increasing (Bonafous, 1989; Simons 1990; Violland, 1988). The full exploitation of a nation’s competitive advantage in an open international economic system has long been recognised as an important key force for maximising national economic growth. At this critical stage in the history of Europe the potential and importance of network infrastructure for a further development and integration of the European economy is increasingly emphasized.

In this context it is noteworthy that Andersson and Strömquist (1989) claimed that each new stage in the history of Europe was accompanied by a so-called logistic revolution. They distinguish four such revolutions: (i) the end of the Middle Ages when new banking and trade systems emerged together with the development of new transport systems (e.g., the Hanseatic League); (ii) the Golden Age when new navigation techniques and trade agreements allowed a rapid expansion of the European economy; (iii) the Industrial Revolution when new industrial mechanics had a decisive impact on transport systems (railways, steamships, cars); (iv) the Informatics revolution when the new information technology and telecommunication exerted a drastic influence on the development of modern logistic systems.

Thus it is evident that there is a close link between economic development and infrastructure (see also Nijkamp, 1988 and Rietveld, 1990). The main question to be dealt with in this paper is however whether the potential of infrastructure is fully exploited. The current discussion is focusing much attention on bottlenecks and congestion in networks, but it may be relevant to pay more attention to the opportunities offered by (adjustments in) network infrastructure.

The present paper will deal with the existence of important barriers (missing links and missing networks) in European infrastructure. First, a brief sketch of some megatrends in European transport and communication infrastructure will be given, followed by an overview of important policy issues. Then the notion of barriers will be elaborated, with a particular view on missing networks which concern essential parts of the European network economy which are not sufficiently present (qualitatively or quantitatively) at the moment, but whose availability is necessary to improve Europe’s competitive position. The evaluation of the European network infrastructure will then be based on five critical success factors comprised in the so-called pentagon prism: hardware, software, orgware, finware and ecoware.

Based on this pentagon model, we will explore the assumption that waterways offer an important potential for regional and national development in Europe. This potential is at the moment highly underutilized, although in view of recent socio-economic and political developments in Europe (the completion of the internal market, the re-unification of Germany, the opening of some East-European markets, the potential of both Mediterranean and Nordic countries) there is much scope for sophisticated waterway transport, both inland waterways and coastal transport. After a description of a great
many empirical facts in this field, the paper will give an overview of bottlenecks in the use of waterway transport, followed by an outline of new policy strategies which might improve the current position of this potentially important part of Europe’s infrastructure.

The general conclusion from these considerations are straightforward: infrastructure is a prerequisite for a further economic development and integration of the European network economy. An effective (and official) recognition of the basic role of infrastructure for economic growth would allow new strategic exploration, inter alia concerning the necessary upgrading of the current service level of transport systems or the design of new infrastructure systems. Quality is apparently nowadays of more strategic relevance than quantity, and therefore infrastructure and transport systems planning ought to take pre-specified performance and service quality levels as a strategic point. This does not only hold for waterways, but for all types of infrastructure.

2. Some European Megatrends

The field of transport, communications and mobility is in full motion. International commodity transport - in terms of both volume and value - is increasing, international passenger transport is rapidly rising, and also international telecommunication is increasingly gaining importance. From an international (i.e. cross European) perspective the following megatrends at the European level can inter alia be observed:

- Despite many institutional frictions, there is an increasing tendency towards an integrated and open European market, which by 1992 will have become the largest trade block of the world. This trade block will increasingly also include EFTA-countries.
- At a European scale, many initiatives are being taken to improve and expand the current infrastructure (e.g. the Channel Tunnel, the extension of the French TGV, the construction of the Trans European Motorway, the design of an advanced European telecommunications system, etc.), so that all European countries will be linked to each other via a common and accessible network.
- Internationally, the heartland of Europe is shifting towards both the east and the south, which has enormous economic and social implications for transport and mobility all over Europe. Furthermore, many different kinds of border problems still have to be solved in Europe’s unification policy.
- Many countries have officially adopted a 'basic right' principle towards peripheral or less accessible areas, which means that a certain level of accessibility is ensured on the basis of this equity paradigm. However, in the case of severe budget stress such principles tend to be easily neglected, particularly when it is accompanied by privatisation of (parts of) the infrastructure networks for public transport services, telecommunications, etc. This may lead to severe imbalances and serious equity problems at the European level.
The European trend toward more deregulation and decentralisation may seduce policy makers to question whether there is a case for planning at all; more particularly, the seemingly higher efficiency gains of a market oriented planning system need to be traded off against the social welfare gains of public interventions.

International spatial interactions in the form of physical movements of persons or commodities are increasingly influenced by recent developments in the field of communication and information technologies (including telematics).

The area of commodity transport is going through a rapid transition phase, especially due to the emergence of modern logistic systems. For both national and European freight transport this development has far reaching consequences, not only in efficiency terms but also in terms of social consequences.

Clearly, the abovementioned examples of transport megatrends are by no means exhaustive, but they suggest in any case that the 1990s will require new methodological directions in which a meaningful blend has to be found between allocative efficiency, distributional equity and environmental spillovers (and other externalities) in a highly dynamic urban and regional setting of European countries marked by structural changes in technology, socioeconomic conditions, scarce (natural and financial) resources, life styles and sociodemographic patterns. (see for an interesting overview also Masser et al., 1992). Coping with barriers will become a major challenge.

