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Inland Waterway Networks in Europe:

**The Neglected Potential, Bottlenecks
and Policy Initiatives**

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1. Introduction

In the last 30 years, trade between European countries had increased dramatically, but the transport infrastructure to support this growth has been mostly conceived and executed at the national level. The result is that most countries in Western Europe now have excellent internal road systems, adequate airport facilities and good national rail systems. But the connections between the fixed links of different countries - the roads, railways and waterways - remain haphazard and at many points unsatisfactory. The European network economy is still in its infancy as far as international transit relationships are concerned. Investments in international network infrastructure have not kept pace with the demands imposed by European economic developments.

More important than mere numbers are the changes required in transportation infrastructure, induced by business changes related to

- the trend towards high value and low weight commodities requiring flexible and varied transportation modes,
- the reduction of batch-sizes made possible by computerised manufacturing,
- the trend towards customised goods leading to a decrease in the role of bulk transport,
- the growing role of information technology in logistics management (e.g., the rise of teleports), and
- the related trend towards integral logistic systems for production and distribution, notably just-in-time deliveries, materials requirement planning and the emergence of logistic platforms.

In addition, the geography of Europe has changed dramatically in recent years. Countries such as Austria who before were on the periphery, now find themselves in the centre of Europe. Especially, urban centres located on nodes of the emerging European network economy will face a situation of decreasing distance friction costs.

The European economy will remain critically dependent on well functioning transport networks as catalysts for future developments. There is nowadays a

growing awareness that the current European infrastructure network is in various aspects outdated (NECTAR 1990, ERT 1991), without being replaced by modern facilities which would position the European economies at a competitive edge.

The present paper will deal with the existence of important bottlenecks in European transport infrastructure in general and waterway transport networks in particular. Section 2 will provide some background notion of the highly neglected potential of inland waterways, while section 3 serves to identify the major bottlenecks in the use of waterway transport, followed by a discussion of new policy strategies in section 4 which might improve the current position of waterway transport.

The general conclusions from these considerations are straightforward. Infrastructure is a prerequisite for further economic development and integration of the European network economy. Quality is apparently nowadays of more strategic relevance than quantity, and thus infrastructure and transport systems planning should take pre-specified performance and service quality levels as a strategic point of departure. This does not only hold for waterways, but for all modes of transport.

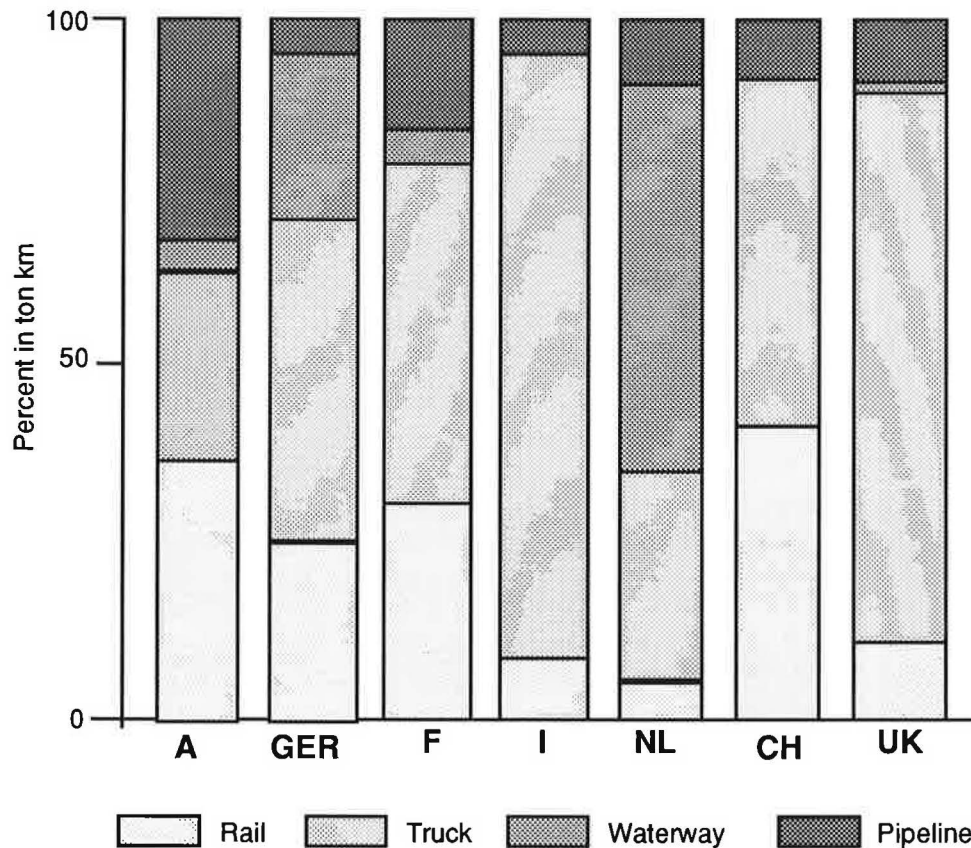
Finally, it is worthwhile to stress that transport nowadays is a multimodal, multiactor and multinational activity which needs both competition and flexible regulation. Deregulation at the European scale may greatly ease the task of responding to the challenge of increasing demand on Europe's transport infrastructure.