Transport and communication systems are thus never static, but always in a state of flux. In general, transport modes - like any other commodity category - exhibit a product life-cycle marked by phases of take-off, adoption, market penetration, large-scale use, saturation and declining market shares. Thus transport modes will tend to show a history beginning with a period of low-volume high-cost adoption, followed by further expansion and improvement, and ending with general acceptance and widespread use. Clearly, in a way parallel to transport technologies, transport management styles will also exhibit similar life-cycle phenomena. Technical change may intervene here by providing new hardware to facilitate better control or enhance the quality of information which is available to management.

Dynamics in transport systems may take various forms: shifts in size and market shares, intermodal substitution or complementary (e.g., intermodal) transport, emergence of new transport modes, qualitative upgrading of existing modes (e.g., rapid trains). Grübler and Nakicenovic (1991) have made an interesting historical overview of the evolution of many transport systems from the viewpoint of a lifecycle approach. Both on a logistic growth hypothesis related to various technologies, they give a sketch of the expected time trajectory of various transport modes (see Figures 1 and 2).
Figure 1. Substitution of transport infrastructures in the USA, shares in length, logit transformation.

Figure 2. Modal split in passenger (intra- and intercity) transport in France, in fractional share of passenger-km performed, logit transformation.
Even if no new technologies become available in the near future, drastic changes in the flows of persons, goods and information might still emerge, notably for two reasons.

In the first place we see increasingly a shift in emphasis from isolated transport modes towards an integrated systems technology. This implies a more efficient use and management of all (sometimes competing) transport infrastructures (e.g., combined transport via roll-on-roll-off techniques). Next, it is noteworthy that an open European market will supposedly generate a high degree of international freight transport, commuting and telecommunications.

Clearly, in the long run completely different transport systems instead of the current ones may emerge, as the prevailing modes (train, bus, private car) seem to be in the final phase of their life-cycle. The current revolutionary changes in the field of superconducting may induce a new generation of rapid, environment-friendly and energy-saving transportation vehicles. An example is the plan to build new subterranean vacuum tunnels for commodity transport in Europe (see Nijkamp 1990).

It is clear that the production of technological trends is fraught with many uncertainties. Given the experience in the private sector that R&D and investments will be oriented towards sectors with relatively long-term financial rewards, it is likely that especially new transport policies with an emphasis on efficient management and control, small environmental impacts and a high degree of polyvalence may become the winners in the competition for new transport modes.

Furthermore, the behavioral responses of individuals, households and firms deserve a closer analysis, as so far these developments turned out to be rather unpredictable.

It should be noticed here, that the evolution of transport systems is not only supply-driven (i.e., technologically-determined), but also critically influenced by the market side and by political interventions. Therefore, in the next section we will point out a few important policy issues governing current European transport developments.

3. European Transport Policy Issues

The way in which governments can influence international transport are numerous (see Nijkamp et al., 1991). In most countries it is still the national government which provides - directly or indirectly - the major components of infrastructure, such as ports, airports, glassfibre networks, railway tracks, etc. Despite deregulation, provision of and presence in infrastructure itself gives power, because through its very location or capacity the infrastructure can influence the magnitude of a country's trade. This is also the background of the current competitive efforts among European mainports.

The power to charge for the use of the national transport or communications infrastructure offers a further device by which a government may attempt to influence trade and hence transport.

Apart from more direct measures and institutional arrangements which also serve to influence the costs of international transport (and thus violate
the principle of laissez faire), governments may also intervene, again in numerous different ways, to protect their own domestic transport industries from external competition. For instance, sabotage is in particular often viewed in the same way as the 'dumping' of goods in a market and is the subject of particularly severe restrictions in many European countries.

An important question in this context is what the limits of deregulation are in the light of the European economic integration with its ambitious goal of one common market in 1992. Clearly, it has to be admitted as well that some level of regulation always seems to be necessary (particularly in view of coordination and economic principles). In this framework, it is interesting to observe that the initial impetus for deregulation - or ultra free competition, as it is perhaps better called - is in the meantime beginning to be questioned.

It is noteworthy that national intervention in the international transport market which is occurring up till now has two distinct effects. Firstly, many national policies are adopted to alleviate some short term problems, or are an attempt to gain some commercial advantage. In general, they bring forth responses from trading partners or from alternative, national suppliers. The long term effect is often a reduction in the efficiency of the international economy. If the policies are all designed to protect local industry or domestic transport suppliers, then this means that almost inevitably the cost of transport is pushed artificially high and overall production is kept below its maximum potential. If the polices involve transport subsidies (e.g., to aid exporting firms), then the long term impact is equally damaging, because the overall cost of transport is too low, meaning that those which are normally deemed inefficient because of their exhorbitant transport needs, now become competitive with their more economically efficient rivals.

Second, unfavourable distributional impacts on less developed regions occur in an even more pronounced way when one realizes that most tightening up of national policy occurs when the economy is in recession. The same holds for less developed border areas (or sectors within them) in the European context.

In terms of substance of policy concerns, an extremely important question nowadays appears to be the role and impact of deregulation (or of complete self-regulation) in transport and telecommunications policy. The policy views about and the evaluation of this 'hot' policy issue cannot be placed under one common denominator, but broadly speaking, most international agencies agree on the usefulness of deregulation (if managed at least with tact), but certainly not at any cost or applied to any policy area; it should rather be seen as an - often useful - means, not as a (final) objective. In view of related trends such as privatisation, decentralisation etc. it may be supposed that for instance, (inter)national railways would function better when freed from state control. It has also been stressed by various agencies that deregulation is not a limitless policy instrument. In any case it should be functional, but its implementation turns out to be extremely difficult in policy areas where it is badly needed. In the context of planning and policy making, a critical self-review and an integrated incremental approach in which a flexible updating and upgrading of global plans seems to be more
important than ever before, is an appropriate policy direction which is gradually taking place in various countries.

Another concern of policy makers is related to financial aspects. The financial burden of large scale investments is often hard to bear for one country. New possibilities for financing (infrastructure) projects with a border crossing character are: private financing, public/private partnerships (as can be illustrated by the Channel Tunnel project), and guaranteed state contracts (with a duration of 15 years or more as proposed by the Belgian government). In any case, the potential profits of international cooperation are by far not exploited to their full extent at the moment.

One achievement of competitive performance levels would need coherent European - rather than a sectorial nationalistic - view. Only in this context sound financing and environmental approach to infrastructure can be reached. Such a European view is also necessary to cope with the phenomenon of missing networks in a pluriform European society.

In the same vein the problem of technological standardisation may be seen. Standardisation does not only pertain to hardware (like voltage systems in railways), but also to software (e.g., information systems for international customs procedures) and orgware (e.g., common carriage on European rails).

Finally, of strategie importance for commodity transport is also a further development of multi-modal transport solutions (such as piggy-back systems and containerisation).

In the light of the previous observations, the following policy concerns can be mentioned in the European transportation scene.

First, transportation plans usually are of long duration so that there is a large amount of built-in uncertainties regarding economic, demographic and technological factors. The identification of sources of uncertainty and finding ways to include them in transportation policy design, is far from being a well developed area with grave consequences for the successful implementation of many transportation projects. Furthermore, some of these uncertainties involve benefits and cost to future generations. Therefore, ways should be devised to introduce directly inter-generation comparisons into transportation policy analysis.

Secondly, as the economies of most European countries are moving further towards heavy reliance on free market mechanisms, the question of market sustainability of transportation plans, becomes a crucial one. Thus, it is possible to devise an optimal transport plan which in the medium and longer-run would not endure market forces and, consequently, would be unsustainable. As with uncertainty, market sustainability analysis is, at present, not an integral component of transportation policy analysis, though it undoubtedly should be so.

A third, and related problem, is that of the degree of market contestability. That is, it seems that the idea of deregulation of transport industries, such as air and bus, is gaining more and more ground among policy makers. However, transportation markets are also prone to markets imperfections due to the existence of factors like scale and scope economies which, in turn, may cause deregulated transport markets to evolve into
undesirable market forms like the domination of large-size monopolies. The theoretical answer, given to this problem, is to argue that such markets will be contestable in the sense that market forces will inhibit monopolistic firms from bringing about market distortions, in terms of prices and outputs. Suffice it to say that, currently, very little is known on how contestable transport markets indeed are functioning and how to incorporate this issue into transportation policy analysis. Public ownership of transport services and facilities vs. franchising, is a major example of a policy alternative which can result from such an analysis.

Fourth, policy analysis of transportation markets (or modes or systems) is commonly carried out in isolation of other markets (or modes). However, the connectivity of transport systems should be the focus of the analysis because of its importance to consumers and because the relative advantage of specific transport systems may emerge only when linked to other systems. In fact, finding ways to make transport systems more compatible with each other should be a major objective of policy analysis.

4. Network Barriers: an Analysis via the Pentagon Prism

The removal of trade barriers in the European economy has brought to light the existence of network barriers impeding international commodity, person and information flows. Such barriers may be of two types:

- missing links: local barriers in infrastructure hampering an efficient flowthrough of commodities, people or information; such barriers have been extensively dealt with by the ERT (1988).
- missing networks: the absence of strategic layers or components of Europe’s transport and communications infrastructure, be it material or immaterial in nature; thus the term ‘missing networks’ applies to the poor performance - in terms of convenience, speed, comfort, flexibility, reliability, costs, safety or social costs - of European infrastructure (see ERT, 1991).

It should be added that networks connecting nodes in a spatial system are often multi-modal in nature. If certain physical modes (e.g., railways) are missing, we have a clear case of a missing network. But it may also happen that a certain mode is present, but that its potential is not used up to its full capacity (e.g., because of organizational barriers, lack of technical standardisation etc.). This is also a case of missing networks. And finally it may happen that connections between different modes (i.e., vertical links between different network layers) are absent. This situation of bad connectivity (e.g., lack of a telematics system for a truck fleet) is also an example of a missing network.

In a recent report by NECTAR (1990) it has been argued that the demand for network services in Europe is rapidly increasing in recent years. At the same time a lack of capacity and malfunctioning in almost all
components of European networks can be observed. The government response to such drastic changes has been unsatisfactory so far, and nowadays the European economy is facing a severe problem not only of 'missing links', but even of 'missing networks' as a whole. This would require a rigorous European response in view of the long-term socio-economic interest of Europe. But instead of systemic solutions most policy-makers have taken resort to piece-meal, partial and uni-modal transport solutions, without keeping an eye on the needs of the European network economy.

As mentioned already, interest in the European scale of networks has not yet been very significant, as transport policy and planning is seldom performed at this scale. National frontiers have always provided a clear physical barrier between countries despite growing transport demand. Intra-European transport infrastructure networks have not followed this trend and show nowadays various bottlenecks in terms of missing links and missing networks. The coming Internal Market between the twelve members of the European community has put the focus of European politicians and industry on issues of socio-economic harmonization in order to remove distortions to free competition between industries in its member states, and increasing consideration is now given to transportation.

The major difference between a (more or less) nationalistic and a European approach to infrastructure planning can best be described in terms of its economic effects. Nationalistic infrastructure planning means focusing on the way in which national infrastructure building companies, vehicle producers and transportation companies are given a competitive advantage at the cost of their foreign counterparts. As other countries will use the same tactics, in most cases however, all parties will be losers in this way, since efficient economics of scale are not reached and large sums of public investments are lost; one of the reasons being that external competitors (e.g., Far Eastern or American companies) - while having large home markets - may outperform European companies.