2. The Neglected Potential of European Waterways

Waterways belong to the most forgotten components of Europe's infrastructure. This is surprising, as the volume of transport via waterways (inland, coastal, sea) is considerable (see Giaoutzi and Nijkamp 1991). Sea transport along the coasts and on inland waterways was the dominant mode of goods transport in Europe until two centuries ago. Sea transport still has its competitive edge in bulk cargo. Supertankers transport crude oil from the Arabian Gulf to west European refineries, while modern diesel barges are used on European rivers and canals. Roll-on/roll-off (RoRo) ferries connect the Mediterranean islands, the British Isles and Scandinavia with the European continent (Masser et al. 1992). The contribution of inland waterway traffic to total goods transport varies between countries depending on their endowment with navigable rivers and canals (see Fig. 1). Waterway transport is strongly used in Germany and the Netherlands, much less in other

countries. The completion of the Rhine-Main-Danube, and eventually later on the Rhone-Rhine and Oder-Elbe-Danube canals, will certainly improve the market share of waterway transport in future.

Fig. 1: Goods Transport by Mode in Seven European Countries (1986)
(modified after Masser et al. 1992, p. 130)



Since 1970 truck transport in western Europe has more than doubled, while rail and water transport (inland waterways) have stagnated or even declined (see Fig. 2). There have been several reasons for the rise of goods transport by road. The road network represents a fine mesh of accessibility to all corners of the continent. The road network, especially the motorway system, has expanded in line with economic growth. However, it should be recognized here that roads goods transport never covered its true social and environmental costs. The success of the truck is mainly due to its advantage in door-to-door speed, flexibility and reliability. Modern economies with their multitude of interdependencies are strongly based on efficient, door-to-door transport links. Even long-distance rail or water transport would not be possible without regional road transport at their start and end (see Masser et al. 1992).

Fig. 2: Goods Transport by Mode in Western Europe (1970-1988)
 (modified after Masser et al. 1992, p. 131)

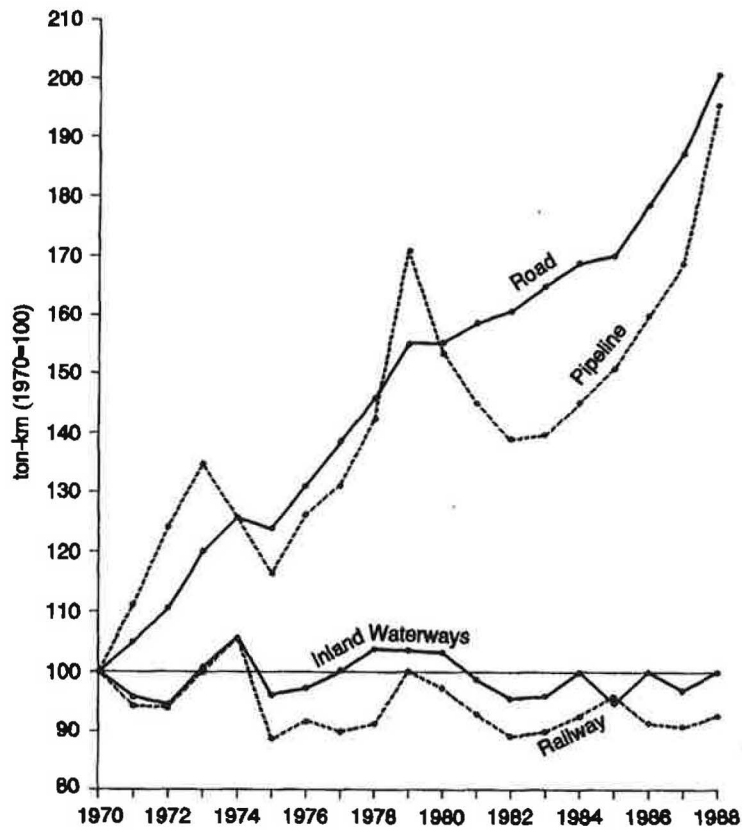
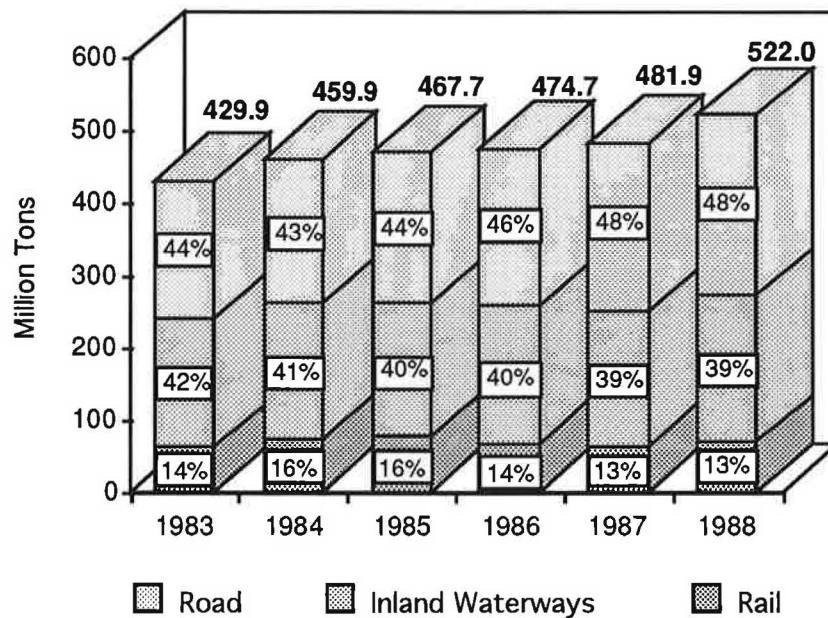


Fig. 3: Annual International Intra EUR-12 Goods Transport by Mode (1983-1988)



Nevertheless, the volume of annual international transport via waterways (inland, coastal, sea) intra EUR-12 (measured in terms of tonnage flows) is considerable (see Fig. 3).