Thus the existence of missing networks in Europe means the existence of missing economic development potential, as will be illustrated below for various transport modes.

A look at the European transport and communications map teaches us the existence of serious missing networks in freight transportation, both in terms of capacity as well as of quality of road and rail networks and goods terminals. This evidence calls for new proposals regarding combined freight terminals, a proliferation of EDI (electronic data interchange) and satellite-based orbital truck fleet management, and new forms of cooperation between transporters in goods distribution.

In air transport major problems relate to lack of runways, transfer and air corridor capacity, and inefficient pre- and post-transport facilities. Policies should focus on a new European network of improved and standardized air traffic management (ATC) systems and a concentration of the large number of air traffic centres.

European high-speed trains present a new challenge of Europe. The lack of a European standard train (e.g. TGV next to ICE) with uniform technical and organizational need and transport potentials, and its insufficient
compatibility with conventional trains (leading to the need for enormous investments in both track and trains) may become a serious stumbling block for its potential. Both track planning and financing problems have led to serious disconcert in Europe, leading to slackening of the pace of investments and actual building and thereby inducing nationalistic thinking. There is a need for a European-oriented high-speed train network (for passenger and goods), which overcomes the problems of national monopolies.

Separating carriage and infrastructure on rail is the key idea of European common carriage. The negative effects of natural monopolies in transportation are however manifest everywhere. A good illustration is provided by the existence of twelve national railway companies in the European community. This calls for a new solution, where for instance the efficient organization may be laid in the hands of a new institution, a European Carriage Organization, whose (low-level) intervention should resolve the needs for transport between major central places in Europe (including Eastern Europe).

European inland waterways show also various missing networks, as a large part of this network cannot be used efficiently, because of geographical conditions and lack of investments in maintenance and new building. Nevertheless, inland waterways together with new forms of efficient coastal transport may certainly have some potential. In some countries there is a revival of container transportation between ships and road vehicles, leading to a need for intermodal freight terminals. Compatibility between the various modes of transport is therefore strongly needed. State regulation (including large subsidization programs to preserve national employment) may also lead to distortions of competition. Furthermore, in an European setting there is a need to improve informatization in this sector.

Finally, in European telecommunication, the basic network that is missing at this moment, is a network for fast and reliable transmission of data throughout Europe. Instead, we have seen a number of small scale pilot projects and lack of investment in (standardized) hard ware and soft ware. Next to substitution of physical transport for non-physical transport, the use of telecom facilities for traffic guidance may be a good option for extending the capacity and quality of other transport networks.

Thus we find many missing networks in Europe which act as barriers for development. There are many reasons for the existence of such missing networks:

- political: emphasis on local benefits rather than on European advantages, or an orientation toward simple short-term, but less strategic solutions.
- nationalistic: emphasis on protection of domestic activities (e.g., via toll systems, landing rights), or an orientation towards sectoral (rather than macro) interests (e.g., in freight transport).
- economic: lack of a financing structure for risky new network investments, or lack of a sound user charging policy.
in institutional: unsatisfactory coordination between different modes, or orientation towards specific interests rather than overall economies.
- technical: lack of standardization (especially in an international setting) or lack of penetration of new or existing technologies.
- social: existence of conflicts between different objectives or groups, which prevent a more coherent network configuration.
- behaviourial: rigidity of attitudes and behaviour, which hampers an adjustment to new conditions.

This illustrative list of considerations clarifies the existence and continuation of missing networks in Europe's infrastructure.

In the past, solutions to infrastructure barriers (including missing networks) were mainly seen as having only one or two dimensions, viz. the hardware (physical infrastructure) and the fin ware (funding) dimension. A number of failures in developing infrastructure projects points to the importance of dealing with these problems in a more sophisticated and comprehensive way. In the abovementioned NECTAR study, it has been argued that proper solutions should take account of the following dimensions:

1) hardware (physical infrastructure)
2) software (logistics and informatics)
3) org ware (institutional and organizational setting)
4) fin ware (financial arrangements/funding)
5) eco ware (environmental and safety effects).

These five critical success factors for appropriate network design and implementation can be represented as a pentagon (see Figure 3). It should be noted, that the pentagon model not only applies to links and uni-modal networks, but in particular to multi-modal network systems in which synergy is a sine qua non. We will briefly elaborate on the elements of this pentagon.

Figure 3. The Pentagon Prism

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When focusing on hard ware, we see the emergence of modern technology (e.g., new materials technology, new information technology) penetrating the transport sector at a rapid pace. This has dramatically increased its potential. The acceptance of advanced hard ware is however found to be hampered by a lack of European uniformity and standardization.

Sophisticated soft ware systems are nowadays available in Europe and they are able in principle to enhance the performance of the transport sector. Co-ordination and harmonization of soft ware is however far from sufficient in Europe to warrant a rapid progress in Europe’s network systems.

Transport is a multi-modal, multi-actor and multi-national activity, which needs both competition and flexible regulation (orgware). The European scene shows many rigid and fragmented decision and planning structures/institutions, which form a severe obstacle to a progressive European space-economy.

Improvement of the European transport and communication networks is often hindered by a severe lack of coordinated European financing initiative/institutions (fin ware) in both the private and public spheres.

There is a growing environmental (eco ware) concern in Europe and transport is increasingly regarded as one of the major sources of social costs of environmental pollution. It is necessary that a market orientation towards environmental quality is pursued, focused on technology, infrastructure design and vehicle use.