The important role of waterways infrastructure was recognized in a recent report of the Group Transport 2000 Plus (1991) which claimed that intermodal water transport (i.e. containers by sea, road rail, inland waterways) is by far the most effective and progressive system of transport with also very low environmental costs involved. Clearly, waterways offer much potential in view of the emerging importance of intermodal transport, the relative absence of limits to capacity, and the new role of Eastern Europe (see Seidel 1988, Simons and Wansink 1990). Of course, waterway traffic cannot be a strategic solution of all countries, as it is highly dependent upon geo-nautical conditions. But major waterways such as the Rhine and the Rhine-Main-Danube may offer a huge potential, as they have a very high capacity. The network connections with other inland waterways, the compatibility with respect to coastal and sea transport (e.g., standardised containerisation) and the linkages with other transport modes of transshipment points (e.g., Ro-Ro techniques) may be viewed as a critical success factor. Both vessel technology and waterway systems design are of utmost importance for a proper competitive functioning of waterway transport.

3. Performance of Inland Waterways Infrastructure - Viewed from a Pentagon of Concerns

The demand for transport network services in Europe has increased rapidly in recent years. At the same time there is a growing capacity shortage and evidence of malfunctioning in almost all components of European networks. Even without economic growth, the new mobility of goods resulting from changed technology and European integration will quickly lead to a crisis (see Nijkamp et al. 1991). Current infrastructure is often inadequate in purely national terms. It is doubly inadequate when set against the needs of integrating Western Europe and bridging the rifts left by the Cold War. Governments have responded too slowly to these changes.

As a result, the European economy is facing a severe problem not only of missing links, but also of missing networks. The term of missing networks refers to the absence of strategic layers or components of Europe's transit infrastructure. The strategic layers involve organisation and/or technical layers between different modes of transport and between these and telecommunications, or planning and

mangement capabilities which correspond to the dimensions of the European economy and to the complex interaction of different modes of transport. In Europe, sectoral fragmentation among networks is reinforced by national fragmentation, creating double fault-lines and bottlenecks for the movement of goods (see ERT 1988, 1989, 1991, NECTAR 1990).

An infrastructure network is traditionally viewed as a set of nodes and links (hardware), linked by an information and processing system (software) which together allow the performance of certain services. As in most other aspects of economic life, the capacity of infrastructure is increasingly determined by soft intelligent elements which govern the way the hardware is organised and can be used. Other essential elements are decisions, management and control (institutions), and the provision of finance to build, operate, and maintain the network. Finally, the network interacts with the environment, whether economic, social or physical, producing both positive and negative externalities. These five elements or dimensions are not always explicit. For the road system (hardware) the driver still largely performs both the information processing and service operation on a do-it-yourself basis, although central traffic management is slowly being introduced on parts of the urban and highway system. The railways are at the opposite extreme. Inland waterway transport lies on a continuum, with at least some central control on user hardware specifications, access conditions, and flow management (see ERT 1991, Maggi and Nijkamp 1991).

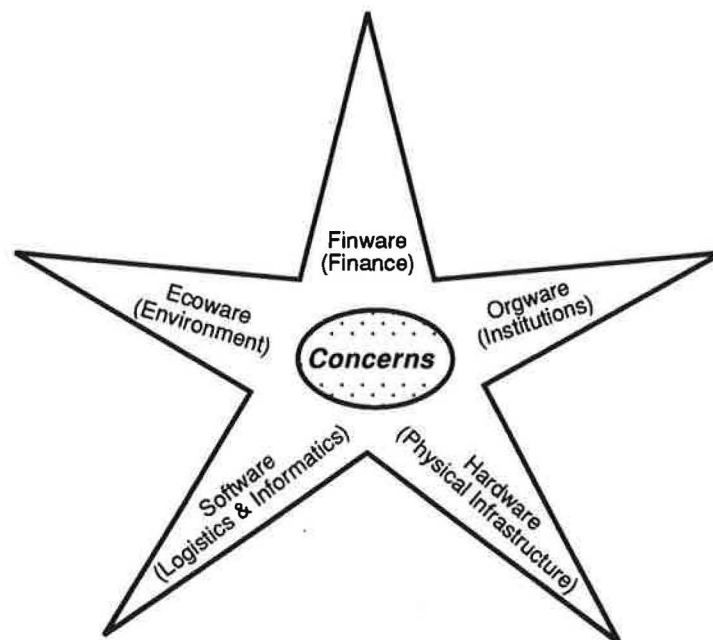
The efficiency of a network might not be evenly distributed, with bottlenecks created by missing bits of hardware, poor software or organisation. Users will therefore tend to use the efficient parts of several networks while underutilizing the rest, with the total carrying capacity pushed well below the combined potential. Eliminating bottlenecks by adding strategic links can greatly improve capacity at little additional cost. Long-distance freight networks have to be increasingly planned with cross-modal road/rail and road/ship transport in mind. What is clear is that piecemeal evolution is not the answer to the transportation challenge for Europe. It neither exploits available new technologies, nor will it meet the increasingly dominant long-distance transport requirements in the European economic space. The two dramatic changes which are currently taking place, the technological revolution and the potential offered by modern information technology and logistics on the one side and the globalisation of economic activity intensified at the European scale by 1992 on the other side, require a corresponding revolutionary change in the approach to infrastructure in all the five dimensions mentioned above.

Modernising networks not only means introducing new technology, but also involves new forms of organisation at various levels (NECTAR 1990)

- *technical*, e.g. in making better use of information technology,
- *institutional*, e.g. new open forms of decision making organisations,
- *financial*, affecting planning horizons, management, etc.
- *political*, notably a stronger emphasis on environmental and safety constraints.

Based on the previous observations, we claim that bottlenecks in European freight transport in general and in waterway transport in particular can be identified in five basic dimensions: hardware (physical infrastructure), finware (finance and funding), software (logistics and informatics), orgware (institutional and organisational setting), and ecoware (environmental impacts). These five dimensions form a pentagon of concerns (see Fig. 4; NECTAR 1990, Maggi and Nijkamp 1991, ERT 1991).

Fig. 4: A Pentagon of Concerns



Hardware refers to the tangible physical components of transportation infrastructure (e.g. technical equipment, terminals harbours, canals). At the hardware level two major types of bottlenecks may be observed (Giaoutzi and Nijkamp 1991): lack of standardisation and network integration (e.g. lack of standardised vessels in transit areas), and lack of infrastructure in nodes

connecting to other transport networks (combined transport - intermodal transfer is hampered by the lack of compatibility between barges, containers, train terminals and port facilities).

The term **software** is used here in the widest sense to include computerised management of transport and communication systems, and computerised services which improve access by users and facilitate intermodal operations (ERT 1991). At the software level inland waterways transportation problems are mainly related to handling and storage operations in general, and to unsatisfactory statistical information and EDI-Systems in particular.

The **orgware** or institutional dimension of the Pentagon model of concerns encompasses all regulatory, administrative, legal, management, and coordination activities and structures governing both the demand and supply side of transport. Market access limitations (licenses), tariff setting procedures and ownership patterns are among the issues currently under discussion in the move towards liberalisation, decentralisation, deregulation, and privatisation initiated in Europe in the mid-1980s and stimulated by '1993' (NECTAR 1990). In a fast changing European economy which favours speed and flexibility, the present institutions show several deficiencies (ERT 1991):

- they are slow in planning and in taking long-term decisions,
- their day-to-day operations are often clumsy and outdated,
- they promote unimodal and single-country network operations and developments.

The European Communities have an important role to play in overcoming such deficiencies. The specific inland waterways related bottlenecks lie in

- the fact that the different parts of the network are state regulated or monopolised with different sets of rules and norms for modes of transport, type of cargo or container, type of investment etc.,
- the lack of an intermodal uniform approach at the European level giving responsibilities for organisational issues to individuals (shipper-forwarder-receiver) rather than to governments,
- the split of the network between East and West (except the R-M-D-link since September 1992),

- 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 increasing demand, while others have a far higher capacity than ever will be required (Giaoutzi and Nijkamp 1991).