It should also be noted that the development of a European infrastructure network takes shape via a double-tier system. On the one hand, the European network economy requires efficient transnational transport and communications connections focusing on long-distance corridors (roads, railways, airline connections, waterways, telecommunications). On the other hand, the nodes of the European network are formed by large metropolitan centres (e.g., Milan, Paris, London, the Dutch Randstad) and these nodes also require a proper and efficient mix of all transport modes. Thus missing networks may also refer to both international infrastructure combinations and interwoven metropolitan infrastructures.

5. Waterways: Neglected Potential

Waterways belong to the most forgotten components of Europe’s infrastructure. This is once more surprising, as the volume of transport via waterways (inland, coastal, sea) is considerable (see Figure 4).

This sector however, has also severe problems. As can be seen from Figures 1 and 2, transport via waterways is reaching the end of its life cycle, unless new innovations are taking place. Apart from the lack of transport speed and the outdated infrastructure (e.g., sluices), there is also a serious barrier in terms of standardisation (especially in case of trans-shipment).
Thus waterways may offer a good case study for testing the above mentioned pentagon prism. They also offer much potential in view of the emerging importance of intermodal transport, the absence of limits to capacity, and the new role of East-Europe (Amber et al. 1985; Seidel, 1988; Simons and Wansink 1990).

The important role of waterways infrastructure was also recognized in a recent report of the Group Transport 2000 Plus (1991), which claimed that intermodal sea transport (i.e., containers by sea, road, rail, inland waterways) is by far the more effective and progressive system of transport. This group also emphasized the very low environmental costs involved in this type of transport. Furthermore, in their report coastal transport was advocated as an important complement and a vigorous improvement of existing transport systems (e.g., for long-haul routes).
The relative environmental burden of waterway transport vis-à-vis road and rail can be found in Figure 5.

![Figure 5](image)

Figure 5. Comparison of the transport potential and space use of barges, trains and trucks for a load of 1,775 tons.


Of course, waterway traffic cannot be a strategic solution of all countries, as it is highly dependent on specific geo-nautical conditions. Major axes may offer in this respect a huge potential, such as the Rhine and the Rhine-Main-Danube Canal. It should be emphasized however, that the connectivity of inland waterways, viz. the network connections with other inland waterways, the compatibility with respect to coastal and sea transport (e.g. standardized containerisation) and the linkages with other transport modes at transhipment points (e.g., ro-ro techniques), is a critical success factor. Thus both vessel technology and waterway systems design are of utmost importance for a proper competitive functioning of waterway transport. An example of a failure in policy leading to barrier and missing networks in this context can be found in Winkelmans (1988), who presents the French case where segmented investments in inland waterways have failed to generate a benefit because of the isolated character of most of these modernised waterway sections (so-called 'culs-de-sac'). This is illustrated in Figure 6.

The latter examples make clear that a system split - rather than a modal split - is critical for the use of various transport modes. Thus connectivity of a network which ensures flexibility, reliability, accessibility and cost-effectiveness are of decisive importance, as the modal choice is actually dictated by the client (i.e., a buyer's market).
Coastal transport in Europe (especially in the Mediterranean) has gone through a difficult stage in the past decade (see MARIN, 1985). Competition is high, though cabotage causes a great deal of inefficiencies. The modernisation of the fleet is not a matter of technology, but of market conditions, coastal transport policy and improvement of waterways infrastructure (e.g., ports, linkage to other modes).

Some figures on the development of the European fleet by flag and type during the period 1980-1984 can be found in Tables 1 and 2 (see MARIN, 1985 and Giaoutzi, 1990).
### Table 1. The European fleet by flag and type at 1984 (’000 dwt)

<table>
<thead>
<tr>
<th>Countries</th>
<th>101 - 1600 grt (1)</th>
<th>1601 - 6000 grt (1)</th>
<th>101 - 6000 grt</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Deck</td>
<td>Multi Deck</td>
<td>Single Deck</td>
<td>Multi Deck</td>
</tr>
<tr>
<td>West Germany</td>
<td>227</td>
<td>992</td>
<td>131</td>
<td>342</td>
</tr>
<tr>
<td>Netherlands</td>
<td>326</td>
<td>307</td>
<td>40</td>
<td>314</td>
</tr>
<tr>
<td>UK</td>
<td>242</td>
<td>76</td>
<td>55</td>
<td>84</td>
</tr>
<tr>
<td>Denmark</td>
<td>75</td>
<td>336</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>Norway</td>
<td>145</td>
<td>235</td>
<td>67</td>
<td>25</td>
</tr>
<tr>
<td>Spain</td>
<td>190</td>
<td>270</td>
<td>353</td>
<td>276</td>
</tr>
<tr>
<td>Other West Europe(3)</td>
<td>183</td>
<td>206</td>
<td>133</td>
<td>209</td>
</tr>
<tr>
<td>Total N. &amp; Atl Europe</td>
<td>1386</td>
<td>2328</td>
<td>786</td>
<td>1308</td>
</tr>
<tr>
<td>Italy</td>
<td>172</td>
<td>158</td>
<td>85</td>
<td>102</td>
</tr>
<tr>
<td>Greece</td>
<td>297</td>
<td>145</td>
<td>417</td>
<td>808</td>
</tr>
<tr>
<td>Cyprus</td>
<td>121</td>
<td>254</td>
<td>404</td>
<td>379</td>
</tr>
<tr>
<td>Total South Europe</td>
<td>580</td>
<td>557</td>
<td>916</td>
<td>1289</td>
</tr>
<tr>
<td>East Europe (4)</td>
<td>274</td>
<td>55</td>
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</tr>
<tr>
<td>Total Europe</td>
<td>2250</td>
<td>2940</td>
<td>5148</td>
<td>4387</td>
</tr>
</tbody>
</table>

(1) Multi - and shelter-deck
(2) Excluding RoRo passenger ferries
(3) Belgium, France, Portugal, Sweden, Finland, Ireland and Iceland
(4) USSR, Poland and East Germany

**Note:** With regard to the specialised container vessels it should be noted that many of the smaller modern vessels, not identified by their container capabilities, are in fact "con-bulkers".

### Table 2. The European fleet by flag and type as at 1980 (’000 dwt)

<table>
<thead>
<tr>
<th>Countries</th>
<th>101 - 160 grt (1)</th>
<th>1601 - 6000 grt (1)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Deck</td>
<td>Multi Deck</td>
<td></td>
</tr>
<tr>
<td>West Germany</td>
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(1) RoRo and container tonnage included, except RoRo passenger ferries
(2) Multi - and shelter-deck
(3) Belgium, France, Portugal, Sweden, Finland, Ireland and Iceland
(4) USSR, Poland and East Germany
These tables have to be interpreted with great care. First, the number of ships sailing under a national flag has shown drastic changes which are not the same for each country. Next, the cabotage regulations which are linked to the previous phenomenon are different in European countries. This means that the previous tables are only indicative for the change in the fleet size in general. Nevertheless, the overall trend is a declining one.

It becomes apparent that the largest reduction in European fleets in terms of (dwt) took place for the size category larger than 1600 grt and particularly for multi-and shelter-deckers. This fleet category decreased from 13.55 to 10.95 mln tons during 1980-1984, a reduction of 19%. The fleet below 1600 grt declined from 6.29 to 5.6 mln dwt, a reduction of 11%. These figures are inclusive of the RoRo and container fleet. In 1984, the size of the RoRo and container fleet above 1600 grt is 1.416.000 dwt, whilst under 1600 grt it is 406.000 dwt. When the number of vessels is considered, the percentage reduction in the smaller size bracket is much larger, caused by the withdrawal of the 499 grt coasters. During 1980 and 1984, the total European fleet decreased in terms of deadweight by 16.6% and by 17.7% in terms of number of vessels.

Nevertheless, the market position of coastal transport is by no means a lost case: its future potential depends to a large extent on network connectivity (i.e., links with complementary infrastructure). The large volumes of goods transported from Northern Europe to Southern Europe by road indicate that there is a market for large-scale North-South commodity transport systems, and coastal transport (being oriented North-South in Europe) could in principle claim a much higher market share than it has nowadays. There are however, many barriers to overcome, and these will be discussed in the next section.

6. Coastal Transport and Inland Waterways in Europe: A Critical Evaluation on the Basis of the Pentagon Model

Changes in the international division of labour are concomitant with a new pattern of international trade flows, especially by sea and waterways. Existing natural barriers impede the development of a common European vision of the latter mode, while strong competition between harbours within the European region has failed to develop the idea that they are part of a European network. The European Community has recently begun to develop the inland waterways network. This also has implications for coastal short sea and deep sea transport. We will first discuss some trends in inland waterways, coastal transport and port traffic followed by some general observations, while next we will identify the causes of missing networks on the as is of our pentagon prism.
6.1 Trends

The main trends in this field are diverse, but indicate that many new developments may be expected. Examples can be found in various fields:

(i) Inland waterways
   Important trends are:
   a) efforts towards unified rules for taxation, standards for infrastructure development, type of ships, cargo, dams, bridges, berths, draft of the rivers, speed etc., in all the parts of the network (standardization).
   b) the increased use of inland waterways as places for conservation of the European ecosystems.
   c) integration of the network which will heavily affect transport time and required cost.
   d) segmented local efforts for infrastructure development; efforts towards a global/unified legal, economic and financial framework.
   e) standardized systems for facilities in transit areas in all parts of the network.
   f) increasing awareness for eco problems resulting from the lack of integration in the system.
   g) integration and co-operation between countries.

(ii) Coastal transport
   A major development is:
   a) a tendency towards removing all types of cabotage.
   b) decline of fleets in the Mediterranean

(iii) Port traffic
   Here we see the following developments:
   a) reduced oil imports, a trend which has developed since 1979.
   b) increased imports of steam coal and household coal, and greater traffic in cereals and other bulk vegetable products. The last few years have been marked by the fairly widespread growth in bulk solids although ore traffic - except in Rotterdam and on the Rhine waterway - has slackened or even disappeared.
   c) a strong upsurge in mixed cargo traffic, although the rise in exports from Europe levelled off after 1979 owing to the recession associated with the second oil crisis. Mixed cargo traffic is increasingly containerized, while general cargo shipping on board conventional vessels is decreasing.
   d) small ports have increased their total trade to a far greater extent than the large ones, due to a combination of factors, such as modernization of port facilities and port linked overland transport infrastructures, and the development of the hinterland's industrial potential.
   e) geographically, ports in the Channel-North Sea and Mediterranean-Adriatic areas have developed more vigorously than those in the...
Atlantic-Irish Sea and Baltic areas. These trends can be seen from the overall traffic figures, although available statistics broken down by categories of freight do not enable specific geographical features to be pinpointed, except for the pronounced increase in container traffic in the ports of Southern Europe which are making up for lost time.