Finware refers to the social economic cost-benefit aspects of new investments, but also to the ways of financing and maintaining new infrastructures, to fare structures, to state contracts for guaranteed finances for public transport deficits. At it simplest, the present and future crisis facing Europe's transport infrastructure reflect the sharp drop in investment since the mid seventies. The problems associated with financing European infrastructure networks are largely a reflection of the institutional side of the pentagon. The basic interface problem between public and private decision-making, planning and control is inherent in the transport infrastructure networks under discussion. The long time scales involved in building transport infrastructure systems make it unique among all other forms of investment. Time is stretched by three factors (ERT 1991):

- **first**, the long planning period of new pieces of infrastructure, related to the inherent complexity of such undertakings, the crossing of administrative boundaries (local, regional, national) as well as the fragmented property rights involved,
- **second**, long construction periods, largely due to inherent technical and geographic factors, but also to fiscal constraints,
- **third**, the long planned lifetime and thus payback of investment.

In addition, key water transportation problems arise from lack of investment in modernisation of existing fleet, lack of support for the purchase of modern equipment or multi-modal solutions, lack of breaking up premiums to lower the level of obsolete capacity, or lack of subvention of new building activities (the latter two categories are officially forbidden in the EC, although **de facto** they exist).

There is a growing environmental (**ecoware**) concern in Europe and transport is increasingly regarded as one of the major sources of social costs of environmental pollution. Ecoware refers to environmental and ecological concerns (including safety and energy questions) in transport systems, as well as to abatement measured for environmental degradation. It concerns both the infrastructure owner and the infrastructure user. From an environmental point of view water transportation has much less strong negative environmental effects than road, rail

and air transportation. The environmental bottlenecks of water transportation include (NECTAR 1990)

- the use of river water to clean ship tanks illegally and dumping a mixture of water, oil and detergents into the environment, instead of using more expensive port facilities,
- the use of environmentally dangerous paints for ship bodies,
- (especially in case of sea transport) 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 vessels, badly trained crews taking too high risks, and collisions with other ships.

In summary, key bottlenecks in inland waterways include lack of standardisation and network integration (e.g., lack of standardised vessels in transit areas), lack of harmonised regulations (cabotage), national protection through restrictive licensing, insufficient investment and planning of new networks or upgrading of existing ones and for fleet modernisation, poorly developed EDI-logistics systems. Intermodal transfers are hampered by the lack of compatibility between barges, containers, train terminals and port facilities. Lengthy planning and building delays have to be added to this list of key bottlenecks.

4. Policy Recommendations and Conclusions

Based on the study of European Round Table of Industrialists (1991) three basic messages can be extracted for European policy makers (see also Nijkamp and Priemus 1992).

The **first** message concerns the predominance of national perspectives in transportation planning. Missing networks in Europe exist because transportation systems have been developed in a segmented manner, each country and each transportation mode looking for its own solution without considering the synergetic effects of coordinated design and the use of advanced infrastructure.

The **second** message of the report is the importance of an European perspective in the analysis and resolution of transportation problems in European countries. This is not only a question of formulating a coordinated standardisation. Lack of standardisation creates bottlenecks on all transport modes ranging from a lack of technical standardisation of cargo in combined transport to problems with the width of canals and services in inland waterways.

The **third** message of this report is the need for multimodal solutions. Although there are many success stories concerning unimodal solutions at the national level, multimodal approaches are rarely found and, if so, are only of minor importance in terms of market shares. Nevertheless, it can be argued that the huge demand for additional transport capacity and quality in Europe can only be met if multimodal solutions are also pursued.

An European waterway network for mass transportation and containerised transport has to foresee multimodal solutions including rail and road transport (e.g. trains for medium distances combined with water transport for long distances). The Danube Link (including the Rhine-Main-Danube Canal) may be viewed as a strategically important inland waterway link between the cities in southeastern Europe and in central Europe and may be seen as the crucial southeastern leg of a transcontinental waterway corridor connecting southeast Europe and the central economic agglomerations.