(iv) General

Some general trends are:
- All shipping categories are undergoing a considerable increase.
- Ship size and specialization are also changing drastically:
  a) increase in size (tankers, bulk, ore, dry cargo, general cargo).
  b) the benefits from economies of scale offered by high carrying capacity are reduced by rising fuel costs.
  c) size and specialization of ships used have been influenced by the geographical features of shipping zones.
- Transhipment and cargo handling techniques to reduce turnaround time are being sought in both ship design, and loading and unloading, handling and storage operations.
- Port activities and employment are also showing signs of drastic change:
  a) cargo handling is changing radically, leading to lower employment, but higher job status.
  b) a number of traditional port activities, particularly ship operation and transport in the broad sense, are in comparative decline, owing to industrial monopolization as much as to rationalization. It is therefore partly a shift of activities to other sectors.
  c) keen competition among ports to attract trading and international transport companies. Key location factors are probably the creation of a suitable business climate and the development of maritime transport along new lines. The Mediterranean is increasingly attractive in this respect.
- Ports improvements include:
  a) container terminals.
  b) heavy cargo and multiple bulk cargo terminals.
  c) gas terminals.

6.2 Missing networks in coastal transport and inland waterways in Europe

Missing networks manifest themselves in various modes and in various configurations:

(i) Inland waterways

Using the Pentagon model, a cross-national comparative analysis (see Giaoutzi, 1990) shows the following results.
At the **hard ware** level, the following barriers appear:
(a) a lack of standardization and network integration (e.g., lack of standardized vessels in transit areas).
(b) a lack of infrastructure in nodes connecting to other transport networks (combined transport) (see transhipment and cargo handling).

At the **soft ware** level, problems are mainly related to barriers regarding handling and storage operations in the ports.

**Org ware** bottlenecks lie in:
(a) the fact that the different parts of the network are state regulated or monopolized with different sets of rules and norms for modes of transport, type of cargo, type of investment etc.
(b) the lack of an intermodal uniform approach at the European level giving responsibilities for organizational issues to individuals (shipper-forwarder-receiver) rather than to governments.
(c) the split of the network between East and West.
(d) the fact that waterways have been used as defence networks in almost every country which implies that bridges, dams, etc. have been adjusted to meet the likely needs of a war situation. As a result certain parts of the network can barely cope with the increasing demand, while others have a far higher capacity than will ever be required).

**Fin ware** bottlenecks are stemming mainly from the segmented initiatives for infrastructure development left in the hands of local actors (lack of integration).

The **eco ware** barriers include:
(a) the use of sea or river water to clean ship tanks illegally and dumping a mixture of water, oil and detergents in the environment, instead of using more expensive port facilities.
(b) the use of environmentally dangerous paints for ship bodies.
(c) numerous cases of wrecked vessels having lost all or part of their (dangerous) freight, due to a mixture of bad weather, the use of old and unsafe (single-chamber) vessels, badly trained crews taking too high risks, and collisions with other ships.

(ii) **Coastal transport**

Coastal transport consists of a number of overlapping networks in the shipping sector. There is no particular problem at the hard ware and the soft ware level. There are severe bottlenecks, in particular though at the fin ware level stemming from the subsidization of vessels as an unemployment buffer, and indirect support for the metal industry and the shipbuilding (e.g., machinery and equipment) industry.
6.3 Suggested improvements

The reason for presenting the shipping sector as a number of separate networks is that integration in one of the networks implies a certain restructuring in the rest of the transport system. The following structural solutions and policies are needed here.

(i) Inland waterways

As far as inland waterways are concerned, solutions should focus on:
- at the org ware level:
  (a) Integration: the harmonization of the regulations where geonoautical conditions allow for waterway transport.
  (b) Coordination: this will be reached by making the different parts of the transport network as a whole compatible, including multimodal solutions. Subdue the system to certain international (commercial) treaties for shipowners, cargo and liabilities, with chapters (partial treaties) on bulk cargo, liquid, container, chemical dangerous transport etc.
  (c) Harmonization of labour regulations. This should also be reflected in a standard list of types of cargo to be transported, types of vessels, and standard rules of transport accepted by all parties involved (e.g., air draught, waiting time, width of vessels, speed, oil pollution control systems etc.). There have already been certain steps by the European Community towards better organization and development of waterways infrastructure. Standardization, harmonization and unification issues will be dealt with at the economic, legal, organizational and technical/technological level. Org ware aspects though should enjoy high priority in order to avoid certain problems in other aspects of the network development.

- at the fin ware level:
  (a) Certain resources required for co-ordination and organization should be found via well regulated taxation systems. Available funds from the European Community should also be utilized.

- at the soft ware level:
  (a) Pilot projects for integrated solutions should also be pursued via the European Community funding.

- at the eco ware level:
  (a) Certain rules similar to the MARPOL (the international treaty to prevent marine pollution) should also apply to environmentally dangerous transport behaviour in the inland waterway network and to harmonization of regulations for environmental protection among the various parties involved in the network. They should also include a ban on unsafe ships.
Coastal transport

Coastal transport as such is going to profit even more from the improvement of the inland waterway system. Some problems will appear as a result of the improvements in Mediterranean transport (1000-3000 grwt) which mainly (80 %) serves the Mediterranean basin. One likely impact for coastal transport will be a slight increase in the average tonnage.

To improve combined transport the following measures are needed:
- at the hard ware level:
  (a) improvement of the hard ware equipment on board the vessels
  (b) development of new technologies for the transportation of semi-processed products.

- concerning org ware:
  (a) improvement of the status of competition between land and sea transport
  (b) integration of transport processes and more particularly of short distance transport, cabotage and land transport
  (c) less restrictions on cabotage
  (d) less transit constraints
  (e) improvement of the port efficiency especially concerning infrastructure and management issues
  (f) development of European standards for the above.