More specific proposals for attacking the problems and bottlenecks identified in section 3 may be divided into five categories in accordance to the pentagon of concerns: hardware level, orgware level, finware level, software level and ecoware level (NECTAR 1990, European Round Table of Industrialists 1991, Vleugel and Nijkamp 1991):

Hardware Level

The inland waterway network should be based on standardised container technology. In order to realise this network, investments in physical infrastructure would above all be needed in the port facilities and terminals. The capacity and especially the quality of the existing equipment is not sufficient in many European countries, an observation made frequently by the OECD, ECMT, the Rhine Commission and the Danube Commission. Ports/container terminals, heavy cargo and multiple bulk cargo terminals have to be equipped with advanced transshipment technologies which allow for a quick transmodal change of goods. Transshipment and cargo handling techniques have to be sought in both ship design, and loading and unloading, handling and storage operations.

Policy makers have to be aware of the lead time when deciding on new physical infrastructure. The use of software based solutions may have a shorter implementation period, given the strong opposition to and long construction periods of new infrastructure. The existing physical transport infrastructure sometimes shows a capacity saturation (with the exception of the Rhine) which can be

overcome by an innovative management approach and by complementary 'light' investments.

Orgware Level

Transport is a multimodal, multiactor and multinational activity which needs both competition and flexible regulation (orgware). In addition to traditional containerised transport solutions, the network has to be based on what is called soft technologies in combined transport. There is a strong need for more sophisticated and standardised equipment to be used in the terminals, in order to meet demand oriented criteria, inter alia reduction of transshipment time and personnel. In particular there is a need for

- **integration:** the harmonisation of the regulation where geo-nautical conditions allow for waterway transport,
- **coordination:** this will be achieved by making the different parts of the transport network as a whole compatible, including multi-modal 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.,
- **harmonisation of labour regulations:** this should be reflected in a standard list of types of cargo to be transported (e.g., dangerous goods), 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 organisation and development of waterways infrastructure. Standardisation, harmonisation and unification issues will be dealt with at the economic, legal, organisational and technical/technological level. Orgware aspects should enjoy high priority in order to avoid certain problems in other aspects of the network development.

Software Level

Concerning software, the absence of logistics strategies as well as instruments of combined transport to control the European wagon, truck and ship fleet on road, rail and water are the most important shortcomings. Sophisticated software systems are nowadays available in Europe and they are able in principle to enhance the performance of the transport sector in general and the waterway transport sector in

particular. Coordination and harmonisation of software is however far from sufficient in Europe to warrant a rapid progress in Europe's network systems. Pilot projects for EDI logistics systems should be pursued for which available funds from the European Community might be utilised.

Finware Level

Improvement of the European transport networks is often hindered by a severe lack of coordinated European financing initiative/institutions (finware) in both the private and public spheres. In finware domain problems arise with the funding of infrastructure projects which have a European impact while being planned by national companies. A European approach to the integrated treatment of funding on the one hand and the equalisation of economic and environmental benefits and costs is urgently needed. Certain resources required for coordination and organisation should be found via well regulated taxation systems. Available funds from the European Community might also be utilised. There is a need for a clear strategy on prioritization of European infrastructure projects with a sound transnational financing, e.g. on the basis of a European Infrastructure Bank associated with a coordinating body for European transport policy.

Ecoware Level

Certain rules similar to the MARPOL (the international treaty to prevent massive pollution) should also apply to environmentally dangerous transport behavior in the inland waterway network and to harmonisation of regulations for environmental protection among the various parties involved in the network. They should also include a ban on unsafe ships.

The overall conclusion from this report is that European waterways offer a massive potential for the European network economy, provided sophisticated hardware and software equipment is used, sufficient financial resources and reserved for more strategic investments, strict eco-policies are imposed, are transnational coordination of policies on European network connections are pursued.

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