- concerning soft ware:
  (a) informatization of maritime procedures
  (b) improvement of statistics in the sector.

- at the eco ware ware level:
  (a) European standards and legal instruments to efficiently prosecute coastal polluters.

Technical standardization of hard ware and soft ware is needed in most sectors (given the need to achieve along term transport policy performance by increasing transport capacity, speed, reliability and safety, and by reducing transport costs) and effective environmental policy strategies (less accidents, more efficient transport etc).

The debate concerning changing cargo and vehicle standards should incorporate the efficiency and costs of transport, the costs of new investments and sunk costs, and the potentials for combined transportation (see Figure 7). This means that that standard dimensions for cargo should serve the transportation needs of all modes. The Eureka-context might be considered as a useful scheme to implement these ideas.
7. Reflections

One of the common problems in transportation is the lack of standardization, both in a uni-modal (e.g., exchange of locomotives in transnational rail transport) as well as in a multi-modal context (e.g., exchange of containers). The need to achieve long term transport policy and environmental policy aims calls attention for changing cargo and vehicle standards; the efficiency and costs of transport, the costs of new investments and sunk costs, and the potentials for combined transportation are not helped by different standards. This means that standard dimensions for cargo should serve the transportation needs of all modes. Lack of standardization is not simply a technical question, but is primarily an institutional problem. National standards in a number of transport modes are in fact used to protect national vehicle manufacturers and transporters from external competition.

In regard to policy actions, ERT (1989) has suggested the following items on a policy agenda in terms of bottlenecks, inefficiencies and ineffective planning processes in the transport sector in general:
Bottlenecks

- Decentralisation of political power in the last 15 years has resulted in increasing the number of stages and levels of the decision-making process on transport issues. The transfer of power to local levels is a response to calls for greater regional autonomy.

- While national autonomy over telecommunication infrastructure is being relaxed to accommodate an integrated European system - in line with the general trend towards European integration and increased worldwide cooperation - national sovereignty in transport matters is strongly defended.

- Bureaucratic claims to exclusive competence play an important role at the national level in decision-making. Conflicts abound between finance ministers, transport ministers and administrators.

- Lack of transparency in the decision-making process for transport infrastructure planning. Out of the conflict between long-term transport policy planning and short term (annual) budget decisions the ultimate result is at best a process which tends to focus on short or medium-term planning.

Inefficiencies in the Decision-making Process

- Complexity has increased as special interest groups (environmental groups, local residents and others affected by infrastructure projects) have become a permanent factor to be reckoned with in the decision-making process. Lack of space in most European countries contributes to make the planning of new or additional infrastructure projects much more complex than in the past. Divergent interests contribute to reinforcing opposition to a global approach.

- There is an insufficient participation of the private sector in the decision-making process for transport infrastructure, leading to a failure to mobilise the considerable resources this sector can bring to bear on many of the problems already cited.

- Many converging factors (budget constraints, economic uncertainty, inefficient and complex decision-making process, limits to growth of transport infrastructures) have lengthened the decision-making process in all European countries to some 10 to 12 years for major infrastructure projects.

Ineffective Planning Processes

- The lack of a 'system' approach for identifying long-term needs and alternative solutions is a serious deficiency at both the national and European levels. Such a concept combines a broad view of European infrastructure problems and priorities and the realistic, knowledgeable input that comes from being close to the problem. Such an approach could give considerable vitality to the planning process and improve its effectiveness.

- The lack of a European-level body to facilitate planning and decision-making inhibits the development of an integrated European transport infrastructure approach. A new institution should serve as a facilitator for
the transport infrastructure development process at the European level rather than serve as a replacement for national governments.

With regard to the specific barriers and missing networks existing in inland waterways and coastal transport, we formulate the following conclusions.

Existing natural barriers seem to impede the development of a European unitarian vision of the latter mode (inland waterways), while issues of strong competition between harbours within the European region have failed to develop the idea that they are part of a European network. In view of the above problems, the European Community should be engaged in an effort to develop the inland waterways network.

Investment in inland waterways (including sluices) and coastal transport systems is necessary to establish a European waterway network for mass transportation as well as for the growing container transport. The proposed and more or less environmentally-induced shift from road to rail transportation is likely to highlight strong capacity constraints in the railway network. Although water transportation has a lower environmental impact than road transportation, building new waterways however, has also a strong negative impact on the environment. An extension of the waterways network and a restructuring of existing facilities should however be considered as a useful option.

In the context of our analysis we have dealt with two different types of networks: inland waterways and coastal transport.

From the large number of bottlenecks in this field we may mention - inter alia - lack of standardization and network integration (e.g., lack of standardized vessels in transit areas); lack of harmonization of regulations (cabotage) - also because national regulation is used to support national firms -; lack of investment and planning of new networks or upgrading existing ones; lack of investments in fleet modernization (also because of environmental reasons); lack of compatibility between barges, cargo specifications, train terminals and port facilities (necessary for multi-modal transport).

And if new infrastructure is eventually being built - as is currently the case with the Rhine-Main-Danube Canal - both planning and investment periods are very long.

To solve missing networks, policy makers should especially concentrate on (transnational) plans for main transport axes connecting at least Europe's major industrial areas with each other. Firms in each industrial area should be able to choose between road, rail and water as means of transport. Integration and harmonization of national policies and regulation (cabotage, labour, etc.), and standardization of hard ware and soft ware should also be favoured. Informatization is also called for to ensure Just-In-Time transportation. Thus competitiveness and connectivity are necessary ingredients of a contestable market for waterway transport.
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